

Communal Land and Agricultural Productivity

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Outline

- 1 Motivation
- 2 Model economy
- 3 Characterization
- 4 Calibration
- 5 Numerical experiment: benchmark
- 6 Numerical experiment: poor economy

Motivation

- Poor vs. rich economies:
 - ① Extremely low **real** relative agricultural productivity.
 - ② Very low **nominal** relative agricultural productivity.

- Factor difference between poorest versus richest decile of countries:
 - ① Real relative agriculture productivity ($\frac{Y_a/L_a}{Y_n/L_n}$): 0.10. [▶ data](#)
 - ② Nominal relative agriculture productivity ($\frac{p_a Y_a/L_a}{p_n Y_n/L_n}$): 0.33. [▶ data](#)

- Employment in agriculture:
 - ① Richest: 3%.
 - ② Poorest: 75%.

Communal land and misallocation

- Candidate explanation: misallocation due to existence of communal land, a characteristic form of land tenure in Sub-Saharan Africa.
- Characteristics of customary/communal land tenure:
 - Exclusive user right per period.
 - Low transferability.
 - Expropriation and redistribution may occur, and are conditional on actions/types.
- What is the effect of such a regime on:
 - ... individual sorting between agriculture and non-agriculture?
 - ... land operations across users?
 - ... real and nominal agricultural productivity?
 - ... aggregate GDP?
- Note: only consider allocations, no investment decisions.

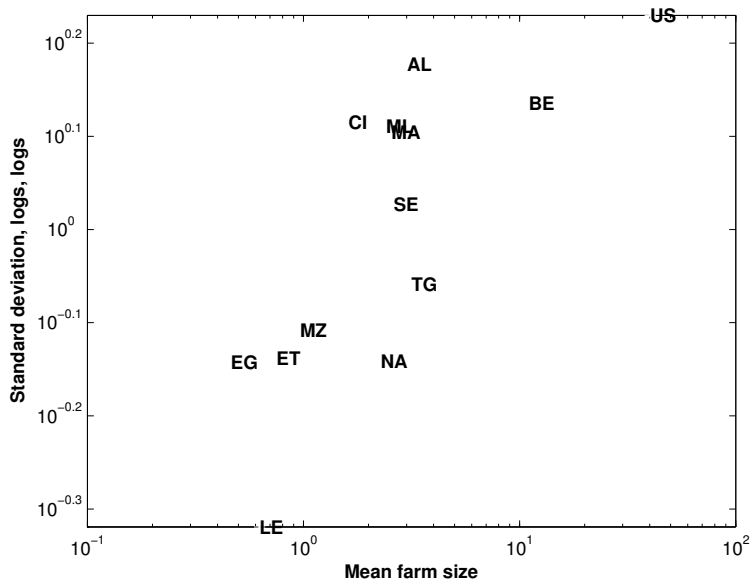
Landownership and access area (land shares)

Country	Accessed	Undocumented ownership	Documented ownership
Ethiopia	0.16	0.41	0.42
Malawi	0.22	0.76	0.01
Niger	0.15	0.78	0.08
Nigeria	0.91	0.09	0.00
Tanzania	0.08	0.81	0.11
Uganda	0.11	0.69	0.19

Source: Doss *et al.* (2013)

- Depending on measure, 70-80% of land in Sub-Saharan Africa is under customary/communal tenure (Holden, Otsuka and Place, 2009).

Farm dispersion across countries



What we do:

- Framework:
 - Model of heterogeneous workers with:
 - occupational choice (agriculture vs. non-agriculture);
 - operational choice of land in agriculture.
 - Communal land is individually held and can be either:
 - operated;
 - rented out (but not sold).
 - Renting out communal land raises probability of expropriation.
 - Expropriated land is redistributed to farmers conditional on their existing holdings.
- Empirical application:
 - Calibrate skills and technology to the U.S. (only private land) and communal land policy to Ethiopia (only communal land).
 - Measure effect of introducing communal land into rich economy (few farmers) as well as representative poor economy (many farmers).

Preview of results

- Only communal land vs. only private land in poor economy implies:
- Drop in real (-5%) and in particular nominal (-30%) relative agricultural productivity ...
- ... with modest consequences on agr. employment (+2 p.p.) and GDP (-2.5%).
- Important GE forces: at prevailing prices, 73% of farmers are constrained in their choices, and 62% would actually prefer to leave farming.

- Macro development:
 - Agricultural productivity: Restuccia, Yang and Zhu (2008); Vollrath (2009); Gollin, Lagakos and Waugh (2014a); Gollin, Lagakos and Waugh (2014b); Tombe (2014).
 - Sorting: Lagakos and Waugh (2013); Young(2013); Young (2014); Herrendorf and Schoellmann (2015).
 - Land misallocation: Chen (2014); Adamopoulos and Restuccia (2014); Adamopoulos and Restuccia (2015); Restuccia and Santaaulalia-Llopis (2015); Adamopoulos, Brandt, Leight, Restuccia (2015).
- Micro development:
 - Investment incentives on undocumented land: Goldstein and Udry (2008); Ali, Dercon and Gautam (2011); Fenske (2011); Sjaastad and Bromley (1997); Place and Otsuka (2002); Deininger and Jin (2006);
 - Misallocation on undocumented land: Holden, Otsuka and Place (2009); Macours, de Janvry and Sadoulet (2010); de Janvry, Emerick, Gonzales-Navarro and Sadoulet (2012).

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Worker types

- Populated by unit measure of workers of type x with CDF $H(x)$:
- Worker's set of characteristics x :
 - Agricultural skill $z_a \geq 0$;
 - Non-agricultural skill $z_n \geq 0$;
 - Communal land holding $\ell_c \geq 0$.
- Skill set (z_a, z_n) drawn from exogenous distribution and persists with probability $1 - \zeta$;
- Risk-neutral workers maximize present-value expenditure b , discounted at rate β ;
- Expenditures b pooled at aggregate level and allocated between C_n and C_a with subsistence constraint $\bar{C}_a > 0$. [▶ Detail](#)

Worker choices and budget

- Each period workers choose occupation ($\mathbb{1}_a$):
 - $\mathbb{1}_a = 1$: agriculture with labor income $w_a(z_a, \ell)$.
 - $\mathbb{1}_a = 0$: non-agriculture with labor income $w_n(z_n) = wz_n$.
- In agriculture, choice of operated land ($\ell \geq 0$):
 - $w_a(z_a, \ell) = py_a(z_a, \ell) - r\ell$ where p is price of agricultural good, and r the rental rate of land.
 - Each farmer operates own farm (no additional labor).
 - Production function:

$$y_a(z_a, \ell) = Az_a^{1-\gamma} \ell^\gamma.$$

- Each individual owns an equal share of aggregate private land, L_p .
- Budget:

$$b = \mathbb{1}_a[py_a(z_a, \ell) - r\ell] + (1 - \mathbb{1}_a)wz_n + rL_p + r\ell_c.$$

Communal land

- A fraction λ of fixed aggregate land L is communal.
- Communal land is held individually as $\ell_c(x)$ with exclusive period user rights (operations, rentals).
- Cannot be sold/purchased.
- Frictions derive from its evolution ...

Expropriation

- In the following period the entire holding l_c is lost with probability

$$m(l, l_c) = \begin{cases} \tau [(l_c - l)/l_c]^\mu & \text{if } l_c - l > 0; \\ 0 & \text{otherwise,} \end{cases}$$

where $\tau \in [0, 1]$, $\mu \geq 1$.

- No expropriation occurs when entire holding is operated, $l \geq l_c$.
- Increasing and convex in fraction of communal holding that is *not* operated.
- Non-agricultural work ($l = 0$) entails highest expropriation probability, τ .
- As $\mu \nearrow$ the tax probability on the interval $l \in (0, l_c)$ drops.

Transfer

- Accumulation of communal land occurs in lump sum transfers v .
- Only current farmers are eligible for transfer in the following period.
- Occurs with probability:

$$g(\mathbb{1}_a, \ell_c) = \begin{cases} \phi \left[1 - \left(\frac{\ell_c/v}{1+\ell_c/v} \right)^\epsilon \right] & \text{if } \mathbb{1}_a = 1; \\ 0 & \text{otherwise,} \end{cases}$$

where $\phi \in [0, 1]$, $\epsilon > 0$.

- Decreasing in number of accumulated transfers ℓ_c/v .
- Landless farmers face highest probability of transfer, ϕ .
- As $\epsilon \nearrow$ the probability of obtaining additional transfers increases.

Evolution of communal land

- Current non-agricultural workers ($\mathbb{1}_a = 0$):

$$\ell'_c(x) = \begin{cases} 0 & \text{with probability } \tau; \\ \ell_c(x) & \text{otherwise.} \end{cases}$$

- Current agricultural workers ($\mathbb{1}_a = 1$) choosing $\ell < \ell_c$:

$$\ell'_c(x) = \begin{cases} \ell_c(x) + v & \text{with probability } g(1, \ell_c)[1 - m(\ell, \ell_c)]; \\ \ell_c(x) & \text{with probability } [1 - g(1, \ell_c)][1 - m(\ell, \ell_c)]; \\ v & \text{with probability } g(1, \ell_c)m(\ell, \ell_c); \\ 0 & \text{otherwise.} \end{cases}$$

- Current agricultural workers ($\mathbb{1}_a = 1$) choosing $\ell \geq \ell_c$:

$$\ell'_c(x) = \begin{cases} \ell_c(x) + v & \text{with probability } g(1, \ell_c); \\ \ell_c(x) & \text{otherwise.} \end{cases}$$

- Production function in non-agriculture:

$$Y_n = A \int [1 - \mathbb{1}_a(x)] z_n(x) dH(x)$$

.

- Market clearing:
 - Land (r);
 - Communal land (v);
 - Goods (p);
 - Non-agricultural labor (w).

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Operational and occupational misallocation

- Efficient benchmark ($\lambda = 0$ or $\tau = 0$):
 - Sorting is intratemporal choice only;
 - Agricultural occupation iff $z_a \geq B^*(z_n; p, r)$;
 - Optimal land operations for all $z_a \geq B^*(z_n; p, r)$.
- When $\lambda > 0$ and $\tau > 0$:
 - **Occupational** misallocation for $\bar{B}(z_n, \ell_C; p, r, v) \leq z_a < B^*(z_n; p, r)$;
 - **Operational** misallocation for $\bar{B}(z_n, \ell_C; p, r, v) \leq z_a < B^\dagger(\ell_C; p, r)$.

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Calibration

Parameter	Value	Target	Data
No communal land ($\lambda = 0$)			
Land endowment (L)	1	Normalization	-
TFP (A)	1	Normalization	-
Fréchet agriculture (ψ_a)	5.3	Variance log agr. income	0.144
Fréchet non-agriculture (ψ_n)	2.7	Variance log non-agr. income	0.224
Interdependence (ρ)	3.5	Labor income agr. vs. non-agr.	0.701
Subsistence (\bar{C}_a)	0.03	U.S. agr. empl. share	0.020
Preference agr. (η)	0.01	Avg. energy intake poorest vs. U.S.	0.420
No private land ($\lambda = 1$)			
Land endowment (L')	1/3	Farmland/person poorest vs. U.S.	-
TFP (A')	1/19	Africa agr. empl share & GDP	-
Discount factor (β)	0.95	Frictionless interest rate	0.04
Hazard skill change (ζ)	0.025	Exp. duration of skill set (years)	40
Span of control (γ)	1/3	Land share/sharecropping	1/3
Max. expropriation probability (τ)	0.5	Max. rented fraction of land	-
Max. transfer probability (ϕ)	0.211	Fraction of landless households	0.034
Progressivity of redistribution (ϵ)	0.024	Expropriation rate	0.006
Curvature of expropriation (μ)	5.341	Share of rented land	0.177

Outline

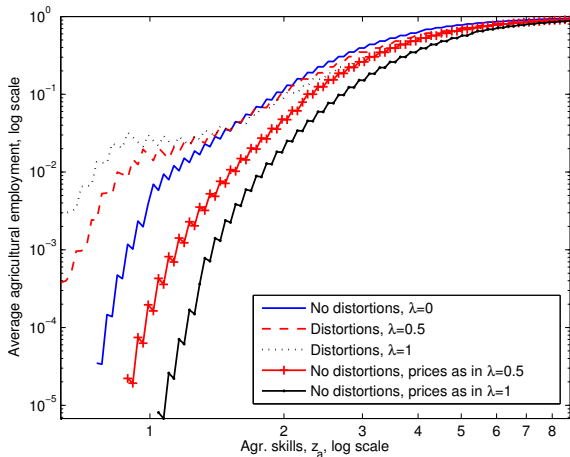
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Introduction of communal land regime

- Investigation of effect of increasing λ from 0 to 1.
- Investigation of sensitivity to other policy parameter $(\tau, \mu, \phi, \epsilon)$.
- Both for rich ($A = 1, L = 1$) and poor ($A' = 1/19, L' = 1/3$) economy. ▶ Rich economy ▶ Poor economy

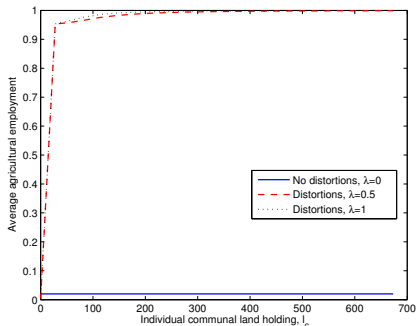
Agricultural employment and skills (rich economy)

- More unskilled and fewer skilled farmers in agriculture;
- Prices counteract the pull effect on unskilled farmers.

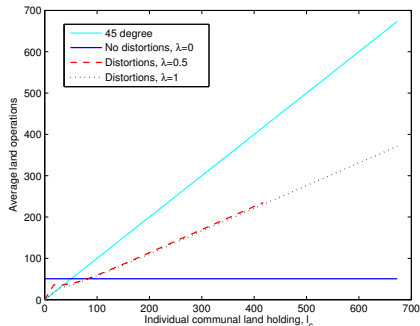


Communal land and choices (rich economy)

- Almost all communal holders are farmers.
- But farmers with much communal land do rent out a lot.

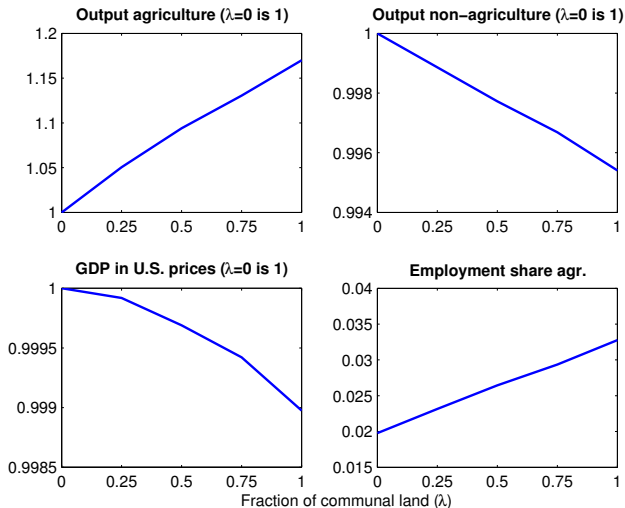


(c) Average agr. employment

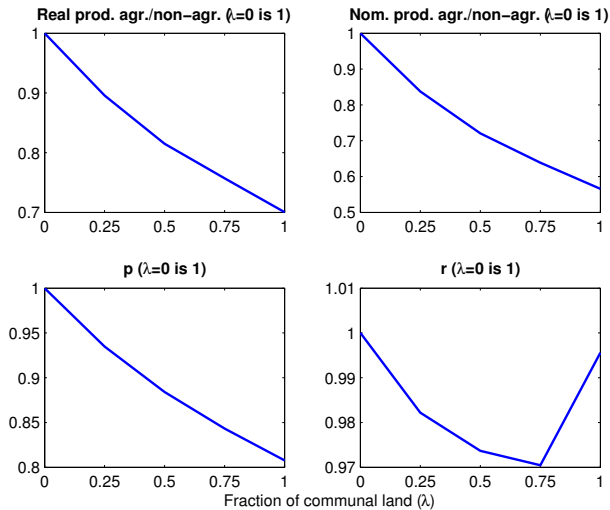


(d) Average land operations

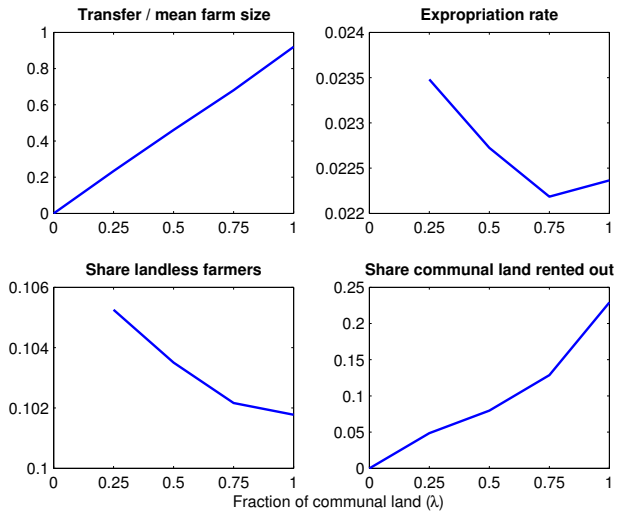
Output, GDP, and employment (rich economy)



Productivity and prices (rich economy)



Communal land statistics (rich economy)



Bottomline (rich economy)

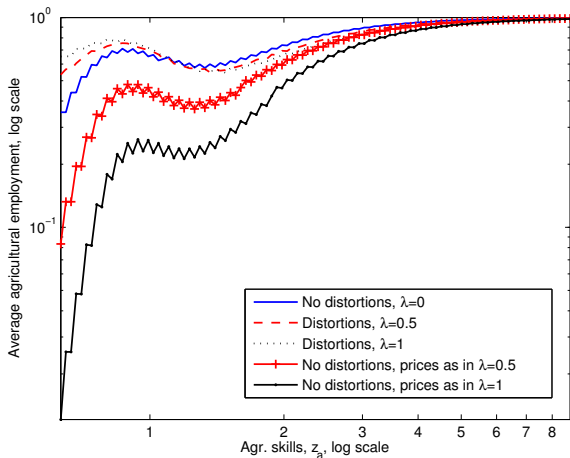
- Communal land lures inefficient workers in agriculture.
- Agricultural employment ↗ by up to 75% ...
- ... which in relative terms is a lot and hence opens the real productivity gap by up to 30%, but ...
- ... it is a tiny mass in the aggregate, so almost no effect on non-agricultural output.
- Agricultural output increases (as its price falls), implying:
- Additional agricultural employment more than makes up for productive distortions, which are not large.
- A drop in the agricultural price prevents even larger agricultural employment ...
- ... so the nominal productivity gap grows large (up to 40%).

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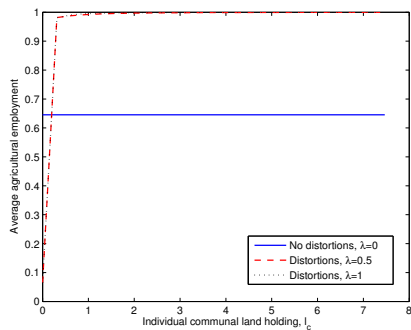
Agricultural employment and skills (poor economy)

- Communal land accentuates the portion of negative assortative matching of agricultural skills and occupations.

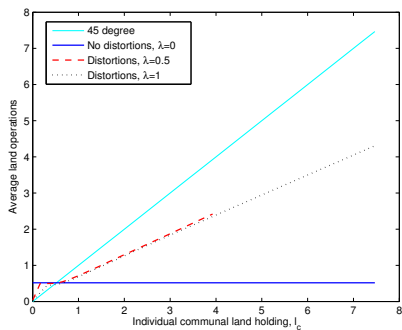


Communal land and choices (poor economy)

- Farmers with much communal land again rent out a large fraction.

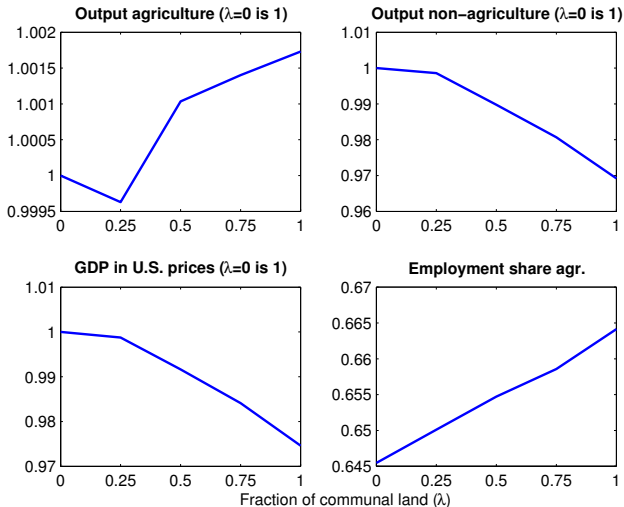


(e) Average agr. employment

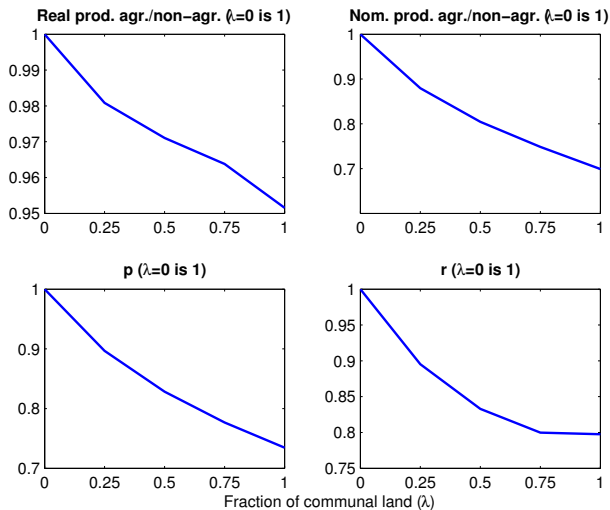


(f) Average land operations

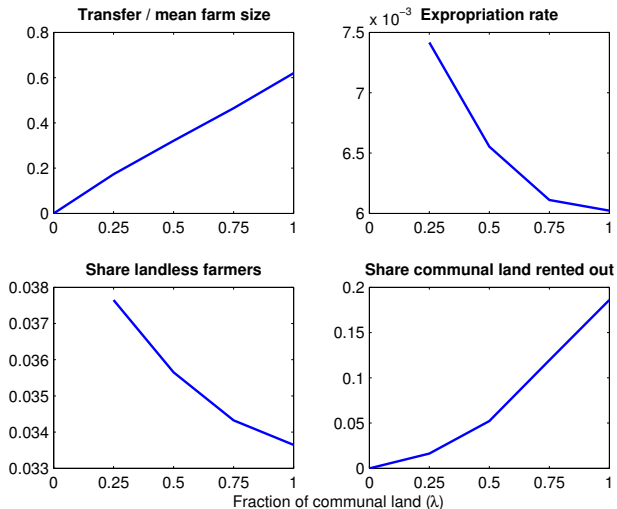
Output, GDP, and employment (poor economy)



Productivity and prices (poor economy)



Communal land statistics (poor economy)



Bottomline (poor economy)

- Agricultural employment ↗ by max. 2 p.p. ...
- ... which is non-negligible, but modest in relative terms.
- Some effect on non-agricultural production/GDP (↘ by max. 2.5%).
- Nominal productivity gap (max. 30%) much larger than real gap (max. 5%).
- Real productivity gap not that large because operations are not strongly distorted.
- Big price drop acts to discourage further inflow of farmers.
- But a majority of farmers feel occupationally and operationally constrained at existing prices (up to 73%).

Conclusion

- Insecure communal land holdings impact real and especially nominal relative agricultural productivity;
- Increase in agricultural employment and decrease in GDP are modest;
- Sorting and little variation in agricultural skills mitigate output loss;
- Little operational misallocation, hence large general equilibrium effect through sectoral prices that mitigates larger employment shifts.

- Possible extensions:
 - Benefits of land redistribution in absence of other redistributive mechanisms;
 - Benefit of preventing land being left unused;
 - Investment effects of *unpredictable* expropriation.

Real productivity

- Variation of $\frac{Y_a}{N_a} / \frac{Y_n}{N_n}$ across countries:

country	value
10th decile	0.72
9th decile	0.50
8th decile	0.25
7th decile	0.19
6th decile	0.35
5th decile	0.14
4th decile	0.12
3th decile	0.12
2nd decile	0.08
1st decile	0.07

Source: FAO, World Bank.

- Gap in poor versus rich countries: $0.07/0.72 = 0.10$.

▶ back

Nominal productivity across countries

- Variation of $\frac{p_a \frac{Y_a}{N_a}}{p_n \frac{Y_n}{N_n}}$ across countries:

country	value
10th decile	0.90
9th decile	0.79
8th decile	0.73
7th decile	0.69
6th decile	0.65
5th decile	0.56
4th decile	0.70
3th decile	0.51
2nd decile	0.45
1st decile	0.30

Source: Gollin, Lagakos and Waugh (2014)

- Gap in poor versus rich countries: $0.30/0.90 = 0.33$.

- Expenditure is pooled by aggregate household with utility

$$u(C_a, C_n) = (C_a - \bar{C}_a)^\eta C_n^{1-\eta};$$

- Agricultural consumption good C_a with subsistence $\bar{C}_a > 0$;
- Non-agricultural consumption C_n ;
- Budget constraint: $pC_a + C_n = \int b(x)dH(x)$. [▶ back](#)

Shielding against expropriation

- Question: “Do farmers in this village take any of the following actions to protect their land from expropriation?”

	Ethiopia		Uganda	
	N	%	N	%
They prefer not to rent out land	2	4.5	1	3.2
They prefer not to reveal their intention to sell	-	-	1	3.2
They prefer not to move away	2	4.5	17	54.8
They use modern agricultural techniques	15	34.1	0	0
They plant trees	10	22.7	11	35.5
They build irrigation canals	5	11.4	0	0
They prefer not to leave land fallow	10	22.7	0	0
Other	0	0	1	3.2
Sample size	44	100	31	100

Source: Own dataset.

▶ Back

Obtaining land

- Question: "Which of the following is the most important reason that local authorities grant land to a farmer?"

	Ethiopia		Uganda	
	N	%	N	%
Output, if farmer produces little	1	2.3	1	4.2
Output, if farmer produces much	4	9.1	7	29.2
Skills, if farmer is skilful	5	11.4	4	16.7
Skills, if farmer is not skilful	0	0	0	0
Land ownership, if farmer has little land	18	40.9	1	4.2
Land ownership, if farmer has much land.	0	0	0	0
Land quality, if farmer has bad quality land	0	0	1	4.2
Land quality, if farmer has good quality land	0	0	0	0
Household size, if farmer has large household	0	0	1	4.2
Household size, if farmer has small household	0	0	0	0
Age, if farmer is old	0	0	0	0
Age, if farmer is young	3	6.8	3	12.5
The household is respected in the community	1	2.3	1	4.2
It is completely random, nothing changes the odds	12	27.3	5	20.8
Sample size	44	100	24	100

Source: Own dataset.

Recursive formulation at stationary equilibrium

$$\begin{aligned} V(z_a, z_n, \ell_c) = \max_{\mathbb{1}_a, \ell} & \left\{ \mathbb{1}_a [py_a(z_a, \ell) - r\ell] + (1 - \mathbb{1}_a)Az_n + r\ell_c \right. \\ & + \beta \left(\mathbb{1}_a [1 - m(\ell_c, \ell)]g(1, \ell_c) \mathbb{E}_{z'|z} [V(z'_a, z'_n, \ell_c + v)] \right. \\ & + \mathbb{1}_a [1 - m(\ell_c, \ell)][1 - g(1, \ell_c)] \mathbb{E}_{z'|z} [V(z'_a, z'_n, \ell_c)] \\ & + \mathbb{1}_a m(\ell_c, \ell)g(1, \ell_c) \mathbb{E}_{z'|z} [V(z'_a, z'_n, v)] \\ & + \mathbb{1}_a m(\ell_c, \ell)[1 - g(1, \ell_c)] \mathbb{E}_{z'|z} [V(z'_a, z'_n, 0)] \\ & + (1 - \mathbb{1}_a)(1 - \tau) \mathbb{E}_{z'|z} [V(z'_a, z'_n, \ell_c)] \\ & \left. \left. + (1 - \mathbb{1}_a)\tau \mathbb{E}_{z'|z} [V(z'_a, z'_n, 0)] \right) \right\} \end{aligned}$$

where

$$\mathbb{E}_{z'|z} [V(z'_a, z'_n, \ell_c)] = (1 - \zeta)V(z_a, z_n, \ell_c) + \zeta \int V(z'_a, z'_n, \ell_c) d\Psi(z'_a, z'_n).$$

Occupational and operational misallocation

$$w_a(z_a, \ell) + \beta \left\{ [\tau - m(\ell_c, \ell)] \left(\mathbb{E}_{z'|z} [V(z'_a, z'_n, \ell_c) - V(z'_a, z'_n, 0)] \right) \right. \\ \left. + g(1, \ell_c) [1 - m(\ell_c, \ell)] \left(\mathbb{E}_{z'|z} [V(z'_a, z'_n, \ell_c + v) - V(z'_a, z'_n, \ell_c)] \right) \right. \\ \left. + g(1, \ell_c) m(\ell_c, \ell) \left(\mathbb{E}_{z'|z} [V(z'_a, z'_n, v) - V(z'_a, z'_n, 0)] \right) \right\} \geq Az_n$$

and

$$\hat{w}_a(z_a) < Az_n$$

where $w_a(z_a, \ell) < \hat{w}_a(z_a) = (1 - \gamma) / \gamma [\gamma p A / r]^{1/(1-\gamma)} r z_a$.

▶ Back

Only occupational misallocation

$$\hat{w}_a(z_a) + \beta \left\{ \tau \left(\mathbb{E}_{z'|z} [V(z'_a, z'_n, \ell_c) - V(z'_a, z'_n, 0)] \right) + g(1, \ell_c) \left(\mathbb{E}_{z'|z} [V(z'_a, z'_n, \ell_c + v) - V(z'_a, z'_n, \ell_c)] \right) \right\} \geq Az_n.$$

and

$$\hat{w}_a(z_a) < Az_n$$

where $\hat{w}_a(z_a) = (1 - \gamma) / \gamma [\gamma p A / r]^{1/(1-\gamma)} r z_a$.

▶ Back

Only operational misallocation

$$w_a(z_a, \ell) + \beta \left\{ [\tau - m(\ell_c, \ell)] \left(\mathbb{E}_{z'|z} [V(z'_a, z'_n, \ell_c) - V(z'_a, z'_n, 0)] \right) \right. \\ \left. + g(1, \ell_c) [1 - m(\ell_c, \ell)] \left(\mathbb{E}_{z'|z} [V(z'_a, z'_n, \ell_c + v) - V(z'_a, z'_n, \ell_c)] \right) \right. \\ \left. + g(1, \ell_c) m(\ell_c, \ell) \left(\mathbb{E}_{z'|z} [V(z'_a, z'_n, v) - V(z'_a, z'_n, 0)] \right) \right\} \geq Az_n$$

and

$$\hat{w}_a(z_a) \geq Az_n$$

where $w_a(z_a, \ell) < \hat{w}_a(z_a) = (1 - \gamma) / \gamma [\gamma p A / r]^{1/(1-\gamma)} r z_a$.

▶ Back

$$w_a(z_a) \geq Az_n$$

and

$$w_a(z_a) = \hat{w}_a(z_a) = (1 - \gamma) / \gamma [\gamma p A / r]^{1/(1-\gamma)} r z_a.$$

▶ Back

Identification of types (rich economy)

- Actions following liberalisation of communal land ($\tau = 0$) for given λ ;
- Without and with ensuing price adjustments.

	$\lambda = 0.5$	$\lambda = 0.5$	$\lambda = 1$	$\lambda = 1$
	Partial eq.	General eq.	Partial eq.	General eq.
Rich economy				
Farmer, oper. unconstrained, stays (% farmers)	24.5	67.5	8.5	39.0
Farmer, oper. constrained, stays (% farmers)	0.3	2.6	0.6	15.0
Farmer, oper. unconstrained, switch (% farmers)	68.6	25.5	38.3	7.9
Farmer, oper. constrained, switch (% farmers)	6.6	4.3	52.6	38.2
Non-farmer, switch (% non-farmers)	0.0	0.1	0.0	0.2
Non-farmer, stay (% non-farmers)	100.0	99.9	100.0	99.8

▶ Back, rich economy

Identification of types (poor economy)

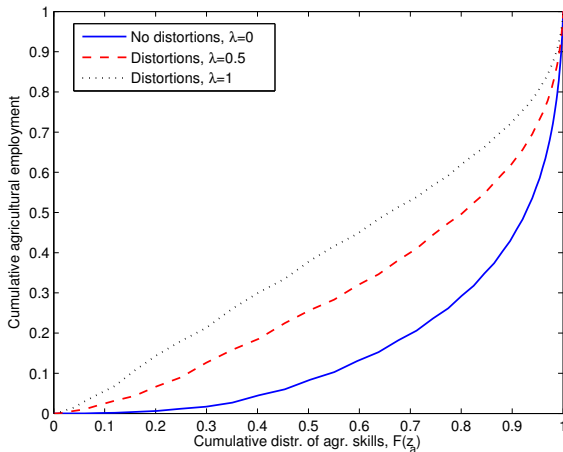
- Actions following liberalisation of communal land ($\tau = 0$) for given λ ;
- Without and with ensuing price adjustments.

	$\lambda = 0.5$	$\lambda = 0.5$	$\lambda = 1$	$\lambda = 1$
	Partial eq.	General eq.	Partial eq.	General eq.
Poor economy				
Farmer, oper. unconstrained, stays (% farmers)	62.3	88.6	26.4	60.6
Farmer, oper. constrained, stays (% farmers)	3.7	5.7	11.3	30.5
Farmer, oper. unconstrained, switch (% farmers)	30.1	3.8	35.2	0.9
Farmer, oper. constrained, switch (% farmers)	3.9	1.9	27.1	8.0
Non-farmer, switch (% non-farmers)	0.0	8.4	0.0	12.1
Non-farmer, stay (% non-farmers)	100.0	91.6	100.0	87.9

▶ Back, poor economy

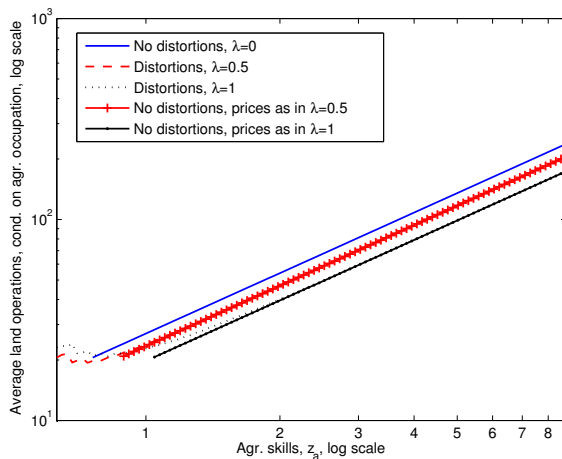
Agricultural employment and skills (rich economy)

- Communal land strongly impacts cumulative distribution of agr. employment as a function of farming skills.



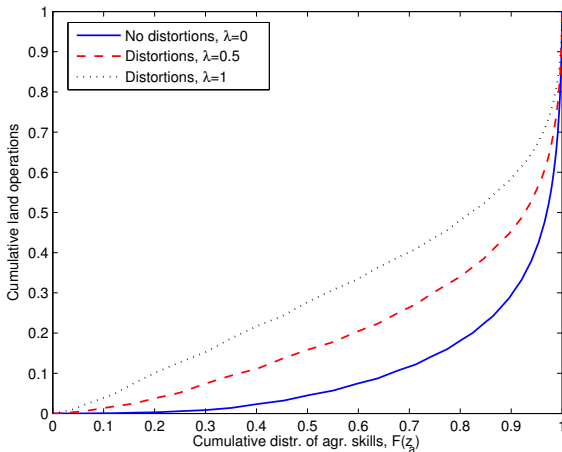
Land operations and skills (rich economy)

- Least skilled farmers feature excessive operations;
- Skilled farmer operate less due to price changes.



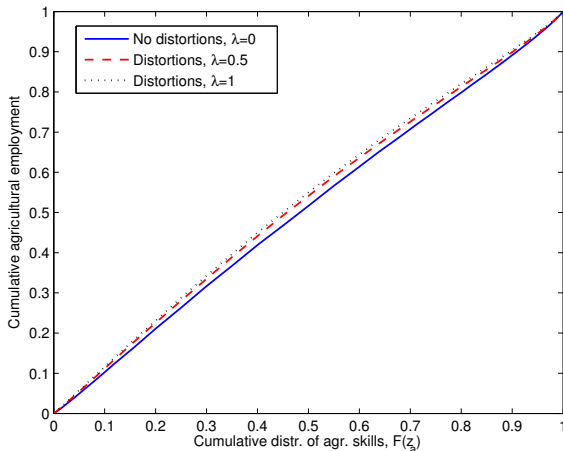
Land operations and skills (rich economy)

- Communal land strongly impacts cumulative distribution of operations as a function of farming skills.



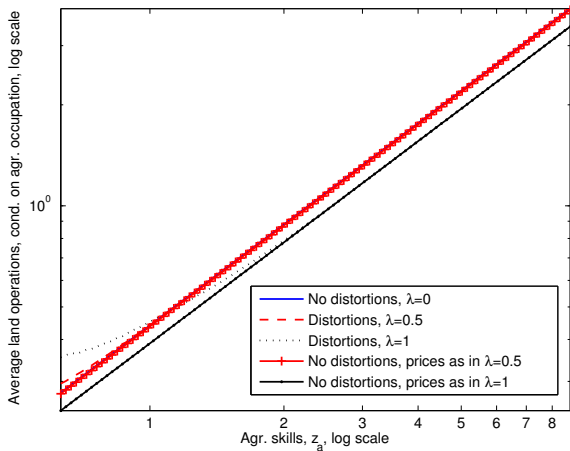
Agricultural employment and skills (poor economy)

- Cumulative distribution of agr. employment very flat to begin with, not much room for potential impact from distortions.



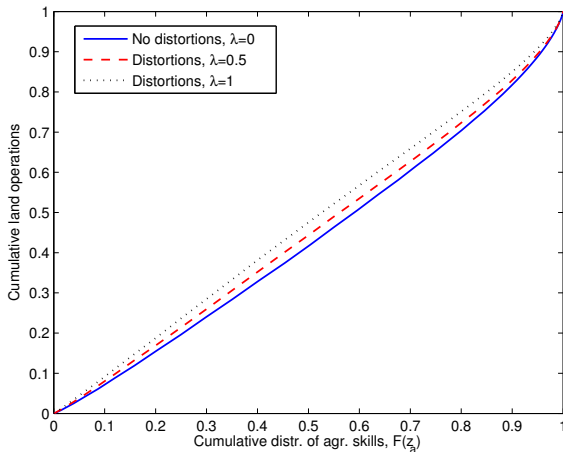
Land operations and skills (poor economy)

- Only large λ produces visible distortions in land operations.

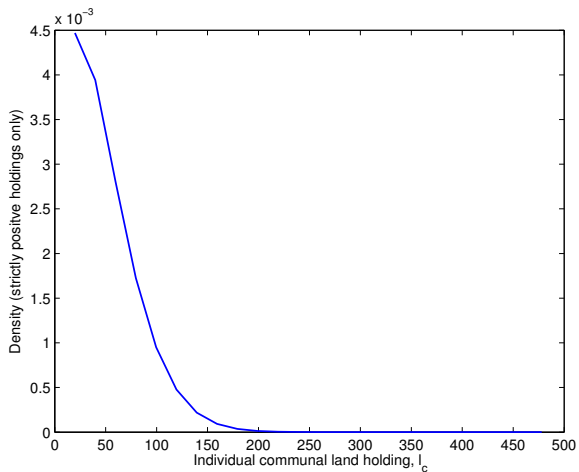


Land operations and skills (poor economy)

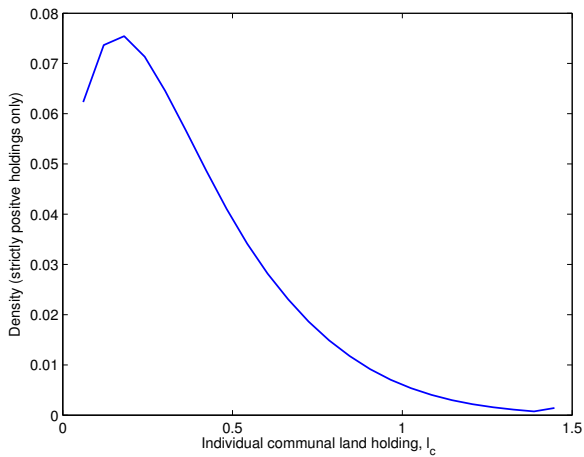
- Cumulative distribution of land operations further skewed by policies, but not substantially.



Distribution of communal land (rich economy)

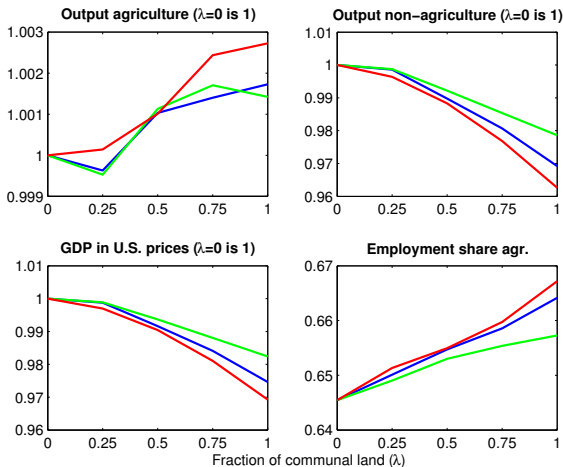


Distribution of communal land (poor economy)



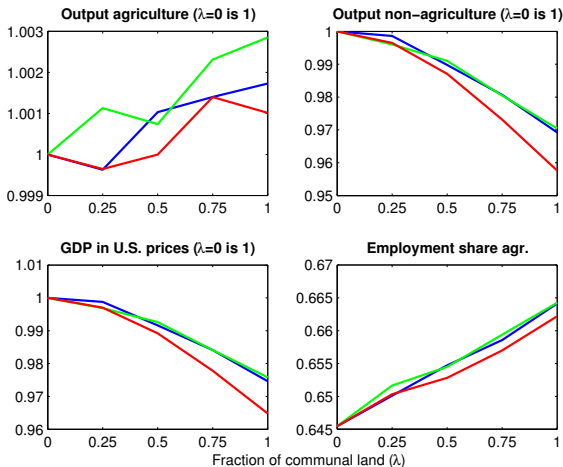
Sensitivity: expropriation risk (poor economy)

- **Benchmark** ($\tau = 0.5$); **Low** ($\tau = 0.1$); **High** ($\tau = 1$).



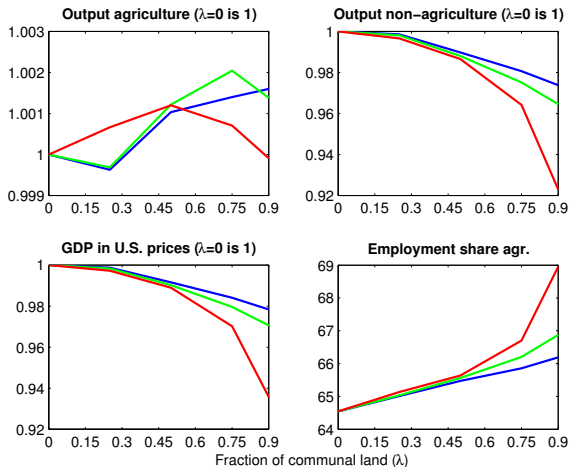
Sensitivity: maximum transfer probability (poor economy)

- **Benchmark** ($\phi = 0.211$); **Low** ($\phi = 0.05$); **High** ($\phi = 1$).



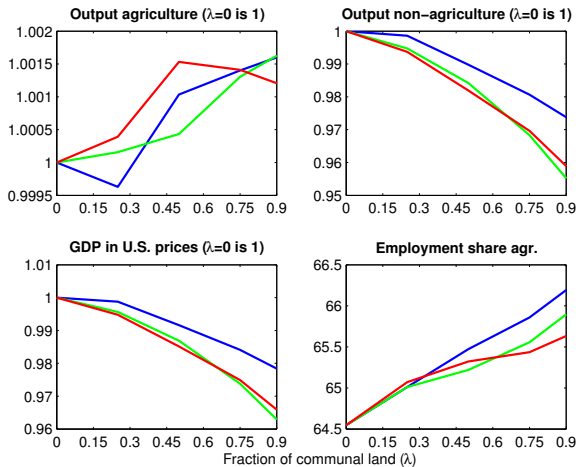
Sensitivity: expropriation curvature (poor economy)

- **Benchmark** ($\mu = 5.341$); **Medium** ($\mu = 3$); **Low** ($\mu = 1$).



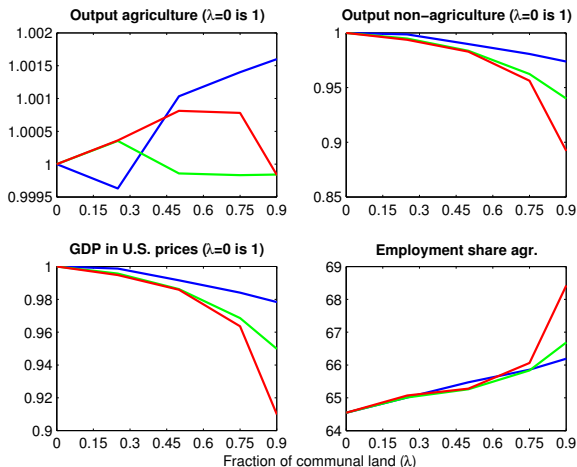
Sensitivity: progressivity of transfer (poor economy)

- **Benchmark** ($\epsilon = 0.0238$); **Medium** ($\epsilon = 1$); **High** ($\epsilon = 3$).



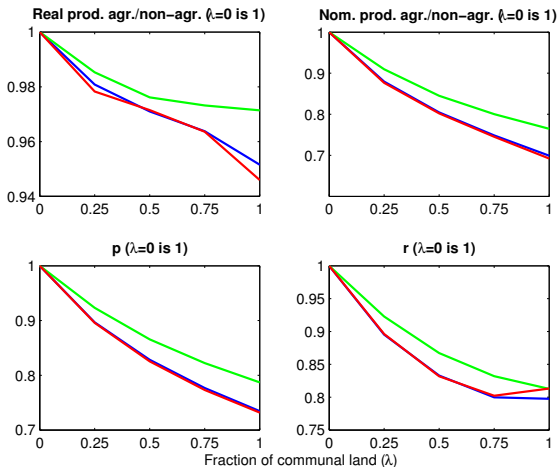
Sensitivity: expropriation and transfer (poor economy)

- **Benchmark** ($\mu = 5.341$, $\epsilon = 0.0238$); **Medium/Medium** ($\mu = 3$, $\epsilon = 1$); **Low/High** ($\mu = 1$, $\epsilon = 3$).



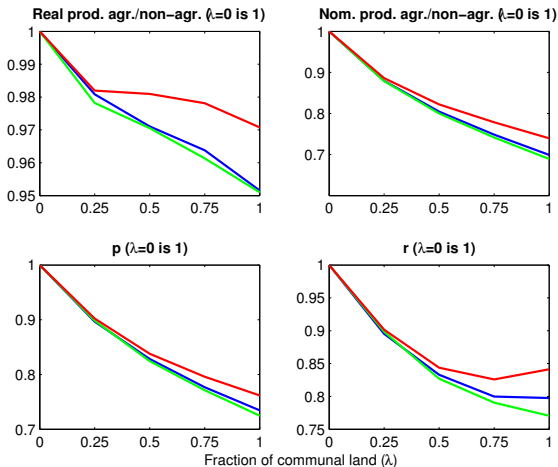
Sensitivity: expropriation risk (poor economy)

- **Benchmark** ($\tau = 0.5$); **Low** ($\tau = 0.1$); **High** ($\tau = 1$).



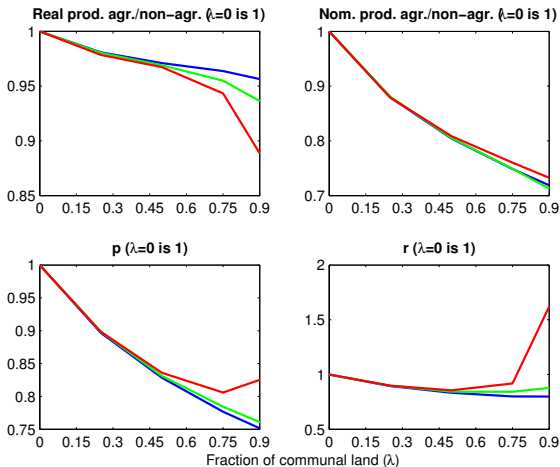
Sensitivity: maximum transfer probability (poor economy)

- **Benchmark** ($\phi = 0.211$); **Low** ($\phi = 0.05$); **High** ($\phi = 1$).



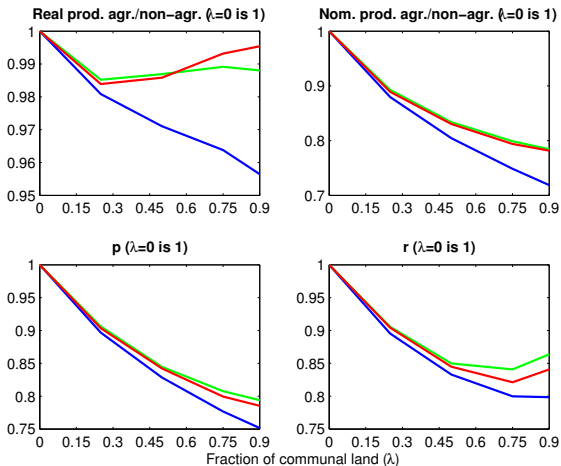
Sensitivity: expropriation curvature (poor economy)

- **Benchmark** ($\mu = 5.341$); **Medium** ($\mu = 3$); **Low** ($\mu = 1$).



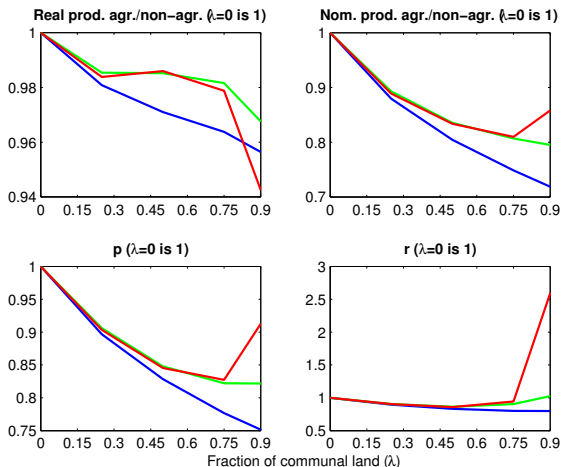
Sensitivity: progressivity of transfer (poor economy)

- **Benchmark** ($\epsilon = 0.0238$); **Medium** ($\epsilon = 1$); **High** ($\epsilon = 3$).



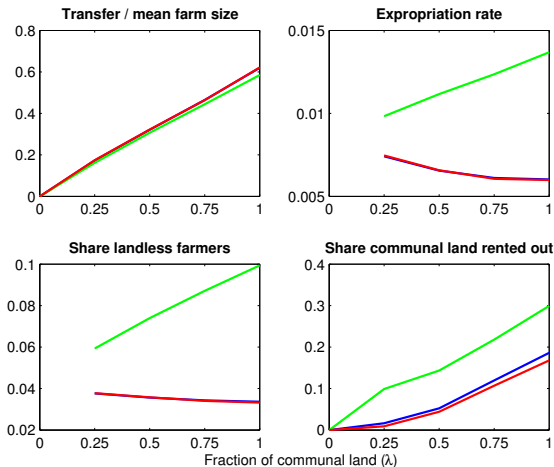
Sensitivity: expropriation and transfer (poor economy)

- **Benchmark** ($\mu = 5.341$, $\epsilon = 0.0238$); **Medium/Medium** ($\mu = 3$, $\epsilon = 1$); **Low/High** ($\mu = 1$, $\epsilon = 3$).



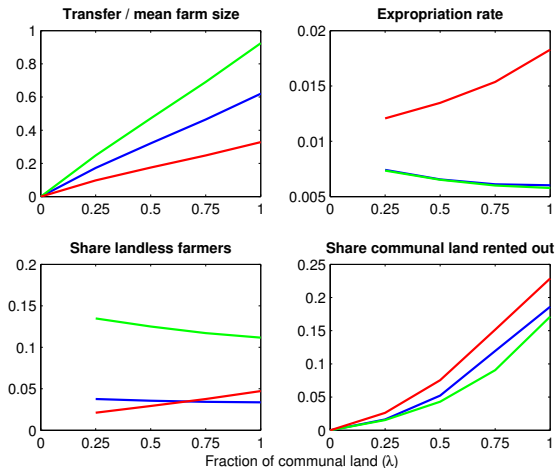
Sensitivity: expropriation risk (poor economy)

- **Benchmark** ($\tau = 0.5$); **Low** ($\tau = 0.1$); **High** ($\tau = 1$).



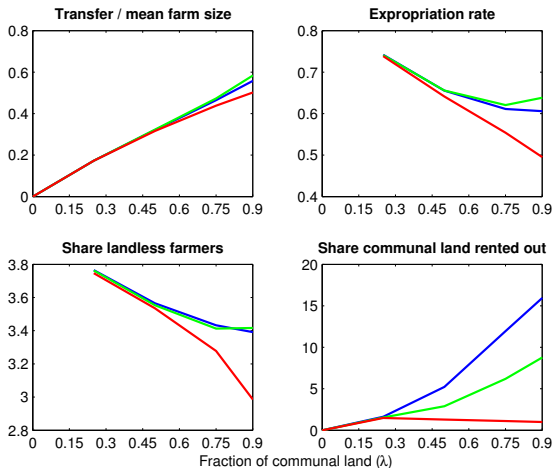
Sensitivity: maximum transfer probability (poor economy)

- **Benchmark** ($\phi = 0.211$); **Low** ($\phi = 0.05$); **High** ($\phi = 1$).



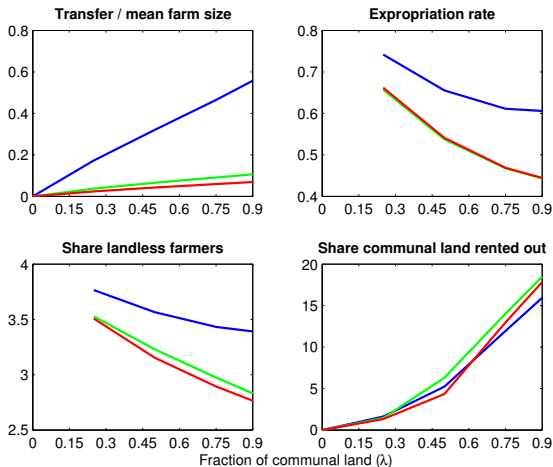
Sensitivity: expropriation curvature (poor economy)

- **Benchmark** ($\mu = 5.341$); **Medium** ($\mu = 3$); **Low** ($\mu = 1$).



Sensitivity: progressivity of transfer (poor economy)

- **Benchmark** ($\epsilon = 0.0238$); **Medium** ($\epsilon = 1$); **High** ($\epsilon = 3$).



Sensitivity: expropriation and transfer (poor economy)

- **Benchmark** ($\mu = 5.341$, $\epsilon = 0.0238$); **Medium/Medium** ($\mu = 3$, $\epsilon = 1$); **Low/High** ($\mu = 1$, $\epsilon = 3$).

