Market Design for Land Trade: Evidence from Uganda and Kenya

Jonathan de Quidt

Covers projects with
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Motivation

- Farms in many low-income countries are small, fragmented, and misallocated.

  Gollin et al. (2002, 2004); Adamopoulos & Restuccia (2014); Deininger et al. (2014); Ali et al. (2015); Lowder et al. (2016); Gollin (2018); Suri & Udry (2022)

- Quantitative/experimental estimates: 20–360% returns to land reallocation.

  Adamopoulos & Restuccia (2014, 2020); Deininger et al. (2014); Restuccia & Santaeulalia-Llopis (2017); Foster & Rosenzweig (2017); Britos et al. (2020); Adamopoulos et al. (2021); Bolhuis et al. (2021); Acampora et al. (2022). (Measurement: Gollin & Udry (2021), Aragon et al. (2021))

- Status-quo markets reallocate land very slowly. Coase theorem fails.

  FAO (2003); Demetriou (2014); Bleakley & Ferrie (2014), Milgrom (2017), Smith (2019), Bartels et al. (2020); Chen et al. (2021)

- **Our agenda: design and implement improved agricultural land markets.**

Example: land fragmentation in Kisoro District, Uganda

Not just a challenge for low-income countries

Excessive fragmentation of land ownership and land use in Terbuf Municipality, Albania. The illustration shows an excerpt of the ortophoto from one of the villages in the municipality with overlay of the cadaster map. In average each family owns 1.72 ha distributed in 5.33 physical parcels. The parcels are often distributed in a distance of 3-4 km from the homestead.

Region	Country	Level of fragmentation of ownership in agricultural land	Level of fragmentation of land use in agricultural land
Baltic countries	Estonia	Medium	Medium
	Latvia	Medium	Medium
	Lithuania	Medium	Medium
Central European countries	Czech Republic	High	Low
	Slovakia	High	Low
	Hungary	High	Medium
	Poland	Medium-high	Medium-high
	Eastern Germany	Medium	Low-medium
Balkan countries except former Yugoslavia	Albania	High	High
	Romania	High	High
	Bulgaria	High	High
Former Yugoslavia countries	Slovenia	High	High
	Croatia	High	High
	Serbia	High	High
	Bosnia-Herzegovina	High	High
	Montenegro	High	High
	Macedonia	High	High
	Kosovo	High	High
Western CIS countries	Moldova	High	Medium-high
	Ukraine	Low-medium	Low
	Russian Federation	Low	Low
	Belarus	Low	Low
Trans Caucasus countries	Armenia	High	High
	Georgia	High	High
	Azerbaijan	High	High

Source: Hartvigsen (2014)

Today's talk

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3. Experiment 2 (lab-in-field) $\Longrightarrow$ a combinatorial land exchange based on "swaps" and "packages" can increase efficiency.
4. Experiment 3 (field) $\Longrightarrow$ a swap mechanism for 1-year leases is implementable and effective. Some counterfactual policy evaluation.

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Coauthors

1–3 Gharad Bryan, Mariajose Silva Vargas, Tom Wilkening, Nitin Yadav

4 Dominik Biesalski, Gharad Bryan, Apollo Tumusiime, Tom Wilkening

Why market design?

- Many governments enacted centrally-planned **land consolidation programs**:

  E.g. France (18th-20th C), Sweden (18th-19th C), Denmark (19th-20th C), Germany (20th C).
  FAO (2003); Demetriou (2014); Hartvigsen (2014) discusses 25 countries.

- Difficult in low-information, low state capacity, potentially coercive settings.

- Markets are voluntary, participatory mechanisms that leverage local information.

- Many success stories, allocating medical residencies, schooling, donor organs, radio spectrum, microcredit, sanitation

Why lab experiments?

- Engineering approach: need to tailor tools to realistic participants

  Roth (2002); Milgrom (2009); Duflo (2017)

- Land issues are incredibly sensitive.

- Abstract from property rights issues

  (de Soto, 2000; Deininger and Feder, 2001; Deininger and Jin, 2006; Goldstein and Udry, 2008; Field, 2007; Besley and Ghatak, 2010; Galiani and Schargrodsky, 2010, 2011; Fenske, 2011; de Janvry et al., 2015; Lawry et al., 2016; Perego (2019); Agyei-Holmes et al., 2020).

Outline

Theory + Survey

- Start with a stylized model of the land trade problem
- Survey data shows this is a reasonable representation of the status quo
- Implies multiple frictions that impede efficient trade

Model

Consolidation: contiguous farms more profitable than fragmented farms

Sorting: Better farmers produce more with better land

Decreasing returns to total farm size

Cultural constraints: Some plots not for sale at any price

+ private information about own values

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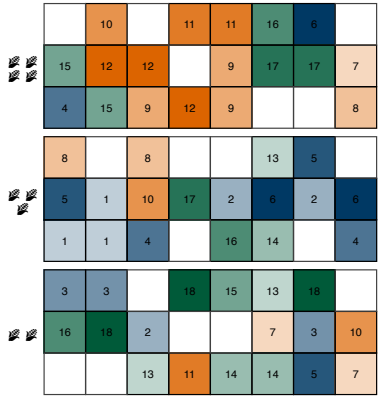
An initial allocation (A)



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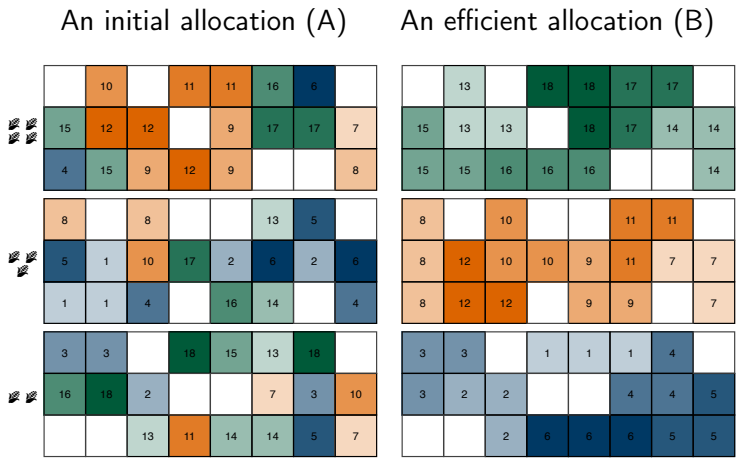

The Constraints Survey

- 1,404 land-owning farmers from 68 villages in Masaka, Uganda

- Wide-ranging questions about production function and trade frictions:
  - **Fragmentation**
  - **Heterogeneity & complementarities**
  - **Returns to scale**
  - **Culture & attitudes to trade**
  - Asymmetric information
  - Land market activity & market institutions
  - Beliefs about impact of different reforms

Validating the model

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Validating the model

Consolidation: contiguous farms more profitable than fragmented farms

Costs and benefits of fragmentation long debated

McCloskey (1972); Blarel et al. (1992); Deininger et al. (2014); Ali et al. (2015); Foster & Rosenzweig (2022), FAO (2003), Demetriou (2014), Hartvigsen (2014)

Validating the model

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Data:

- 64% have fragmented farms.
- 91% prefer consolidated land.
- 88% believe consolidation increases profits.

Experiment 3: consolidation increases land rental value

Validating the model

Sorting: Better farmers produce more with better land

Taken as given in the quantitative literature

Data:

- $\approx$ 99% think ability and quality are heterogeneous and complementary

Validating the model

Decreasing returns to total farm size

Largely taken as given in the quantitative literature

Data:

- 40% think they could not farm more than their current endowment

Validating the model

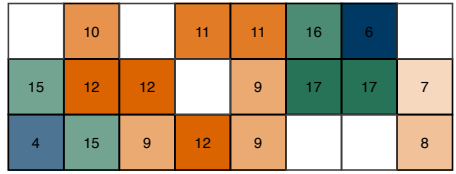
Cultural constraints: Some plots not for sale at any price

Data:

- 90% think ancestral land should not be sold.
- 31% think people should not sell outside the tribe
- (Leases are less controversial)

Why is efficient trade hard?

Farmer 17 wants
3 consolidated plots



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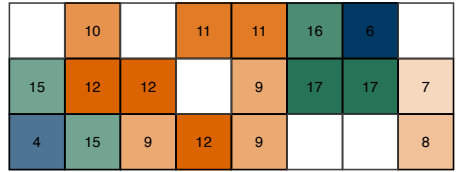

1. **Thin markets**

   Myerson & Satterthwaite (1983)
   - Efficient trades may not take place

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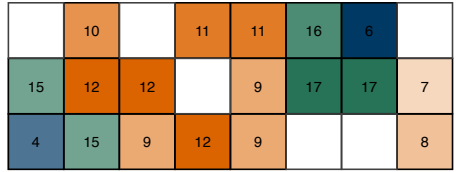

1. **Thin markets**
2. **Exposure risk**

   Goeree & Lindsay (2019)
   - Buy then sell? May get held up, or stuck with 4 plots.
   - Sell then buy? May get held up, or stuck with 2 plots.

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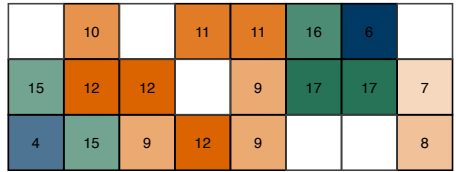

1. **Thin markets**
2. **Exposure risk**
3. **Coordination frictions**

   Milgrom (2017)
   - Chains of transactions hard to find & implement

Why is efficient trade hard?

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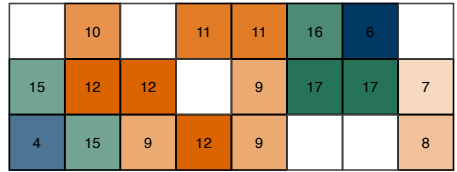


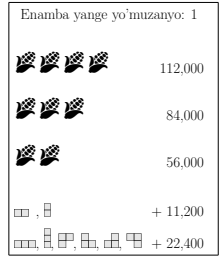
1. **Thin markets**
2. **Exposure risk**
3. **Coordination frictions**
4. **Liquidity constraints**
   - Can't buy without selling first.

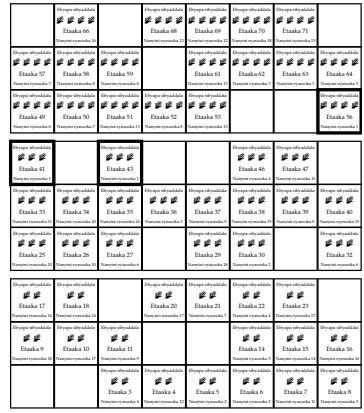
Outline

Experiment 1: Design

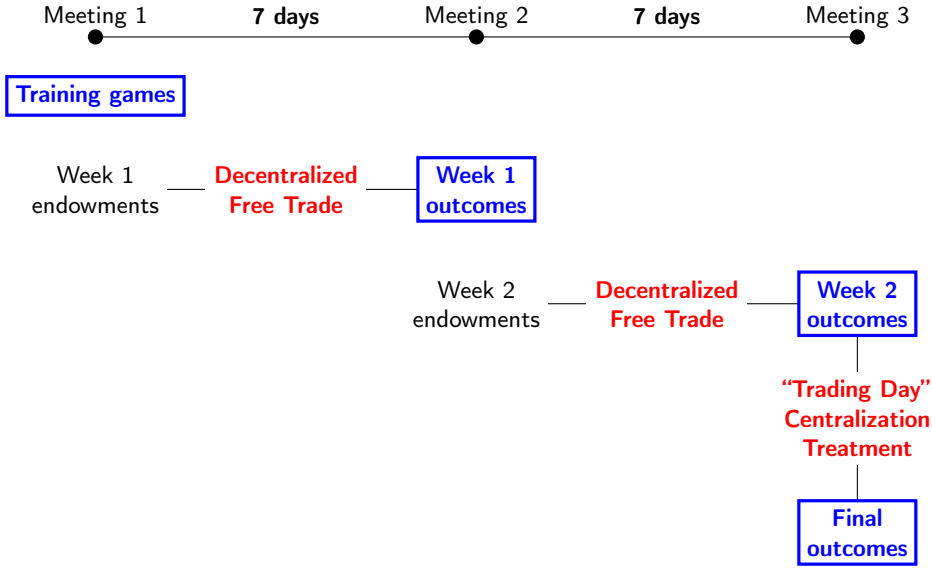
Parameters | Descriptives

- Same farmers in Masaka, Uganda
- Game:
  - 18 players x 3 plots each
  - Paper game currency
- Strong monetary incentives.
  - 1 day's wage showup fee
  - + up to 2.2 days' wages in trade
- Mechanism: **Decentralized free-form bargaining over 7 days**





Timeline


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

Analysis

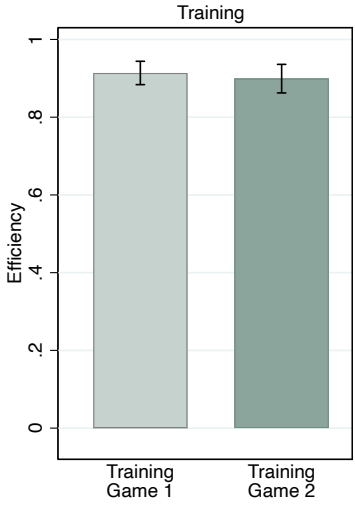
Gains from trade scaled by total potential gains:

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

Decomposition:

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

Result 1: Efficient trade is hard



Training games

1. Standard lab market game based on Chamberlin (1948)
2. Market game with multiple "titles" but no spatial dimension

$\Rightarrow$ Close to first-best outcomes.

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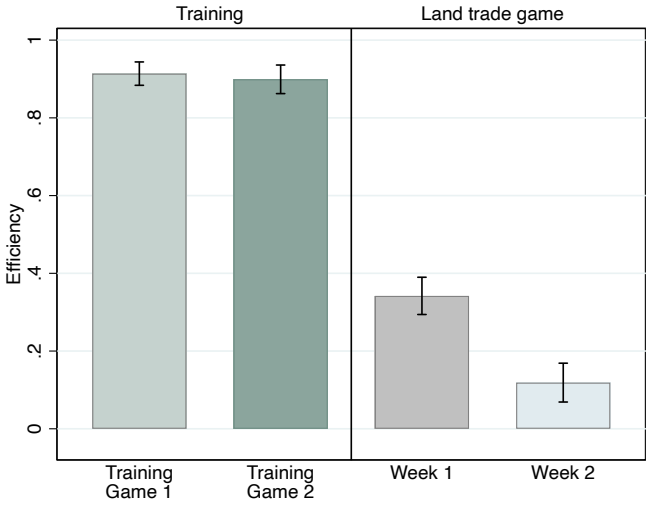

Training games

1. Standard lab market game based on Chamberlin (1948)
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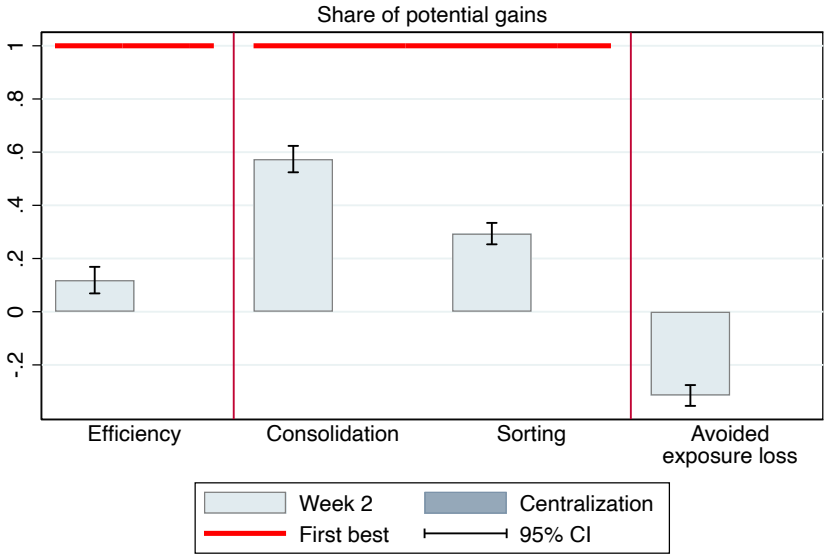
$\Rightarrow$ Close to first-best outcomes.

Decentralized land trade

- 95% try to buy at least 1 plot
- 87% succeed
- Half of plots change hands
- But **very low efficiency**

Result 2: Decomposition



Most gains from Consolidation

Substantial losses due to people left with too much or too little land

Market centralization intervention

- 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

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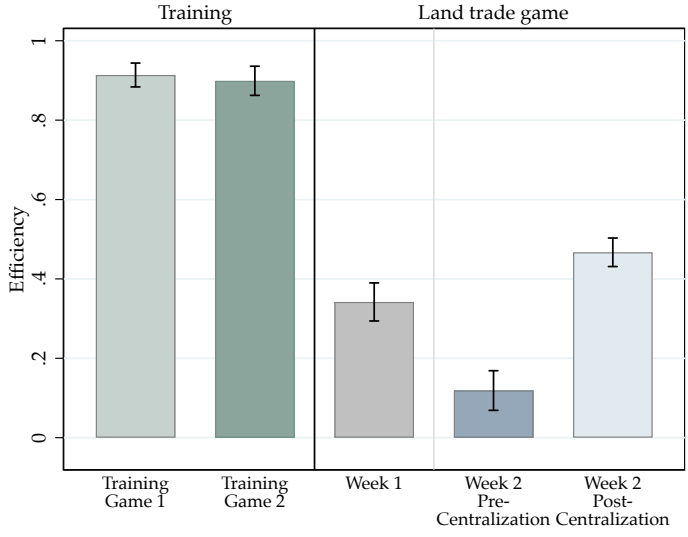
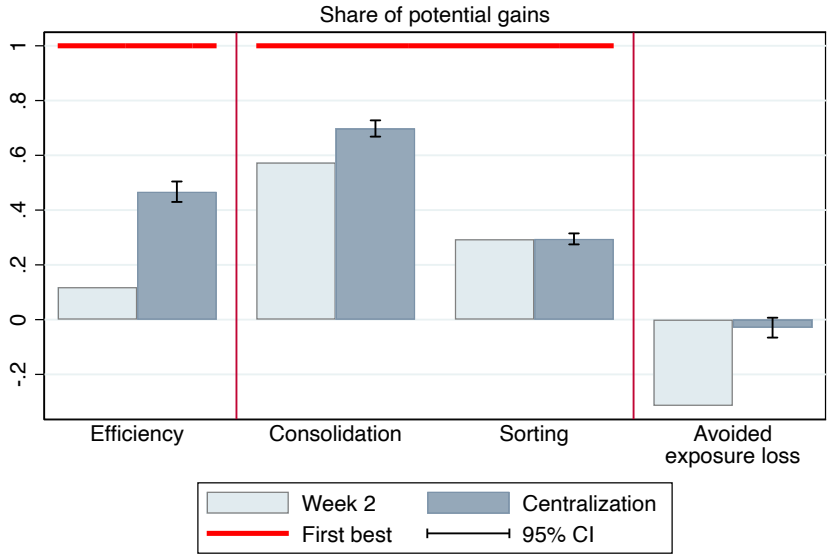
Centralization should

- Thicken the market
- Support enforcement
- Facilitate finding and bargaining over chains

Result 3: Efficiency gains from centralization



Result 4: Decomposition



Outline

Experiment 2

- Experiment 1: decentralized trade is inefficient; centralization unlocks some gains from trade.
- Experiment 2 studies tailored mechanisms that try to address frictions directly.

Experiment 2: Design

▸ Parameters ▸ Descriptives

- 48 sessions with land-owning farmers in Kiambu county, Kenya
- Game: 6 participants $\times$ 2 plots each
- Session: eight 10-minute computerized "land auctions" (all paid)
- Incentives: \$3 show-up + \$4 average earnings $\approx$ 1.5 days' wages

Mechanisms

Three **continuous double auctions** with varying **package size**.

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- **CDA-Broker:** Buy or sell one plot at a time.
  - E.g. "Buy plot 3 for at most 300"

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Three **continuous double auctions** with varying **package size**.

- **CDA-Broker:** Buy or sell one plot at a time.
- **CDA-Swap:** can also bid to buy **and** sell one plot.
  - E.g. "Buy plot 3 and sell plot 7, pay at most 50"

Mechanisms

Three **continuous double auctions** with varying **package size**.

- **CDA-Broker:** Buy or sell one plot at a time.
- **CDA-Swap:** can also bid to buy **and** sell one plot.
- **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"

Mechanisms

Three **continuous double auctions** with varying **package size**.

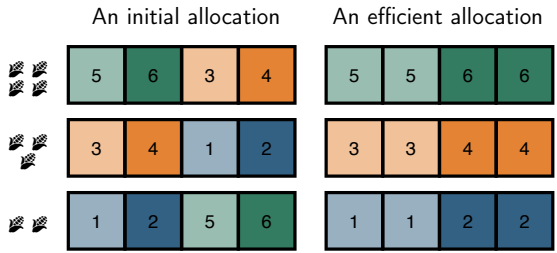
- **CDA-Broker:** Buy or sell one plot at a time.
- **CDA-Swap:** can also bid to buy **and** sell one plot.
- **CDA-Package:** can also bid to buy **and** sell up to two plots

All treatments:

- Centralized platform.
- A trade/chain/cycle triggered when sum of bids ≥ 0
- Verbal communication permitted
- "Bidding assistants" operate software
- XOR bids

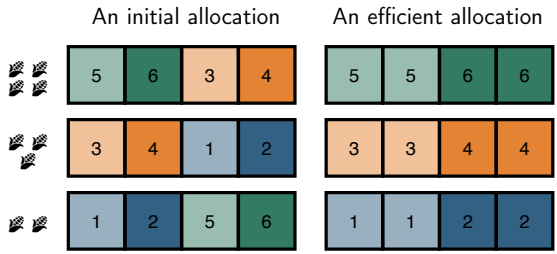
Potential advantages of combinatorial bids

1. **Thickens** the market
   - Easier to "relocate" $\Rightarrow$ more potential buyers
   - XOR: Safe to bid on many packages



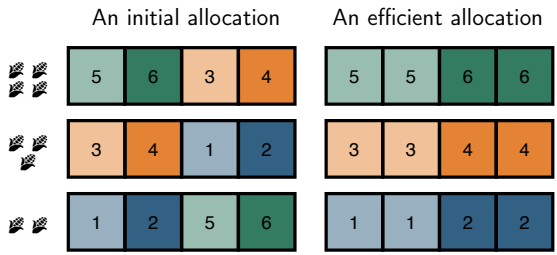
Potential advantages of combinatorial bids

1. **Thickens** the market
2. Reduces **exposure risk**
   - Conditional bids prevent hold up



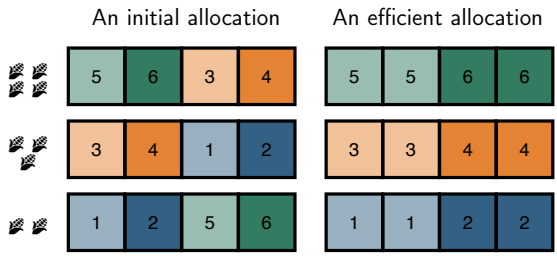
Potential advantages of combinatorial bids

1. **Thickens** the market
2. Reduces **exposure risk**
3. Reduces **coordination frictions**
   - Bidder states preferences, auctioneer finds chains and prices



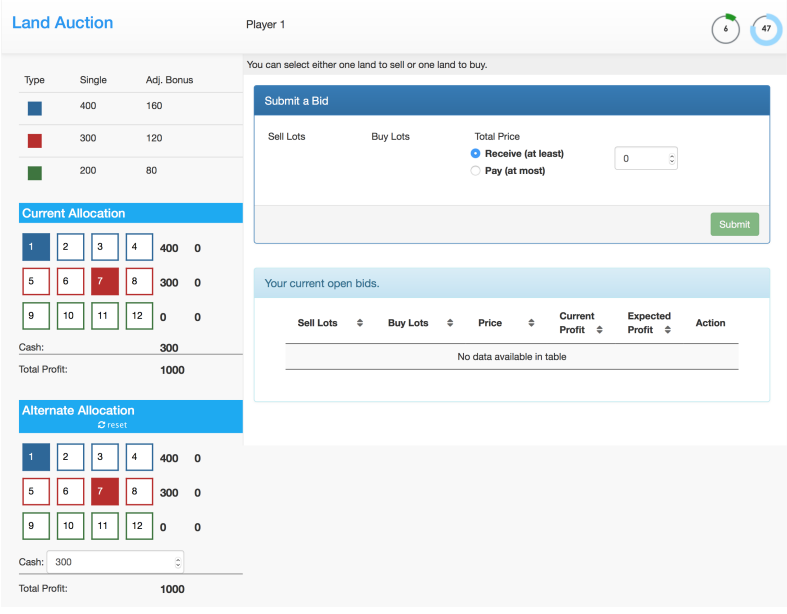
Potential advantages of combinatorial bids

1. **Thickens** the market
2. Reduces **exposure risk**
3. Reduces **coordination frictions**
4. Alleviates **liquidity constraints**
   - Can "pay with land" instead of money

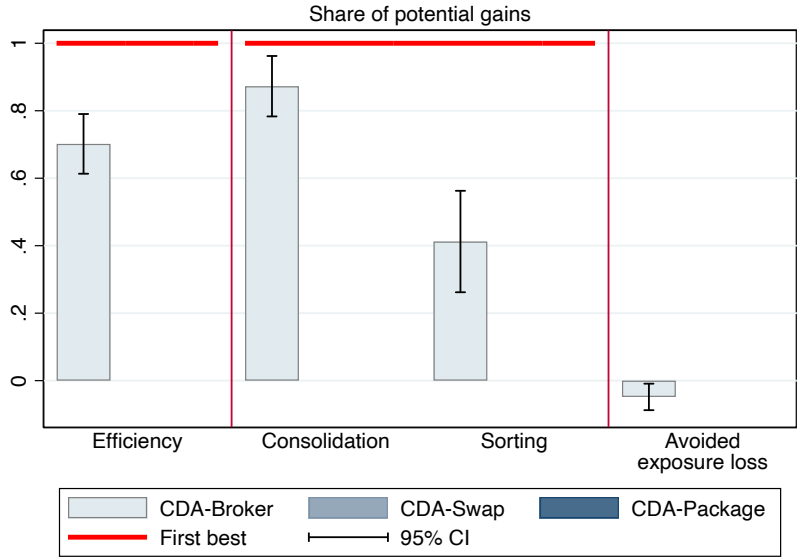


But...

- Bidding language is complex
- Space of potential packages is large
  - 20 1-for-1 packages
  - 45 2-for-2 packages
- Difficult to provide real-time feedback
- **Allowing combinatorial bids could decrease efficiency**

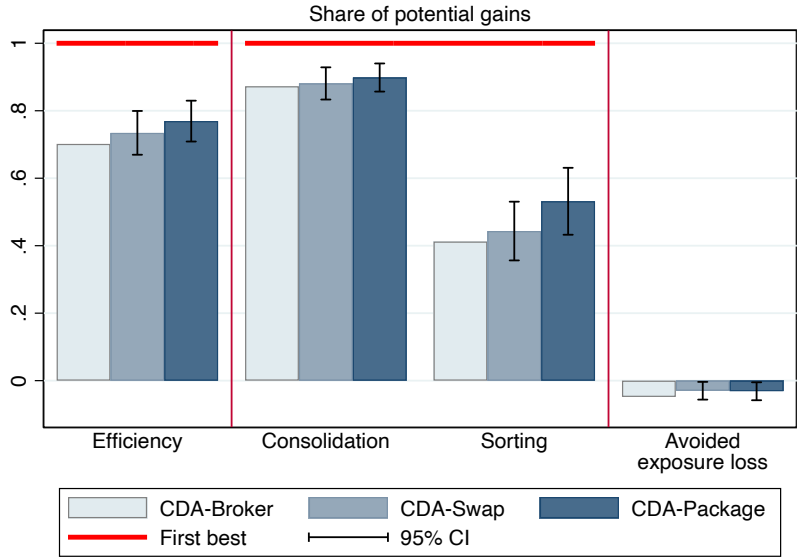

Land Auction
Player 1
6
47
You can select either one land to sell or one land to buy.
Type
Single
Adj. Bonus
400
160
300
120
200
80
Current Allocation
1
2
3
4
400
0
5
6
7
8
300
0
9
10
11
12
0
0
Cash:
300
Total Profit:
1000
Alternate Allocation
reset
1
2
3
4
400
0
5
6
7
8
300
0
9
10
11
12
0
0
Cash:
300
Total Profit:
1000
Submit a Bid
Sell Lots
Buy Lots
Total Price
Receive (at least)
Pay (at most)
0
Submit
Your current open bids.
Sell Lots
Buy Lots
Price
Current Profit
Expected Profit
Action
No data available in table

Result 5: High baseline efficiency, mostly from consolidation



Result 6: Combinatorial bids increase efficiency and sorting

▸ Robustness



Outline

Moving to the field

- Lab results: farmers can understand and benefit from improved land market design.
- Policy relevance depends on real-world implementability.

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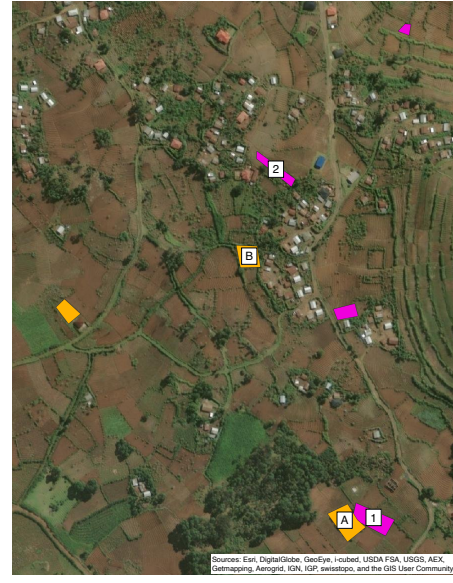
- Lab results: farmers can understand and benefit from improved land market design.
- Policy relevance depends on real-world implementability.
- This experiment:
  - Can we implement combinatorial trades for real?
  - How should prices be set? Are subsidies needed?
  - (Also: measure value and impacts of consolidation.)
- Fieldwork still in progress

Experiment 3: Design

- 5 villages in Kisoro district, Uganda.
- We map ownership of every plot (satellite images + field verification).
- Identify pairs of farmers who could increase consolidation by **swapping one plot** ($N = 224$)
- Elicit willingness to pay/accept for **1-year swap leases**.
- Implement a subset of swaps.

Example

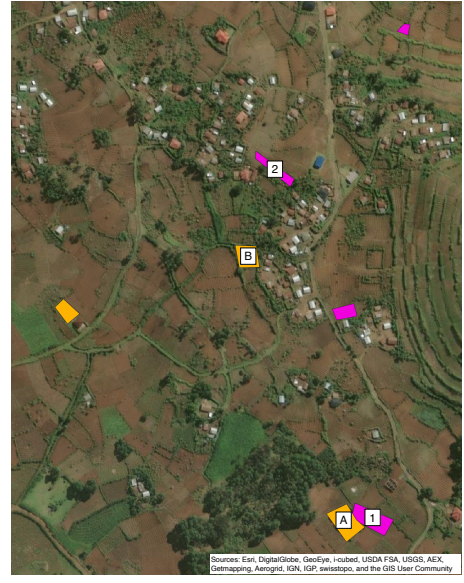
Consider three possible swaps between **orange** farmer and **pink** farmer.



Example

Consider three possible swaps between **orange** farmer and **pink** farmer.

1. Swap **1** for **B** (**orange** consolidates)
2. Swap **2** for **A** (**pink** consolidates)
3. Swap **1**+**2** for **A**+**B** $\Rightarrow$ no consolidation



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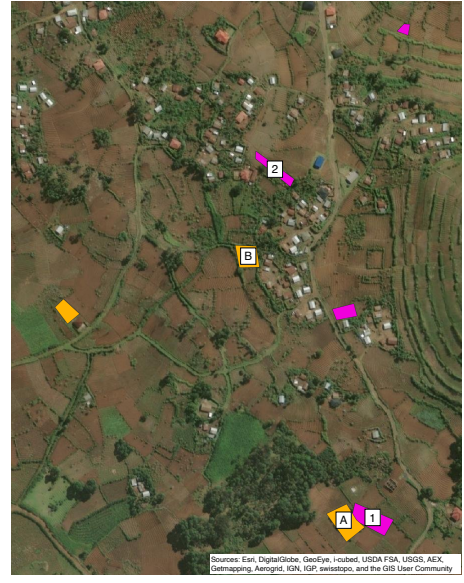
1. Swap **1** for **B** (**orange** consolidates)
2. Swap **2** for **A** (**pink** consolidates)
3. Swap **1+2** for **A+B** $\Rightarrow$ no consolidation

Structural model with transaction costs implies:

$$\text{Consolidation value} \approx v_1 + v_2 - v_3$$



Design

- Elicit willingness to pay/accept for up to 9 swaps per visit (max 2 visits)
  - We target "interesting" swaps (similar sizes, convenient locations)

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- Elicit willingness to pay/accept for up to 9 swaps per visit (max 2 visits)
  - We target "interesting" swaps (similar sizes, convenient locations)
- Make sure valuations are well informed
  - Farmer visits all relevant plots (up to 6 owned + 6 non-owned)
  - Info sheet: map, owner's name, area, distance. Encourage note taking.
  - At least 24 hours for deliberation.

Design

Implementation mimics a second-price auction (Becker-DeGroot-Marschak)

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$$(WTP_1 \geq \text{Price}_1) \wedge (WTP_2 \geq \text{Price}_2)$$

- Truth-telling is incentive compatible
- Contracts written according to local customs

(Preliminary) results

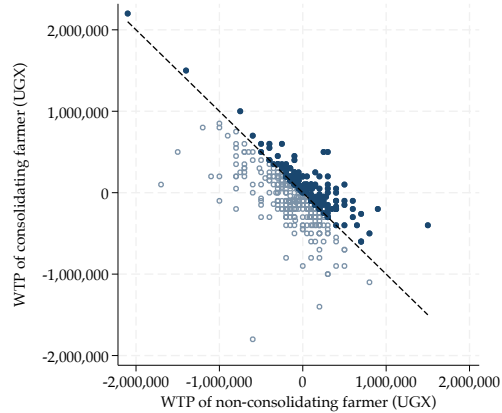
- Farmers understand and are willing pay for swap leases
  - 88 "for real" swaps. 69 should be implemented, 68 were implemented.
  - 61% of participants swapped.
  - Anecdotally, most want to renew the lease next year.

(Preliminary) results

- Farmers understand and are willing pay for swap leases
  - 88 "for real" swaps. 69 should be implemented, 68 were implemented.
  - 61% of participants swapped.
  - Anecdotally, most want to renew the lease next year.
- Valuation data show:
  - Farmers value increases or decreases in land area at around $\frac{1}{2}$ market rate
  - Consolidation increases rental value by about 10%
  - Trade incurs a transaction cost of similar magnitude

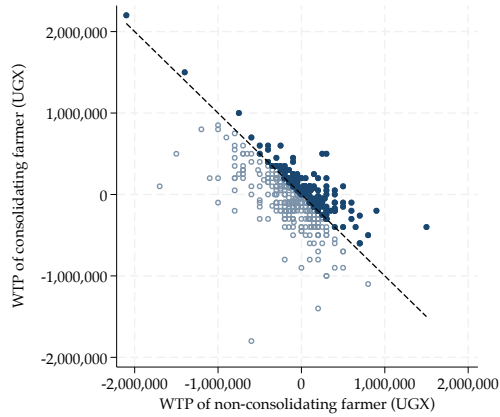
Policy evaluation

- If trade occurs, surplus equals $WTP_1 + WTP_2$.
- 40% of 1-for-1 swaps are efficient: $WTP_1 + WTP_2 \geq 0$.
- What designs are good at finding efficient swaps/avoiding inefficient ones?



Policy evaluation

- **Vickrey-Clark-Groves** mechanism implements all efficient trades.
  (requires large subsidies; risk of collusion).



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- **Vickrey-Clark-Groves** mechanism implements all efficient trades.
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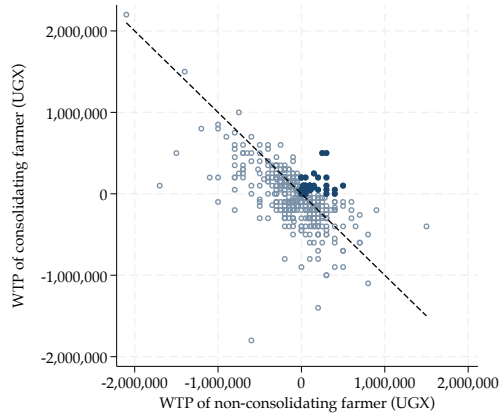
- **Matching** (zero-price swaps). Trade if:
  $(WTP_1 \geq 0) \wedge (WTP_2 \geq 0)$.
  $= 21\%$ of efficient trades



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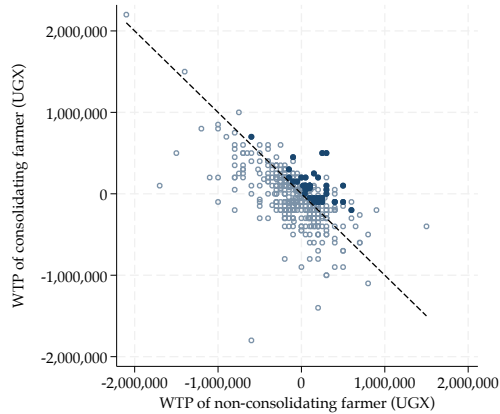
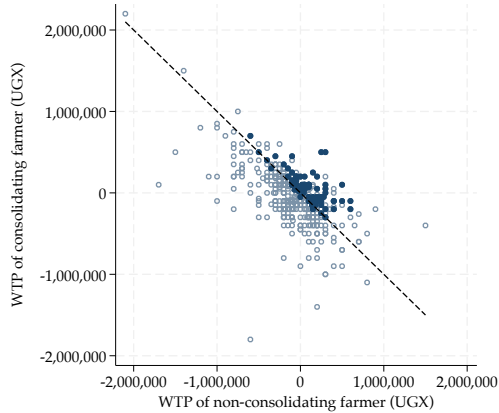
- **Fixed rent**. Farmers pay one another the market rental rate. 23% of efficient trades.



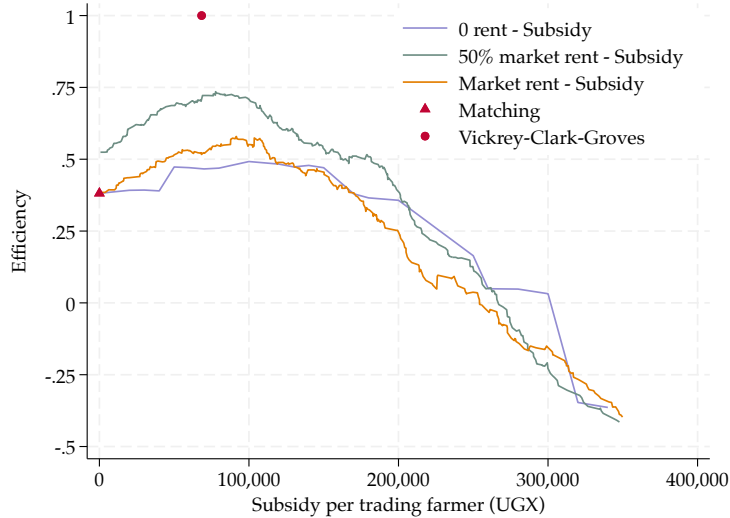
Policy evaluation

- **Vickrey-Clark-Groves** mechanism implements all efficient trades. (requires large subsidies; risk of collusion).
- **Matching** (zero-price swaps). Trade if: $(WTP_1 \geq 0) \wedge (WTP_2 \geq 0)$. $= 21\%$ of efficient trades
- **Fixed rent**. Farmers pay one another the market rental rate. 23% of efficient trades.
- **Fixed rent + lump sum**. Adding a 40,000 UGX subsidy implements 41% of efficient trades (and 2% of inefficient)



Policy evaluation

- Measure total surplus under different policies; compare to first best.
- 50% market rent with 78k subsidy achieves 74% efficiency.
- Implements 61% of efficient trades and 8% of inefficient trades.



Outline

Conclusion

- Great potential for market design improvements to unlock gains from trade.
- Lab findings: centralized, combinatorial mechanisms can help with consolidation, sorting, reducing exposure losses.
- Field: combinatorial trades (swaps) are implementable in the field, and popular.
- Rich valuation data important for finding efficient trades.

Pipeline

- Endline data collection ongoing for experiment 3
- Lab work to develop field-implementable trading interfaces
- New work in Ethiopia with the World Bank, leveraging the rural land registry

Appendix

Inequality

- A significant potential concern: market design might exacerbate inequality.
- Particularly in complex mechanisms: sophisticates might profit at others' expense.[1]

[1] Related concerns in school choice: Abdulkadiroglu et al. (2006); Pathak and Sönmez, (2008).

Inequality

- A significant potential concern: market design might exacerbate inequality.
- Particularly in complex mechanisms: sophisticates might profit at others' expense.[1]
- We compute an Atkinson Index of final assets (assuming log utility):

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

- Significantly **reduced** by both market design interventions.
  ▸ Uganda ▸ Kenya
- Seems to be primarily by reducing very bad outcomes

[1] Related concerns in school choice: Abdulkadiroglu et al. (2006); Pathak and Sönmez, (2008).

Additional results

- Can't households just centralize the market themselves? ▸ Endogenous Trading Day
  - They try! But fail.
  - Conjecture: big difference between complete and partial centralization

- Role of non-tradable plots ▸ Efficiency ▸ Inequality
  - Experiment 1 randomized "Complex" maps with holes, and "Simple" maps without.
  - Hardly matters for efficiency, but exacerbates inequality (more holdout?)

- Role of liquidity constraints ▸ Efficiency ▸ Inequality
  - Experiment 2 randomized initial cash balances (Low vs High)
  - **No efficiency effect**
  - But exacerbates inequality when packages not available (worsens exposure risk?)

- Role of communication ▸ Verbal bargaining
  - We allow verbal communication in all treatments.
  - Package exchange seems to crowd out verbal bargaining.

Include Block 1

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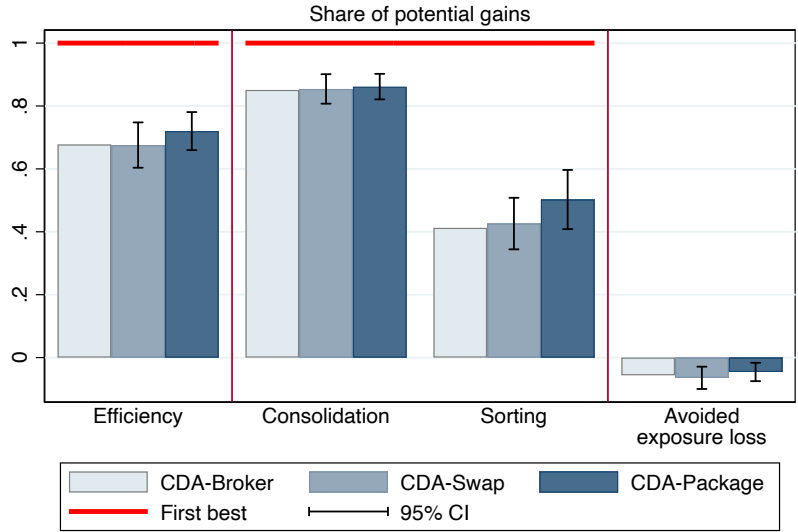

These regressions include block 1

Endogenous Trading Day

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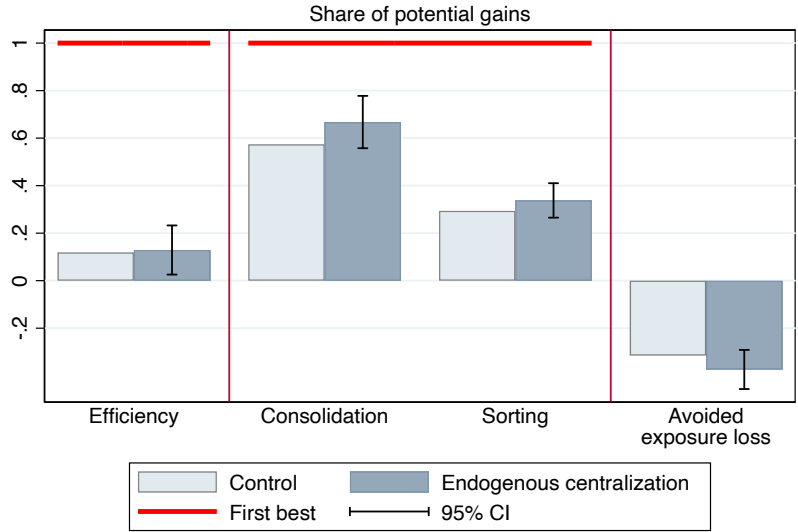

Note: these regressions include week 2 (pre centralization)

Simple versus Complex maps

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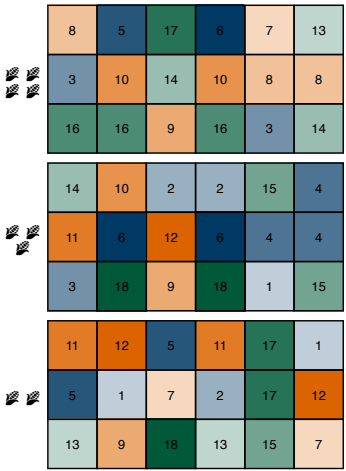
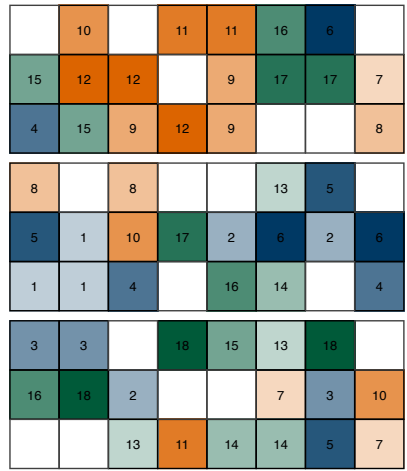
Simple map



Complex map



Results

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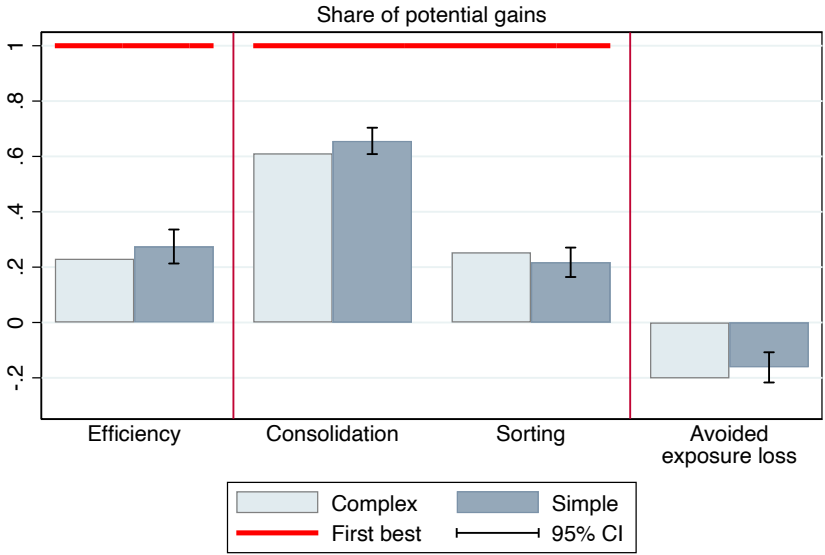

Low vs High Cash

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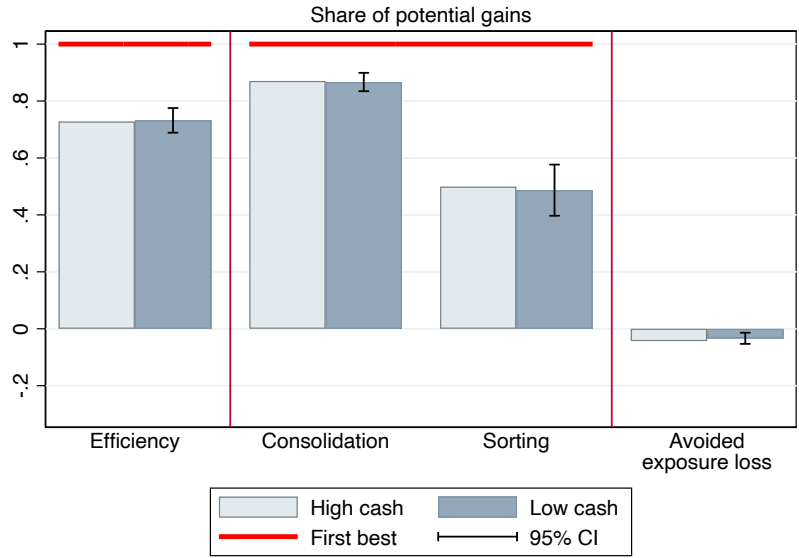

Verbal bargaining

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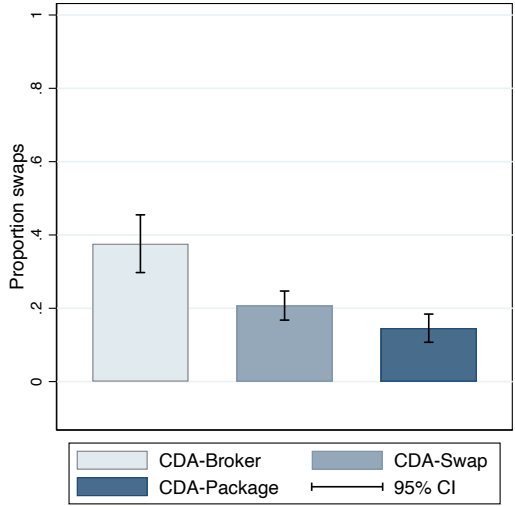

Table 1: Game parameters in the experiments

	Centralization experiment	Package exchange experiment
Mode of interaction	Free-form bargaining	Computerized trade
Market design variation	Decentralized/Centralized trade	CDA-Broker/CDA-Swap/CDA-Package
Other treatments	Simple/Complex maps	High/Low initial cash
Number of players	18	6
Number of tradable plots	54	12
Span of control	3 plots	2 plots
Land quality types	{Low, Med, High} = $\{1, 1.5, 2\}$	
Farmer ability types	Low $\{0.8, 0.9, 1, 1, 1.1, 1.2\}$ Med $\{1.3, 1.4, 1.5, 1.5, 1.6, 1.7\}$ High $\{1.8, 1.9, 2, 2, 2.1, 2.2\}$	Low $\{1, 1\}$ Med $\{1.5, 1.5\}$ High $\{2, 2\}$
Value of a single plot	Land quality × Farmer ability	
Bonus for 2 adjacent plots	Farmer ability × 0.4	Land quality × Farmer ability × 0.4
Initial cash balance	6	Low cash treatment 2.5 High cash treatment 7.5
Information structure	Initial endowments are common knowledge, own values are private information.	
Verbal communication permitted?	Yes	
Potential efficiency gains from consolidation (% of first best)	50%	73.3%
Debt	Initial assets − 1.75	None
Incentives (per trading round)	8,000 UGX × (Final assets − Debt)	5 KES × Final assets
Trading rounds	2 (plus "trading day")	8
Duration of trading rounds	Free-form trade: 1 week Trading day: as much time as needed	10 minutes

Notes: parameters have been normalized such that the average value of a low-quality plot held by a low-ability farmer is 1. Share of efficiency gains from consolidation/sorting varies by initial allocation. In the centralization experiment we selected initial allocations to target a 50-50 split.

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Table B1: Summary Statistics: Experiment 1

	Our sample			Uganda		
Demographics	mean	S.D.	obs	mean	S.D.	obs
Age	43.76	13.52	1404	39.11	17.48	3338
Female	0.51	0.50	1404	0.51	0.50	3338
Head of household	0.65	0.48	1404	0.38	0.49	3338
Married: monogamous	0.63	0.48	1404	0.49	0.50	3338
Married: polygamous	0.06	0.24	1404	0.11	0.32	3338
Nr adults (inc respondent)	2.99	1.54	1404	2.60	1.27	1246
Nr children in household	3.37	2.07	1404	2.97	2.13	1246
Education						
Education (years)	7.16	3.21	1404	6.34	3.24	2551
Numeracy	0.76	0.37	1224			
Farm size and income						
How many plots do you own and cultivate?	2.10	1.15	1404	1.69	0.93	1246
Total land holdings cultivated (in acres)	2.95	3.32	1349	2.94	4.22	1244
Income from agriculture (1000 UGX/season)	1482	2174	1349	897	1995	847
Income from agriculture (USD PPP/season)	1365	2002	1349	826	1837	847
Farming ability (self-evaluated, relative to best in village)						
Farmer's total production	0.47	0.30	1403			
Max farm size (w/o hired labor)	0.59	0.35	1403			
Preferences (1-5 scale)					GPS	
Patience	4.35	0.66	1404	3.52	1.17	1000
Risk tolerance	4.09	0.90	1404	3.40	0.91	1000

Note: Comparison demographic data is from the Living Standards Measurement Study - Integrated Surveys on Agriculture 2019–2020 (Uganda National Bureau of Statistics, 2020) and the sample is restricted to respondents aged 18 and older whose main income comes from agri-

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Table D1: Summary Statistics: Experiment 2

	Our sample			Kenya		
Demographics	mean	S.D.	obs	mean	S.D.	obs
Age	42.65	10.45	263	38.73	16.61	51535
Female	0.58	0.50	264	0.52	0.50	51535
Married	0.77	0.42	264	0.63	0.48	51535
Nr of people in household	4.06	1.71	264	4.31	2.48	23785
Education						
Education (years)	9.75	2.94	264	8.01	4.23	51416
Land tenure						
Owns two or more plots	0.22	0.41	264			
Total land ownership in acres	1.01	1.52	237	2.56	3.79	23230
Land trade						
Fraction of plots with joint ownership	0.61	0.49	303			
Fraction of plots that are far from home	0.24	0.43	303			
Fraction of plots with a title	0.64	0.48	303			
Fraction who bought a plot (last 12 months)	0.05	0.22	264			
If has bought land: How many acres	0.83	1.42	11			
Fraction who sold a plot (last 12 months)	0.02	0.14	264			
If has sold land: How many acres	7.62	11.80	4			
Fraction of sales due to emergencies	0.40	0.55	5			
Consolidation						
How important is it to have all your plots together? (1–10, 1 is better to have spread out)						
1	0.43	0.50	264			
2 – 9	0.08	0.27	264			
10	0.47	0.50	264			
Why?						
Why fragment? Less risky	0.25	0.43	264			
Why consolidate? More productive	0.38	0.49	264			
Preferences (1–5)					GPS	
Risk tolerance	3.95	1.42	264	3.49	0.93	998

Comparison demographic data is from the Kenya Demographic and Health Survey 2014 (Kenya National Bureau of Statistics et al., 2015), for individuals aged 18 and older that own

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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

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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

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