# Land Property Rights, Financial Frictions, and Resource Allocation in Developing Countries

Kristina Manysheva
Princeton University

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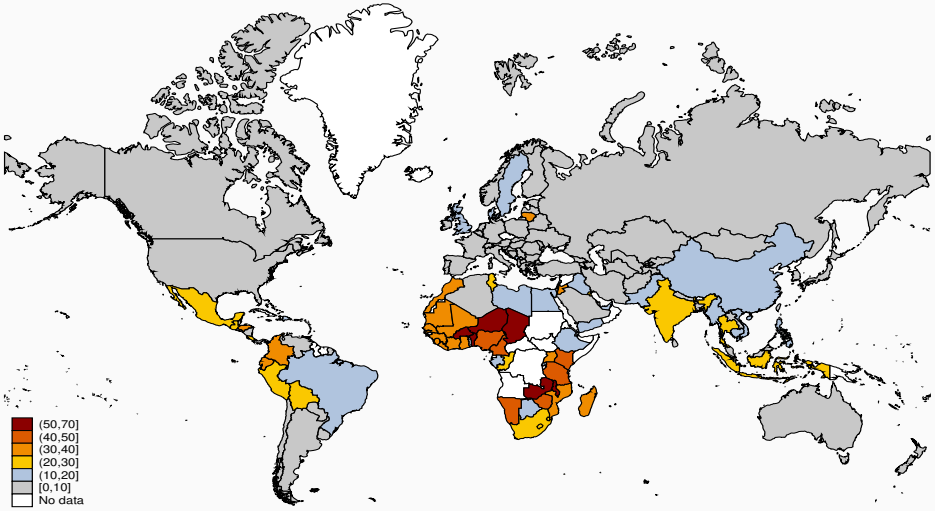
# Low Financial Development & Insecure Property Rights in Developing World




Share of Land with No Documentation (2020)

map insecurity

# Lack of Land Formalization & Communal Land

As a result, **LAND**

- ... can't be sold/rented out
- ... subject to expropriation risk
- ... **can't be used as collateral**

# This Paper: Land, Finance and Economic Development

**Effect of land and financial frictions on economic development? Role of their interaction?**

- Incorporate land and financial market frictions into HA macro model
- Use micro data from Tanzania to estimate parameters of model
- Quantify and compare effects of land and financial reforms in GE setting
- Assess impact of various channels of land reform, including better access to credit

# Preview of the Results

- Data to show resource misallocation linked to land & credit market frictions
- Model to quantify GE effect of land reform:
  - More efficient land allocation across HH $\Rightarrow \Uparrow$ in agricultural output by 7.4%
  - More efficient allocation of HH across occupations $\Rightarrow \Uparrow$ non-agric. output by 8.2%
  - Shift of HH away from agriculture to other occupations (share of farmers $\Downarrow$ by 8.6%)
  - Impact of collateral channel is qualitatively $\approx$ to impact of financial reform
- **Land market frictions amplify effect of financial market imperfections, especially among poorest**

Literature

# Plan of the Talk

1. Model Framework
2. Reduced Form & Model Calibration
3. Quantitative Analysis: Model Mechanism
4. Land Reform

# Organizing Framework

- Heterogeneous agent model (in wealth, land ownership, and ability) details
- Infinite horizon and discrete time
- Measure one of households indexed by $i \in [0, 1]$
- Model incorporates
  - Endogenous occupational choice (farmers, workers, entrepreneurs) details
  - Endogenous evolution of communal land details
  - Forward-looking saving decision
  - Land and financial markets are incomplete

# Land Market Imperfections

- Economy's aggregate land endowment is $L$
  - $\mu_l \in [0, 1]$: communal
  - $1 - \mu_l$: private

Each household endowed with some $l \geq 0$ under property right regime, $pr = \{c, p\}$

- Communal land
  - can't be rented out
  - subject to expropriation risk if not used ($\pi_E$ land expropriated, $\pi_R$ – reallocated)
  - can't be used as collateral

# Financial Market Imperfections

- Competitive financial intermediary receives deposits and makes loans ($r_t^k = r_t + \delta$)
- No state-contingent bonds, and financial wealth is non-negative

$$a_{i,t+1} \geq 0 \text{ for all } t$$

- Only within-period credit to finance capital
- Obtained *loan and assets* are costlessly transformed into capital
- Due to limited enforceability borrowing limited by collateral constraint
- Private land can also be used as collateral
- Within-period borrowing to finance capital up to the limit

$$k_t \leq \lambda_k a_t + (\lambda_k - 1) q_t^l l_t \mathbb{I}_{\{land=private\}}$$

# Household Problem Conditional on Occupational Choice – Private Land

$$V_t(s_{it}) = \max_{c_{it}, a_{it+1}, k_{it}^{o\in\{E,F\}}, n_{it}^{o\in\{E\}}, l_{it,d}^{o\in\{F\}}} \frac{c_{it}^{1-\sigma}}{1-\sigma} + \beta \mathbb{E}_t[V_{t+1}(s_{it+1}|s_{it})], \text{ where } s_{it} = (a_{it}, z_{it}^a, z_{it}^e, l_i)$$

s.t.

$$c_{it} + a_{it+1} \leq y_{it}^o + (1 + r_t) a_{it} + r_t^l l_i$$

$$k_{it} \leq \lambda_k a_{it} + (\lambda_k - 1) q_t^l l_i, \quad o \in \{Entrep, Farmer\} \quad (a_{it+1} \geq 0)$$

And

$$y_{it}^{Entrep} = z_{it}^e k_{it}^{\alpha_e} n_{it}^{\gamma_e} - w_t n_{it} - r_t^k k_{it}$$
$$y_{it}^{Worker} = w_t$$
$$y_{it}^{Farmer} = z_{it}^a k_{it}^{\alpha_a} (l_{it}^d)^{\gamma_a} - r_t^k k_{it} - r_t^l l_{it}^d, \quad \alpha + \gamma < 1$$

# Household Problem of a Farmer – Communal Land

$$V_t(a_{it}, z^a_{it}, z^e_{it}, l_{it}) = \max_{c_{it}, a_{it+1}, k_{it}, l^d_{it}} \frac{c_{it}^{1-\sigma}}{1-\sigma} \quad +$$

$$+\beta \left\{ \pi_R \mathbb{E}_t[V_{t+1}(s_{it+1}, l_{it+1} = l_{it} + \eta_t | s_{it})] + (1 - \pi_R)\mathbb{E}_t[V_{t+1}(s_{it+1}, l_{it+1} = l_{it} | s_{it})] \right\}$$

s.t.

$$c_{it} + a_{it+1} \leq y_{it} + (1 + r_t)a_{it}$$

$$k_{it} \leq \lambda_k a_{it} \quad \text{and} \quad a_{it+1} \geq 0$$

where

$$y_{it} = z^a_{it} k_{it}^{\alpha_a} (l^d_{it})^{\gamma_a} - r^k_t k_{it} - r^l_t (l^d_{it} - l_{it}) \mathbb{I}_{\{l^d_{it} \geq l_{it}\}}$$

# Household Problem of Worker and Entrepreneur – Communal Land

$$V_t(a_{it}, z^a_{it}, z^e_{it}, l_{it}) = \max_{c_{it}, a_{it+1}, k^{o\in E}_{it}, n^{o\in W}_{it}} \frac{c_{it}^{1-\sigma}}{1-\sigma} \quad +$$

$$+\beta\left\{\pi_E \mathbb{E}_t[V_{t+1}(s_{it+1}, l_{it+1}=0|s_{it})] + (1-\pi_E)\mathbb{E}_t[V_{t+1}(s_{it+1}, l_{it+1}=l_{it}|s_{it})]\right\}$$

s.t.

$$c_{it} + a_{it+1} \leq y^o_{it} + (1+r_t)a_{it}$$

$$k_{it} \leq \lambda_k a_{it} \ , \ o \in \{E\} \quad \text{and} \quad a_{it+1} \geq 0$$

And

$$y^{Entrep}_{it} = z^e_{it} k_{it}^{\alpha_e} n_{it}^{\gamma_e} - w_t n_{it} - r^k_t k_{it}$$

$$y^{Worker}_{it} = w_t$$

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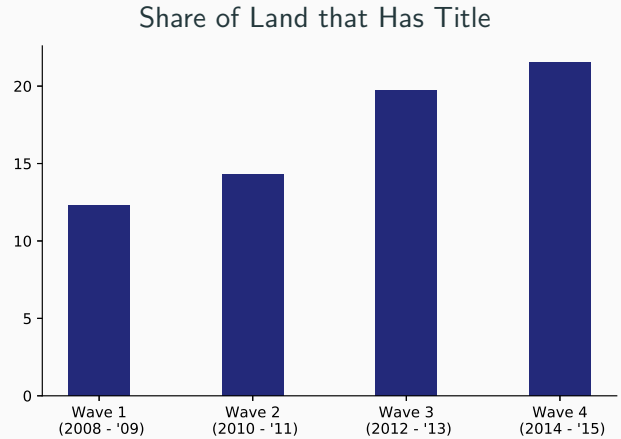
# Measure of Land Property Rights in Tanzania




agricultural data | other measures

# Land Property Rights and Allocation of Land

- Estimate agricultural production function
  - Dynamic panel approach to address endogeneity — Econometric approach, Data
  - Agriculture is labor and land intensive & exhibits *decreasing return to scale* — Results
- Efficient static allocation with no market frictions: — Conceptual framework

$$\log\left(L_i^*\right) \propto \log\left(e_i\right)$$

- Test if relationship holds in data and same across households — Results
- Find that coefficient is
  - more than 50% higher for households with land under strong property rights
  - more than twice as high for households that use credit
- **Land misallocation linked to land and financial market imperfections**

# Robustness and Other Findings

- Relax assumption of Cobb-Douglas production function — Factor Ratios, CES
- Production function and misallocation exercise without shocks — Results
- Selection issues — HH Fixed Effects, Other Measures of Property Rights
- HH characteristics: HH with titled land also have higher probability of — Results
  - getting a loan
  - rent out their land
  - operate non-agricultural enterprise
  - lower probability of agriculture being the main employment

Model Calibration

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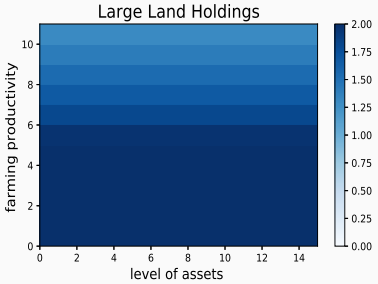
# Land Property Rights and Economic Efficiency

Three main channels:

- Expropriation risk => efficiency of labor allocation
- Inability to rent out land => efficiency of land allocation
- Inability to use land as collateral => access to credit (especially among poorest)

# Mechanism: Land Misallocation

Ratio of Land Usage by Communal Farmers Relative to Private Farmers



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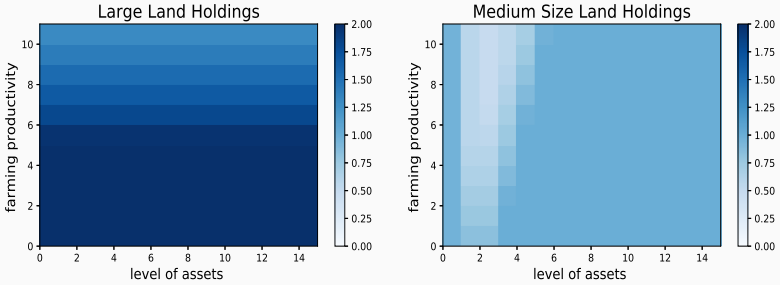
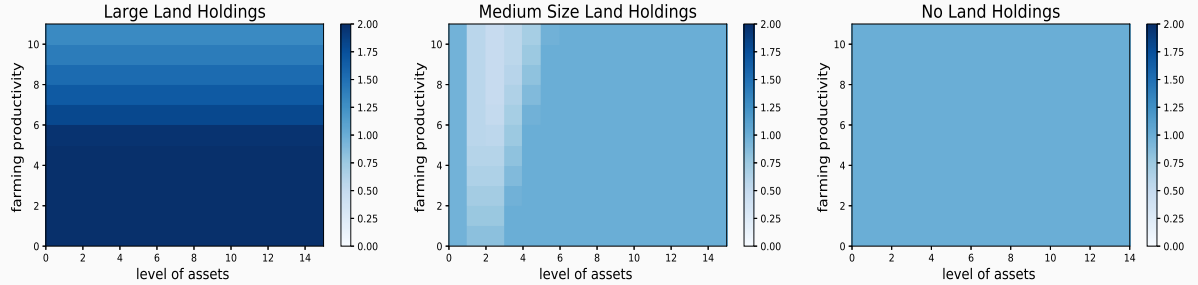


# Mechanism: Land Misallocation

## Ratio of Land Usage by Communal Farmers Relative to Private Farmers

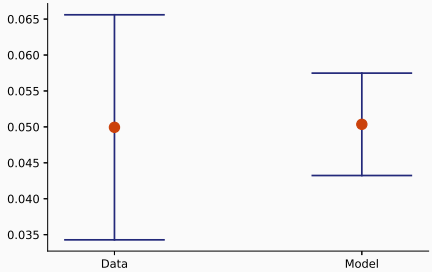



Proposition 1 Proposition 2 Full picture

# Land and Productivity Relationship: Data vs Model

Efficient static allocation:

$$\log(L_i^*) \propto \log(e_i)$$

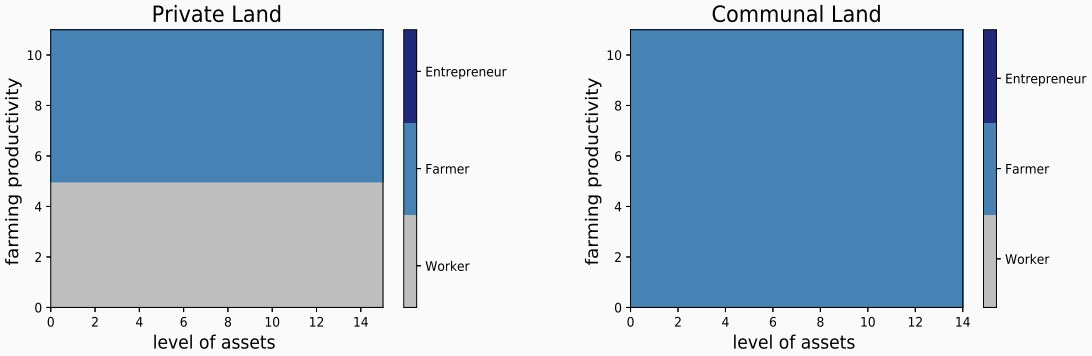



Homogeneous across farmers?

- Data: 50.5%
- Model: 48.8% higher coefficient for farmers with titled land

# Mechanism: Labor Misallocation

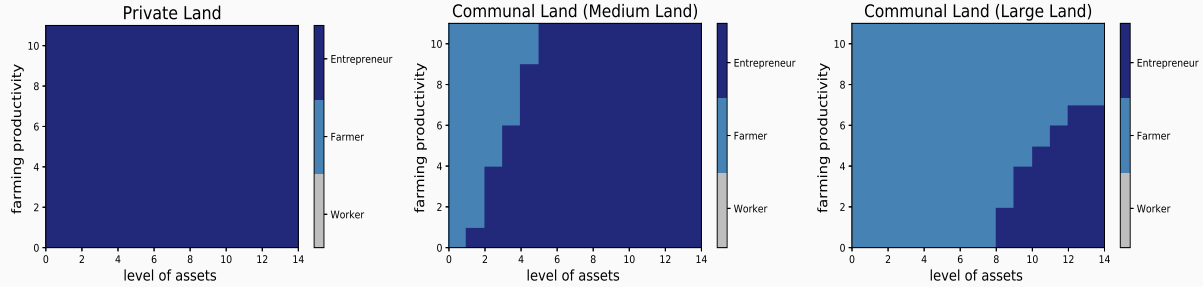
Households with Low Entrepreneurial Productivity




Data: In HH with titled land the probability of head's main employment be (share of working hours) in agriculture is *lower*

# Mechanism: Labor Misallocation

Households with High Entrepreneurial Productivity




Data: In HH with larger plot size (untitled!) the probability of head's main employment be (share of working hours) in agriculture is *higher*

Full picture

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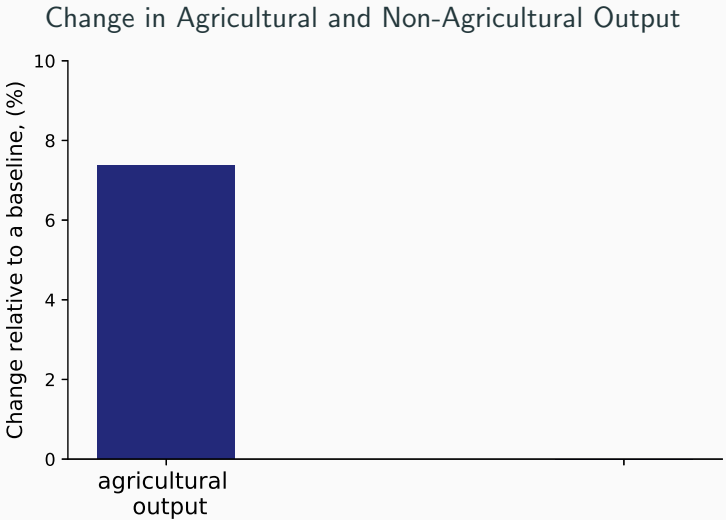
# Land Reform: 100% of Private Land



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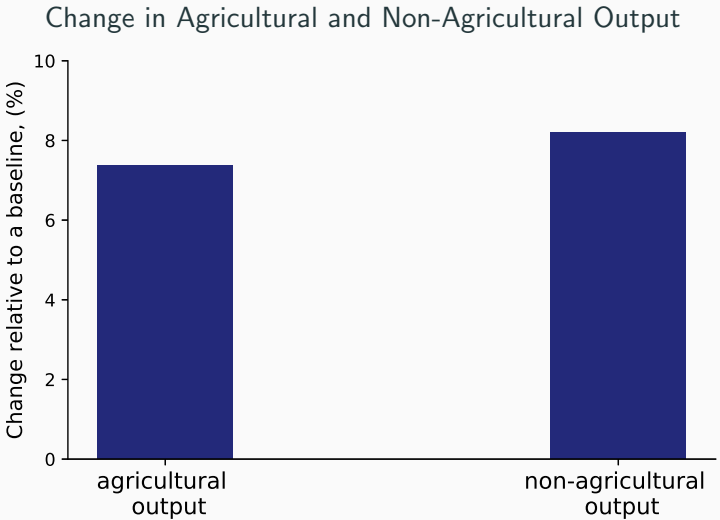

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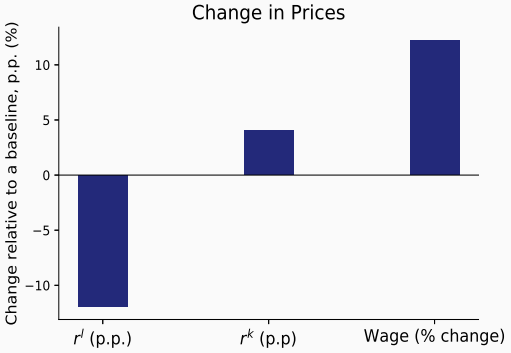
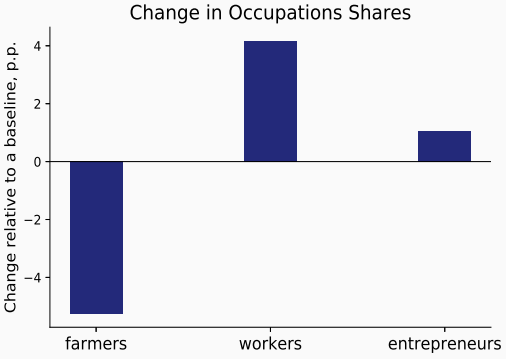



Partial vs General Equilibrium

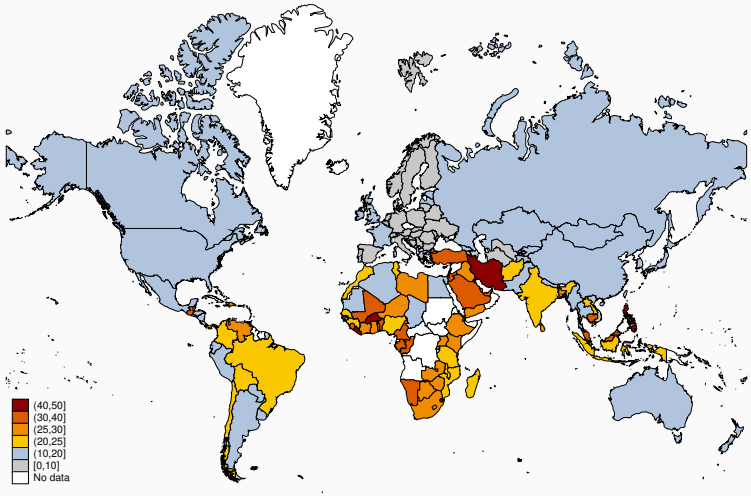
# Other Counterfactual Exercises

- Exploit different mechanisms of land reform by removing one friction at a time
  - Different channels affect economy differently results
  - Ability to rent out land $\Rightarrow \Uparrow$ in agricultural output
  - Ability to use land as collateral + no expropriation risk $\Rightarrow \Uparrow$ non-agricultural output
- Compare Land Reform and Financial Reform results
  - Financial reform has *similar* aggregate effect to collateral channel of land reform, but *different* distributional impact
- Land reform $\Rightarrow$ positive welfare gains, but not evenly distributed distribution
- Postreform transition dynamics: most changes $\approx$ 7 yr, new st. st. $\approx$ 15-20 yr plot
- Model Extensions/Future Work details

# Conclusions

- In data, insecure property rights are associated with misallocation of resources
- Quantitative model with both land and financial markets frictions:
  - Land reform $\Rightarrow \Uparrow$ agricultural and non-agricultural output, $\Downarrow$ farmers and $\Uparrow$ entrepr.
  - Land reform $\Rightarrow \Uparrow$ financial inclusion, *especially among poorest*

# Share of Adults Who Feel Insecure about Property (2020)

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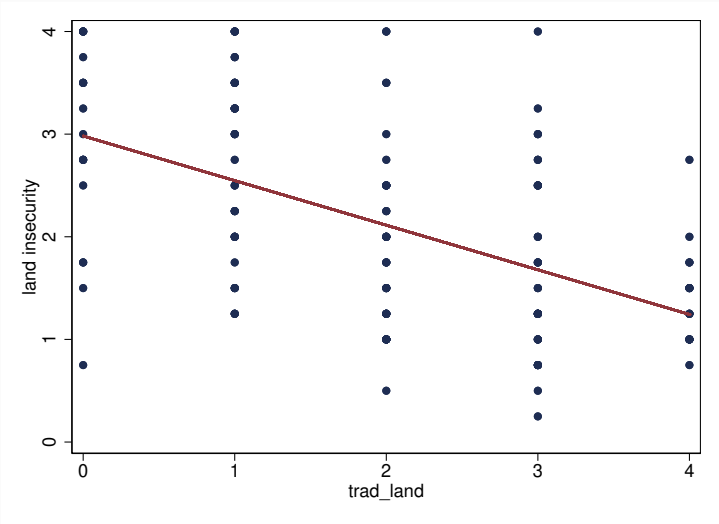
# Communal land and land tenure security

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# Contributions

- Model with *both* land and financial markets frictions in GE setting
  - *Lagakos, Waugh ('13); Gollin et al. ('14); Moll ('14); Bick et al. ('16); Yu, Zheng ('16); Adamopoulos et al. ('17); Chen et al. ('17); Bergquist et al.('19); Greenwood et al.('19); Gottlieb, Grobovšek ('19); Ngai et al. ('19); Adamopoulos, Restuccia ('20); Buera et al. ('20); Dabla-Norris et al. ('20), Donovan ('20); Le ('20)*
- Evidence of resource misallocation in developing country
  - **Misallocation:** *Hsieh, Klenow ('09); Banerjee, Moll ('10); Collard-Wexler et al. ('11); Oberfield ('13); Kalemli-Ozcan, Sørensen ('14); Restuccia, Rogerson ('17); Gollin, Udry ('19); David, Venkateswaran ('19); Baqaee, Farhi ('20)*
  - **Land Property Rights:** *Bromley ('10); Macours et al. ('10); de Janvry et al. ('15); Chari et al. ('17); Beg ('21)*
- Link between land property rights, access to credit, entrepreneurship & firm growth
  - *McKenzie D, Woodruff C. ('08); Buera et al. ('15); Lagakos ('16); Meager ('19); Quinn, Woodruff ('19)*

back

# Model: Main Features

- Household's state
  - productive skill in agricultural sector, $z_a > 0$
  - productive skill in entrepreneurship, $z_e > 0$
  - land endowment , $l \geq 0$
  - property right regime, $pr = \{c, p\}$
    - communal (weak)
    - private (strong)
  - level of assets, $a \geq 0$

- Skills exogenous and given by stationary transition process (AR1 in logs)

back

# Occupational Choice

- Household can choose to be
  - entrepreneur
  - worker
  - farmer
- Single final good is produced both by farmers and entrepreneurs
- Workers hired by households that operate their own business

**Assumption:** *Occupational choices mutually exclusive within a period $t$, but can be freely changed across periods with no cost.*

back

# Evolution of Communal Land

Land not used at $t$ subject to expropriation risk at $t+1$ with probability $\pi_E$:

$$\pi_E = \begin{cases} \in (0,1] & \text{if } I_{\mathbb{I}\{land=communal\}} - I^d \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

Expropriated land reallocated via *endogenous* lump-sum transfer $\eta_t$ with probability $\pi_R$:

$$\pi_R = \begin{cases} \in (0,1] & \text{if } occupation = farmer \\ 0 & \text{otherwise} \end{cases}$$

Both $\pi_E$ and $\pi_R$ can be generalized to any function that is state dependent

back

# Equilibrium

## Competitive Equilibrium

Given an initial distribution of state variables $\mathcal{F}_t(a_{it}, l_{it}, z^a_{it}, z^e_{it}, pr_{it})$ and a sequence of wages, interest rate of capital and land, and communal land reallocation $\{w_t, r_t, r^l_t, \eta_t\}^{\infty}_{t=o}$, a competitive equilibrium is given by a sequence of allocations $\{c_t(s), ...\}^{\infty}_{t=o}$ and occupational choices $\{e_t(s) = \{Worker, Entrepreneur, Farmer\}\}^{\infty}_{t=o}$ such that $(i)$ households maximize utility by solving $(...)$ subject to $(...)$, $(ii)$ the financial intermediary sector makes zero profits and $(iii)$ there is market clearing in the labor market, capital market, and land market.

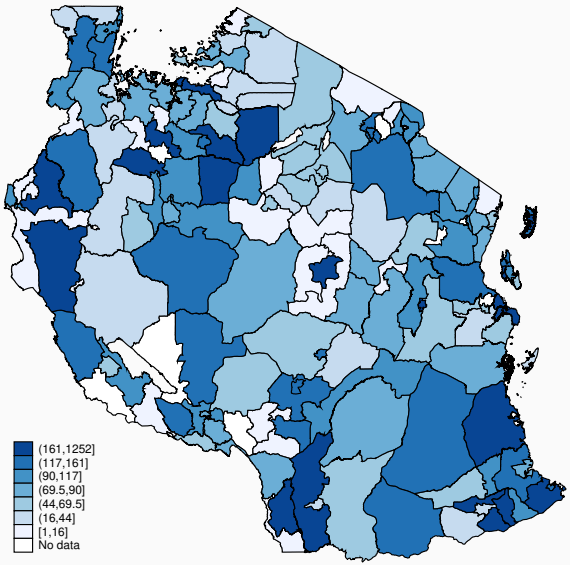
back

# Agricultural Data: Tanzania

- Agriculture $\approx$ 30% of GDP & 65% of employm.
- Nationally representative panel survey
  - Four waves – 2008-09, 10-11, 12-13, 14-15
  - Detailed data on agricultural production
- Dominated by smallholders (mean $\approx$ 2 ha)
- Mean annual harvest $\approx$ \$500
- On average $<$ 10% is hired labor, low mechanization
- $<$ 15% of land titled, $\approx$ 10% of HH borrow

Summary Statistics | Enterprise Survey | back

Distribution of survey sample



# Summary Statistics

| Variable | Mean | Median | Std. Dev. |
|---|---|---|---|
| Total harvest (ths TZS) | 722.9 | 164.4 | 25,460 |
| Yield (ths TZS/acre) | 163.3 | 62.5 | 2,288 |
| Land cultivated (acres) | 5.5 | 2.8 | 12.3 |
| Land available (acres) | 6.2 | 3.0 | 14.9 |
| Total labor (per-day) | 172.9 | 116.0 | 185.7 |
| HH labor (per-day) | 158.6 | 104.0 | 178.2 |
| Hired labor (per-day) | 14.3 | 0 | 37.9 |
| Daily wage (ths TZS) | 3.8 | 2.5 | 4.7 |
| Capital (ths TZS) | 1,887.9 | 13.5 | 7,850.4 |
| Chemicals (ths TZS) | 2.5 | 0 | 7.6 |

Average exchange rate in 2013 was $\approx$ 1,600 TZS per 1 USD

| Variable | % of obs |
|---|---|
| HH own/cultivate plot | 65.4 |
| Plots cultivated | 85.0 |
| Land utilization | 85.2 |
| Hire workers | 43.1 |
| Use chemicals | 35.5 |
| Can leave plot | 86.5 |
| Right sell/coll | 68.4 |
| Title/certificate | 12.5 |
| Took loan (1 yr) | 10.5 |
| Took loan, ag (1 yr) | 1.3 |
| Took loan, bus (1 yr) | 2.7 |

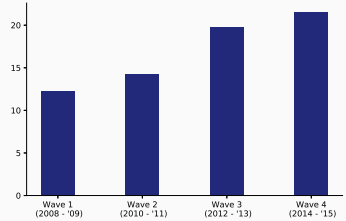
back

# Entrepreneurship Dynamics in Tanzania

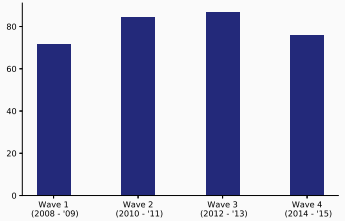
- 90.2% of firms in Tanzania are SME, with 63.2% having employment $< 20$ empl.
- 95.3% of firms are private domestic firms, and 75.2% are sole proprietorship
- Access to finance is limited by international standards
  - 18% of firms use banks to finance investment, and $\approx$ 17% have a loan/credit line
  - 38% of firms report access to finance as the biggest obstacle for their operations
- Evidence from pilot titling projects in Tanzania that households used their land to obtain credit

back

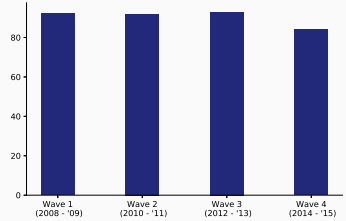
# Other Measures of Land Property Rights



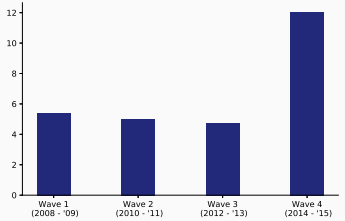

**(a)** Titled Land




**(b)** Can be Sold or Used as Collateral




**(c)** Can be Leaved Fallowed




**(d)** Used Free of Charge

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# Production Function

Estimate Cobb-Douglas production:

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_n n_{it} + \beta_k k_{it} + \omega_{it} + \varepsilon_{it}$$

where

$y_{it}$ is log output, $l_{it}$ is log of land input, $n_{it}$ is log labor, $k_{it}$ – log of capital.

$\varepsilon_{it}$ – shocks to productivity not predictable by farmer before decide on inputs

$\omega_{it}$ – observed/predictable by farmers (soil quality, expected rainfall, etc.)

$=>$ **endogeneity problem** as $l_{it}, n_{it}, k_{it} \propto \omega_{it}$

back

# Dynamic Panel Approach

Assume $\varepsilon_{it}$ is i.i.d. over time & uncorrelated with $\mathcal{I}_{it}$, and the process for $\omega_{it}$ is AR(1):

$$\omega_{it} = \rho\omega_{it-1} + \xi_{it}$$

Quasi-difference production function to get estimating equation:

$$y_{it} - \rho y_{it-1} = \beta_0(1-\rho) + \beta_l(l_{it} - \rho l_{it-1}) + \beta_n(n_{it} - \rho n_{it-1}) + \beta_k(k_{it} - \rho k_{it-1}) + \xi_{it} + (\varepsilon_{it} - \rho\varepsilon_{it-1})$$

Assume $\xi_{it}$ is uncorrelated with $\mathcal{I}_{it-1}$, estimate model using the moment conditions

$$\mathbb{E}[\xi_{it} + (\varepsilon_{it} - \rho\varepsilon_{it-1})|\mathcal{I}_{it-1}] = \mathbb{E}[(\xi_{it} + (\varepsilon_{it} - \rho\varepsilon_{it-1})) \cdot \begin{pmatrix} l_{it-1} \\ n_{it-1} \\ k_{it-1} \end{pmatrix}] = 0$$

back

# Production Function: Data

- Focus on long rainy season in each year and on temporarily crops
- Match households that split off based on the plots cultivated
- $Y_{it}$ - real agricultural output aggregated at the hh level (median prices in wave2 of each crop used as weights)
- $L_{it}$ - the size of the land that was actually cultivated in acres
- $N_{it}$ - total number of person-days (includes domestic and hired)
- $K_{it}$ - capital inputs aggregated at the hh level (include owned and used capital, rented in capital, and chemicals such as fertilizers)

back

# Production Function Estimates

| | (OLS) | (OLS FE) | (DP) |
|---|---|---|---|
| log(Land) | 0.343 | 0.264 | 0.299 |
| | (0.015) | (0.026) | (0.071) |
| log(Labor) | 0.404 | 0.366 | 0.368 |
| | (0.017) | (0.025) | (0.161) |
| log(Capital) | 0.111 | 0.051 | 0.035 |
| | (0.006) | (0.009) | (0.025) |
| $\beta_l$ | | | 0.294 |
| $\beta_n$ | | | 0.412 |
| $\beta_k$ | | | 0.050 |
| $\rho$ | | | 0.533 |
| Return to scale | 0.85 | 0.68 | 0.76 |
| Test on common factor restrictions | | | 0.835 |
| Unexpected Shocks | ✓ | ✓ | ✓ |
| # obs. | 8,949 | 6,073 | 3,641 |

St. errors two-way clustered at district & HH levels. Regressions include Year FE, OLS - also district-year FE back

# Conceptual Framework

$n$ heterogenous farmers producing single homogeneous good:

$$Y_i = e_i A L_i^{\alpha_L} \prod_k X_{k,i}^{\alpha_{X_k}}$$

where $L_i$ is land input and $e_i$ – farmer's individual productivity, $X_{k,i}$ - other inputs

Efficient static allocation with no market frictions:

$$\log\left(L_i^*\right) \propto \log\left(e_i\right)$$

and $\frac{L_i^*}{X_{k,i}^*} = \frac{L_{\_i}^*}{X_{k,\_i}^*}$ , $\forall k, \_i$ back

# Land Property Rights and Allocation of Land

| | ln(land) | | |
|---|---|---|---|
| HH productivity | 0.050 | 0.047 | 0.044 |
| | (0.013) | (0.008) | (0.008) |
| HH productivity × land_rights | | 0.023 | 0.023 |
| | | (0.005) | (0.005) |
| HH productivity × credit | | | 0.051 |
| | | | (0.010) |
| # obs. | 8,939 | 8,939 | 8,939 |
| # households | 5,095 | 5,095 | 5,095 |
| Wave#District FE | Y | Y | Y |
| $R^2$ | 0.290 | 0.292 | 0.295 |

Standard errors are in parentheses two-way clustered at district & household levels. *land_rights* is the share of land under "strong" property rights at hh level; *credit* is a dummy indicating whether hh obtained a credit in a given year from any source

back

# Factor ratios

| | ln(land) | | | |
|---|---|---|---|---|
| | labor | | capital | |
| ln(Input) | 0.586 | 0.576 | 0.177 | 0.173 |
| | (0.013) | (0.013) | (0.007) | (0.007) |
| ln(Input) × land_rights | | 0.042 | | 0.022 |
| | | (0.008) | | (0.004) |
| ln(Input) × credit | | 0.050 | | 0.033 |
| | | (0.014) | | (0.007) |
| # obs. | 10,054 | 10,054 | 10,047 | 10,047 |
| # households | 5,515 | 5,515 | 5,515 | 5,515 |
| Wave#District FE | Y | Y | Y | Y |

Standard errors are in parentheses two-way clustered at district & household levels

back

# Marginal product of land and market frictions (CES)

| | ln(MPL) | | | |
|---|---|---|---|---|
| | leave fallow | right sell | title | obtain free |
| land_rights | -0.196 | -0.184 | -0.034 | 0.216 |
| | (0.035) | (0.029) | (0.045) | (0.042) |
| credit | 0.403 | 0.414 | 0.404 | 0.410 |
| | (0.093) | (0.092) | (0.093) | (0.092) |
| # obs. | 8,925 | 8,925 | 8,925 | 8,925 |
| Wave#District FE | ✓ | ✓ | ✓ | ✓ |

Standard errors are in parentheses two-way clustered at district & household levels.

back

# Land Misallocation (No shocks)

| | ln(land) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | leave fallow | | | right sell | | title | | obtain free | |
| HH productivity | 0.119 | 0.085 | 0.079 | 0.081 | 0.076 | 0.114 | 0.109 | 0.126 | 0.121 |
| | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) | (0.013) |
| HH productivity × land_rights | | 0.043 | 0.043 | 0.055 | 0.055 | 0.023 | 0.023 | -0.059 | -0.059 |
| | | (0.004) | (0.004) | (0.003) | (0.003) | (0.005) | (0.005) | (0.005) | (0.005) |
| HH productivity × credit | | | 0.045 | | 0.042 | | 0.044 | | 0.043 |
| | | | (0.009) | | (0.009) | | (0.009) | | (0.009) |
| # obs. | 8,939 | 8,939 | 8,939 | 8,939 | 8,939 | 8,939 | 8,939 | 8,939 | 8,939 |
| # households | 5,095 | 5,095 | 5,095 | 5,095 | 5,095 | 5,095 | 5,095 | 5,095 | 5,095 |
| Wave#District FE | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| $R^2$ | 0.296 | 0.307 | 0.310 | 0.326 | 0.328 | 0.298 | 0.300 | 0.312 | 0.313 |

Standard errors are in parentheses two-way clustered at district & household levels. back

# Land Misallocation: Across Time Variation

| | ln(land) | | | |
|---|---|---|---|---|
| | leave fallow | right sell | title | obtain free |
| HH productivity | -0.014 | -0.018 | -0.013 | -0.009 |
| | (0.014) | (0.014) | (0.014) | (0.014) |
| HH productivity × land_rights | 0.001 | 0.008 | 0.009 | -0.023 |
| | (0.004) | (0.003) | (0.004) | (0.006) |
| HH productivity × credit | 0.021 | 0.021 | 0.021 | 0.022 |
| | (0.009) | (0.009) | (0.009) | (0.009) |
| # obs. | 6,043 | 6,043 | 6,043 | 6,043 |
| # households | 2,218 | 2,218 | 2,218 | 2,218 |
| Wave#District FE | Y | Y | Y | Y |
| HH FE | Y | Y | Y | Y |
| $R^2$ | 0.833 | 0.833 | 0.833 | 0.833 |

Standard errors are in parentheses two-way clustered at district & household levels

back

# Land Misallocation (Different Measures)

| | ln(land) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | leave fallow | | | right sell | | title | | obtain free | |
| HH productivity | 0.050 | 0.014 | 0.011 | 0.014 | 0.011 | 0.047 | 0.044 | 0.057 | 0.056 |
| | (0.013) | (0.009) | (0.009) | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) |
| HH productivity × land_rights | | 0.044 | 0.044 | 0.056 | 0.056 | 0.023 | 0.023 | -0.060 | -0.059 |
| | | (0.004) | (0.004) | (0.003) | (0.003) | (0.005) | (0.005) | (0.005) | (0.005) |
| HH productivity × credit | | | 0.052 | | 0.050 | | 0.051 | | 0.050 |
| | | | (0.009) | | (0.009) | | (0.010) | | (0.010) |
| # obs. | 8,939 | 8,939 | 8,939 | 8,939 | 8,939 | 8,939 | 8,939 | 8,939 | 8,939 |
| # households | 5,095 | 5,095 | 5,095 | 5,095 | 5,095 | 5,095 | 5,095 | 5,095 | 5,095 |
| Wave#District FE | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| $R^2$ | 0.290 | 0.301 | 0.304 | 0.319 | 0.322 | 0.292 | 0.295 | 0.305 | 0.307 |

Standard errors are in parentheses two-way clustered at district & household levels

back

# Land property rights and other household characteristics

| | Dependent variable | | | | |
|---|---|---|---|---|---|
| | rent out land | head of HH in agriculture | obtained credit | size of a loan | operate a business |
| land_rights | 0.015 | -0.037 | 0.028 | 0.574 | 0.023 |
| | (0.006) | (0.014) | (0.013) | (0.199) | (0.015) |
| # obs. | 7,874 | 11,752 | 11,752 | 448 | 11,752 |
| Household FE | ✓ | ✓ | ✓ | ✓ | ✓ |

Standard errors are in parentheses two-way clustered at district & household levels.

back

# Calibration Approach

- Baseline calibration for the Tanzanian economy in period 2012-2014
- Some parameters recovered from data and literature
- Other parameters are calibrated to jointly match a set of moments

# Direct Calibration

| Parameter | Value | Source/Description |
|---|---|---|
| $\mu_l$ | 0.807 | Share of land without any document |
| $\alpha_a$ | 0.05 | Production function estimates |
| $\gamma_a$ | 0.294 | Production function estimates |
| $\rho_a$ | 0.533 | Production function estimates |
| $\rho_e$ | 0.262 | Autocorellation coefficient on entrepreneurial productivity |
| $\pi_E$ | 0.09 | Share of undocumented land that HH believed can be expropr. |
| $\sigma$ | 1.5 | CRRA coefficient (Buera et al., 2021) |
| $\delta$ | 0.06 | Depreciation rate (Buera et al., 2021) |
| $\alpha_e$ | 0.33 | Capital share (entrepreneurs) (Buera et al., 2021) |

Additional assumptions

# Method of Moments

| Target Moment | Data | Model | Parameter | Description |
|---|---|---|---|---|
| Real interest rate (%) | 3.8% | 3.75% | $\beta = 0.813$ | Discount factor |
| Share of workers (% of emp.) | 20.5% | 20.5% | $\nu = 0.535$ | Span of control |
| Share of farmers (% of emp.) | 61.0% | 61.1% | $\sigma_a = 0.09$ | S.d. of prod. shock |
| Share of entrepren. (% of emp.) | 18.5% | 18.4% | $\sigma_e = 0.75$ | S.d. of prod. shock |
| Land distribution | | graph | $\pi_R = 0.13$ | Probability of realloc. |
| Collateral/loan value | 240.2% | 240.4% | $\lambda_k$=1.416 | Collateral constraint |

Non-targeted moments back

# Model: Additional Assumptions

- Logarithm of productivity for each sector $s$ follows a first-order autoregressive process

$$z_{s,t} = \rho z_{s,t-1} + \varepsilon_{s,t}$$

where $|\rho| < 1$ and $\varepsilon_t$ is a white noise process with variance $\sigma_\varepsilon^2$

- Production function of entrepreneurs is Cobb-Douglas

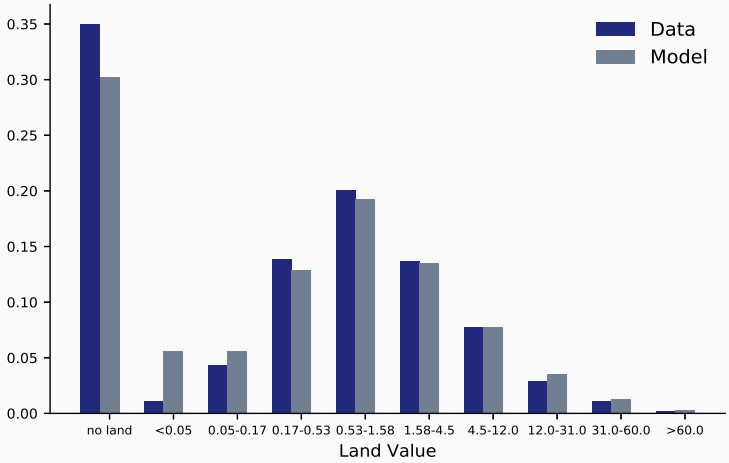
$$y^e = \exp(z^e)(k^{\alpha_e} n^{1-\alpha_e})^{1-\nu}$$

where $(1-\nu)$ is the span-of-control parameters, representing the share of output accruing to variable factors. Fraction $\alpha$ goes to capital and $(1-\alpha)$ – to labor.

- $\pi_R$ and $\pi_E$ are independent of household characteristics

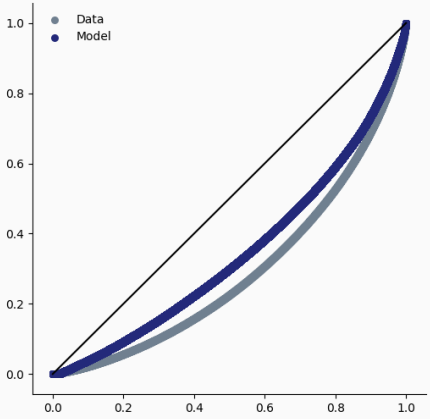
back

# Distribution of Land: Model vs Data




*Note: the distribution is based on price of land in mln TZS such that it is equispaced on a log scale* back

# Non-targeted Moments: Lorenz Curve for Consumption




Land utilization in the model is 92% (data – 88%) back

# Model Mechanism: Land

## Proposition 1

*Denote optimal choices of land used by farmers who owns land under communal and private property right regimes as $l_c^*$ and $l_p^*$, respectively. Then, if optimal land usage is larger than household land holding, $l_p^* > l_p$, and farmers' initial conditions in private and communal part of the economy are the same (i.e. same amount of land, skills and assets):*

$$l_c^* \leq l_p^*$$

*and for assets holdings $a_{small} < a_{large}$, given everything else the same:*

$$l_p^*(a_{small}) - l_c^*(a_{small}) \geq l_p^*(a_{large}) - l_c^*(a_{large}),$$

*and for the levels of agricultural productivity $z_{small} < z_{large}$:*

$$l_p^*(z_{small}) - l_c^*(z_{small}) \leq l_p^*(z_{large}) - l_c^*(z_{large}),$$

*and for the levels of land holdings $l_{small} < l_{large}$, given everything else the same:*

$$l_p^*(l_{small}) - l_c^*(l_{small}) \leq l_p^*(l_{large}) - l_c^*(l_{large}).$$

# Model Mechanism: Land

## Proposition 2

*Denote optimal choices of land used by farmers who owns land under communal and private property right regimes as $l_c^*$ and $l_p^*$, respectively. Then, if optimal land usage is lower than household land holding, $l_p^* < l_p$, and farmers' initial conditions in private and communal part of the economy are the same (i.e. same amount of land, skills and assets):*

$$l_c^* \geq l_p^*$$

*and for the levels of agricultural productivity $z_{small} < z_{large}$, given everything else the same*

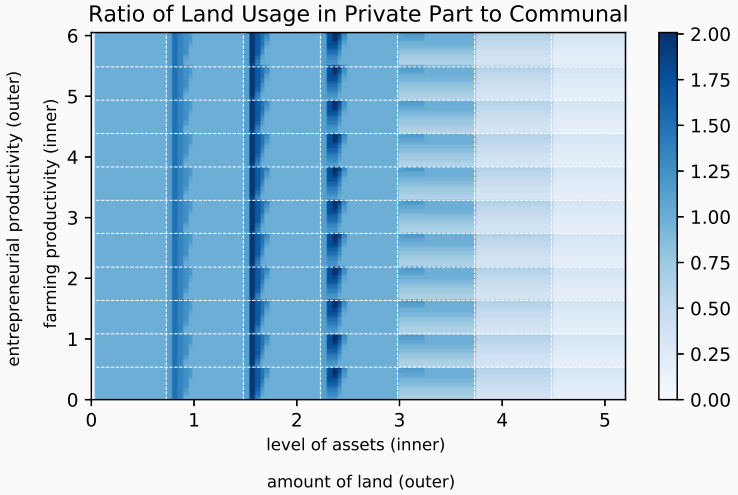
$$l_c^*(z_{small}) - l_p^*(z_{small}) \geq l_c^*(z_{large}) - l_p^*(z_{large})$$

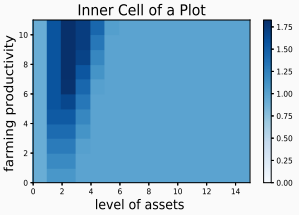
*and for the levels of land holdings $l_{small} < l_{large}$, given everything else the same, we get*

$$l_c^*(l_{small}) - l_p^*(l_{small}) \leq l_c^*(l_{large}) - l_p^*(l_{large})$$

back

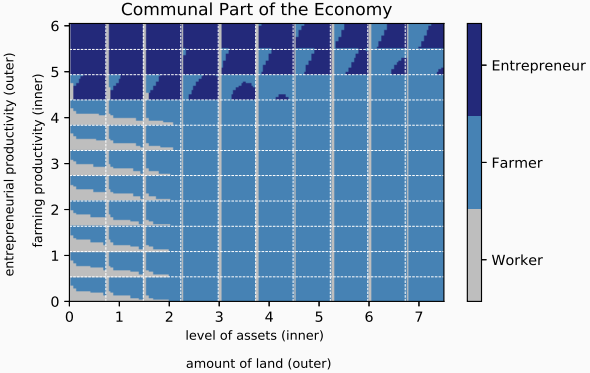
# Mechanism: Land Misallocation

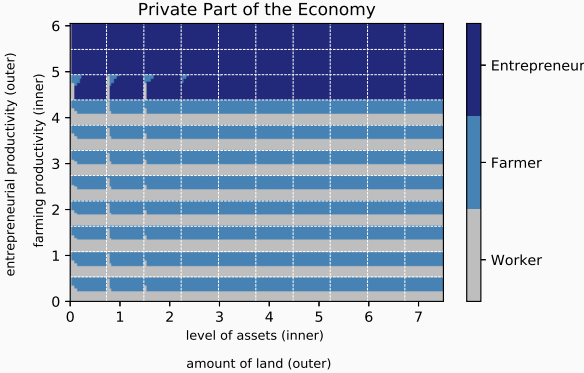



back

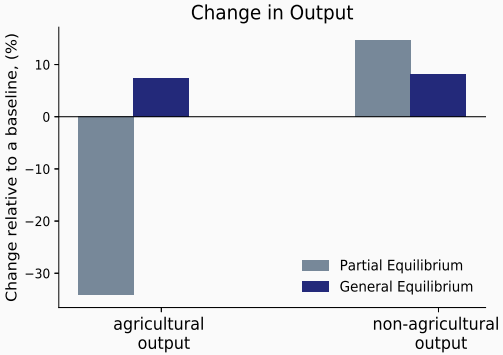
# Mechanism: Labor Misallocation

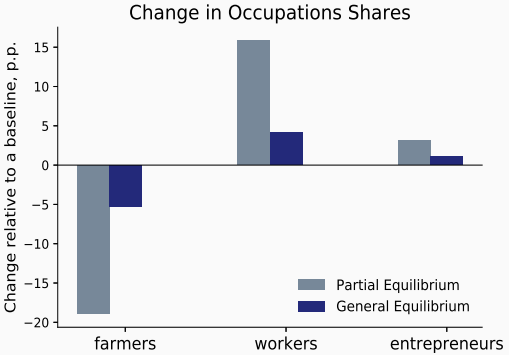



back

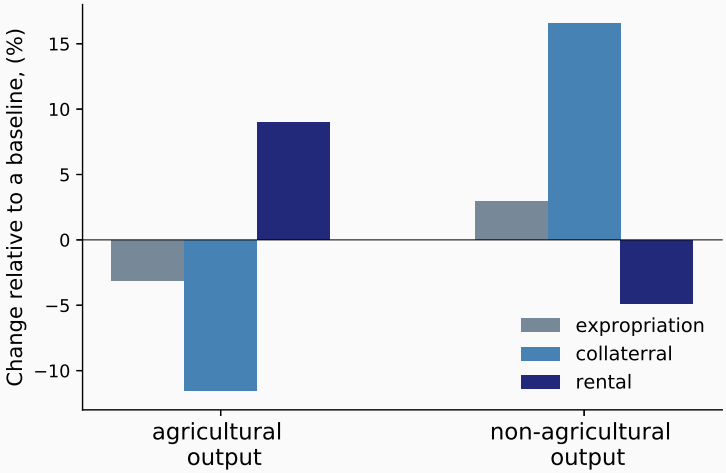
# Land Reform: Partial vs General Equilibrium



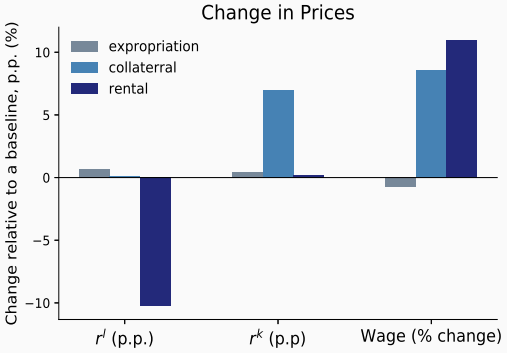

back

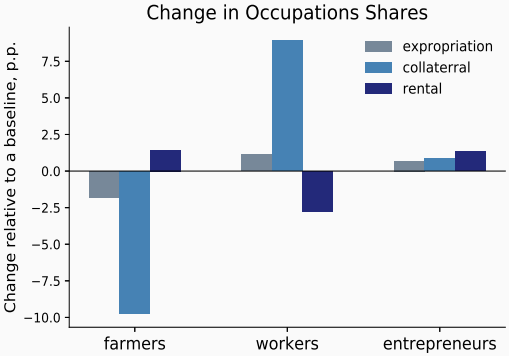
# Main Channels: Output




back

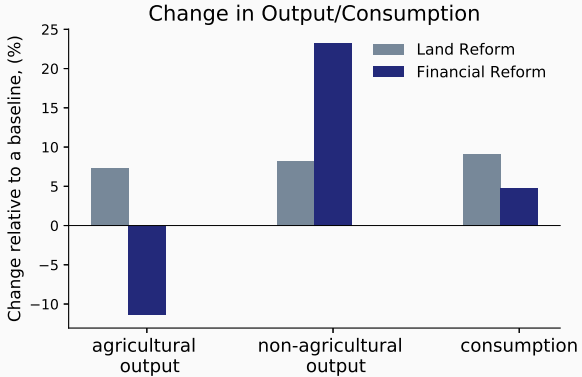
# Main Channels: Prices and Occupations




back

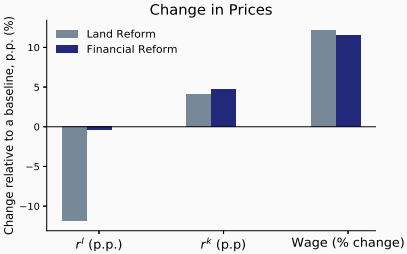
# Land vs Financial Reform

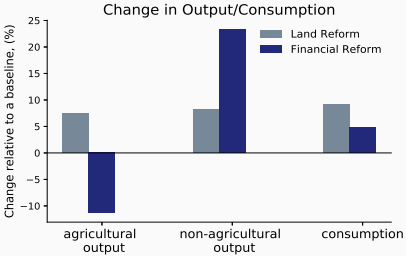


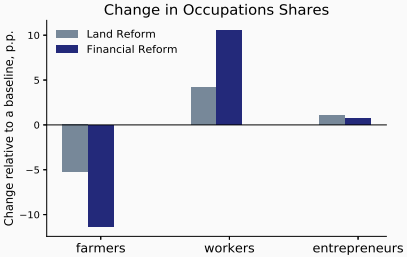

*Note: financial constraint relaxed so that loan to collateral same as in Sweden (83.9%)*

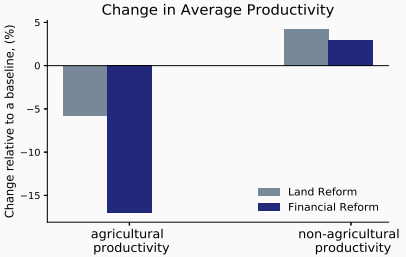
all outcomes back

# Land vs Financial Reform



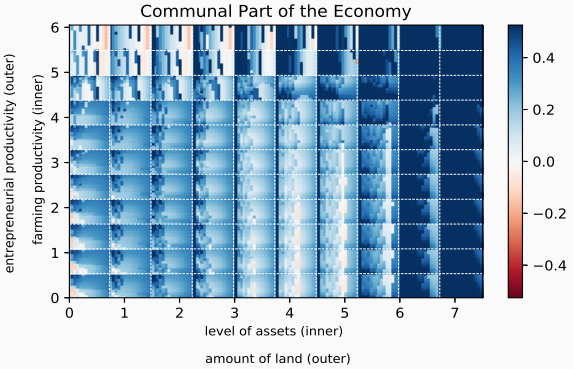



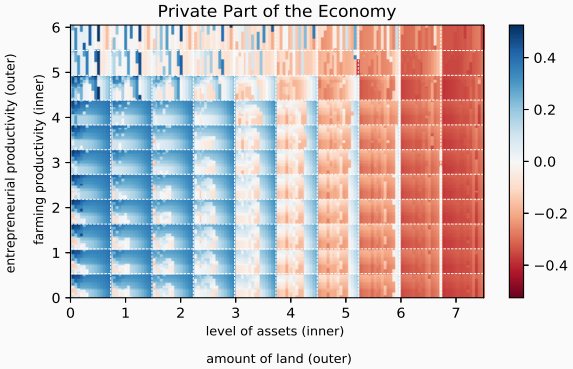




back

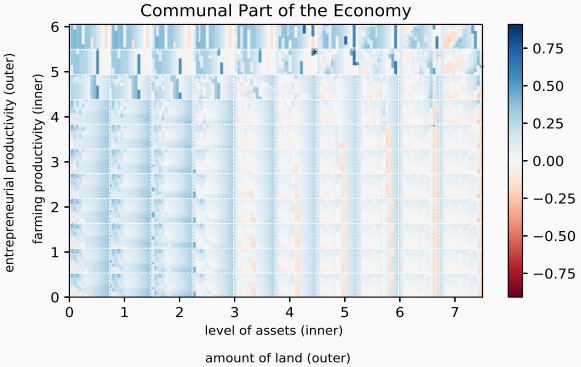
# Welfare: Winners and Losers Land Reform

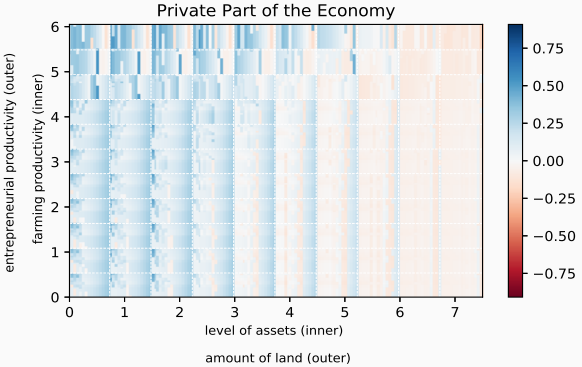



Overall consumption increases, while consumption inequality slightly decreases (Gini 30.9 $=>$ 29.6) financial reform back

# Welfare: Winners and Losers Financial Reform



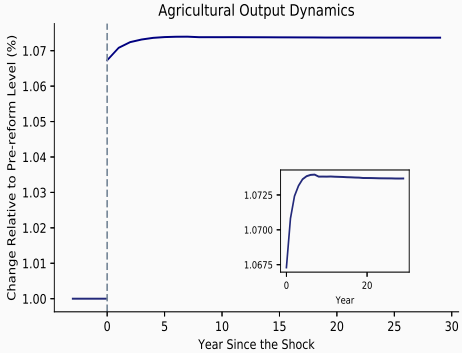

back

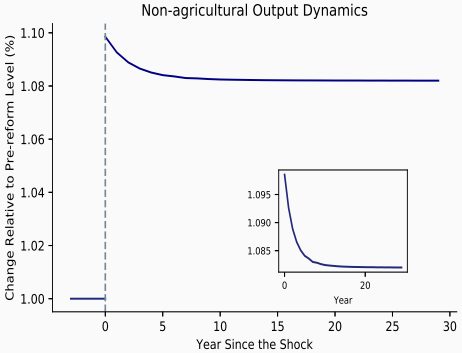
# Postreform Transition Dynamics

- Study the transition dynamics triggered by a sudden unexpected reform that eliminates communal property rights
- Once reform is implemented, everyone understands that it is permanent change
- Assume that financial frictions remain the same throughout transition period
- Simplifies actual reform episodes, which tended to be more gradual
- The dynamics following the reform are wholly endogenous

back

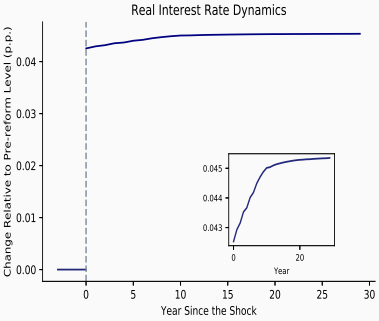
# Postreform Transition Dynamics: Output

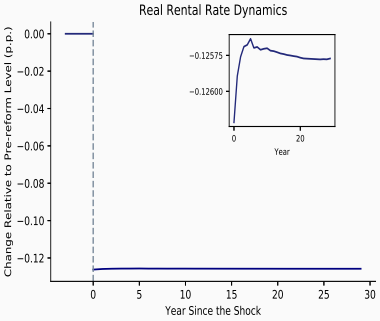


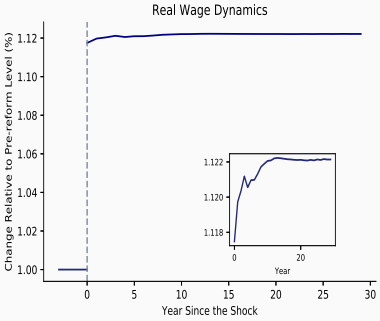




Prices back

# Postreform Transition Dynamics: Prices




back

# Model Extensions /Future Work

- Communal land as insurance
- Role of collateral for agriculture $\Rightarrow$ mechanization $/\Uparrow$ hired labor/pre-paid rent
- Endogenous financial reform?
- Default

back