# Digitization and Development: Property Rights Security, and Land and Labor Markets
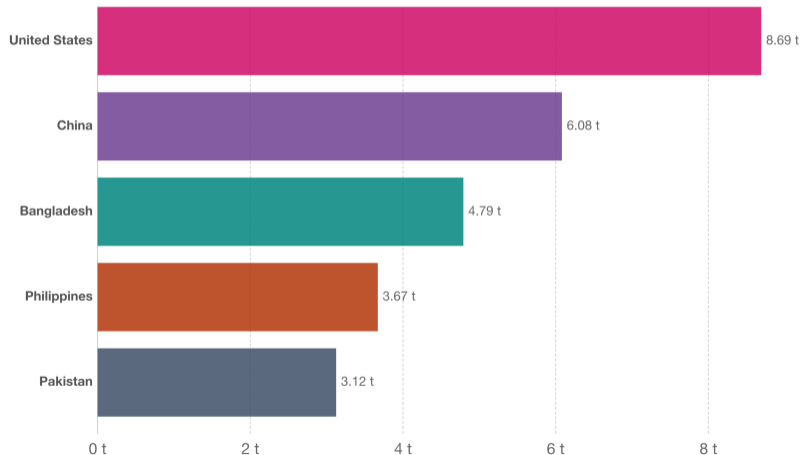
## Sabrin Beg

Teaching Materials

June 10, 2021

# Agricultural productivity differences across countries

## Cereal yield, 2018

Cereal yields are measured in tonnes per hectare. Cereals include wheat, rice, maize, barley, oats, rye, millet, sorghum, buckwheat, and mixed grains.

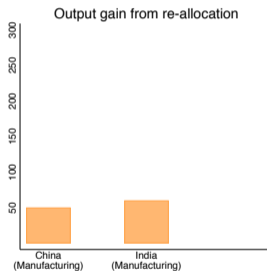| Country | Yield |
|---|---|
| United States | 8.69 t |
| China | 6.08 t |
| Bangladesh | 4.79 t |
| Philippines | 3.67 t |
| Pakistan | 3.12 t |

0 t     2 t     4 t     6 t     8 t

Source: UN Food and Agriculture Organization (FAO)

OurWorldInData.org/crop-yields • CC BY

# Misallocation and productivity differences

**Gap in aggregate productivity across countries due to misallocation of factors of production** (Hseigh and Klenow 2017; Restuccia and Santaeulalia-Llopis 2017)
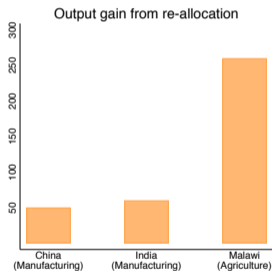
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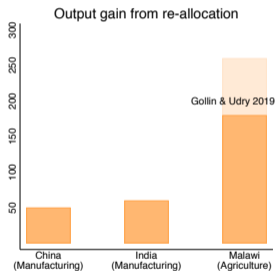


Output gain from re-allocation

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Output gain from re-allocation

Gollin & Udry 2019

China (Manufacturing)   India (Manufacturing)   Malawi (Agriculture)

# Role of land markets (lack of) in misallocation

- Correlational /Theoretical (Adamopoulos et al. 2017; Chen 2017; Restuccia and Santaeulàlia-Llopis 2017)
    - 34-fold difference in average farm size (land per farm) between rich and poor countries (Adamopoulos and Restuccia 2014)
    - A third of labor in agriculture in lower middle income countries, but only 15% of value added in GDP. (World Bank 2017)
- Empirical Challenge: Policy experiment that shocks land markets
- Existing work examines contracting / certification in contexts without private property rights (Chen, Restuccia and Santaeulàlia-Llopis 2017; Chari et al. 2019)
    - What is the role of "tenure security" in land/labor market outcomes and misallocation?

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# This paper

**Study effects of a World Bank led "Land record digitization" reform in Punjab, Pakistan**

- Program increases tenure security (potentially lowers transaction costs) in the land market

- Use the staggered roll-out of the program to get causal effects

- Document effect of removing frictions in land markets on land allocation, labor allocation, farmsize and output

- Document effect of digitized transactions and biometric verification on females' access to land

## Summary of Findings

▶ The reform increases rental activity and scale of farming

▶ Findings consistent with improved allocation of land after the reform — land allocated to higher productivity farmers

▶ Also find effects on labor market re-allocation

  ▶ Landowning households increase participation in non-agricultural activities.

▶ Aggregate production is higher

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# Literature and Contribution

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   ▶ (Hsieh and Klenow 2009; Restuccia and Santaeulàlia-Llopis 2014, Foster and Rosenzweig 2011; Adamopoulos and Restuccia 2015, Foster and Rosenzweig 2010)

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# Background—Agriculture

- 70% of the population is rural, with majority participating in the agriculture sector (under 20% of GDP).

- Farming is characterized by small-scale, owner-operated farms, with thin market for renting or selling.

  - 80% of farms under 10 acres
  - 20% of landowners participate in leasing market
  - 1% report any sale/purchase in the last year

- Gender gap in ownership: 22% women report they inherited land from father/husband

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# Background—Land Rights

- Cadastral map



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# Background—Record of Rights



Source (Adeel 2010)

# Background—'Patwaris'



Source (Dhakku 2016)

# Background—The Reform

1. Computerization of Land Records.

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# What changes? 1. Centralized Records

# 1. Centralized Records

## and available on the World wide web

- Prior: 76% of farm households report illegal occupation of land as the main form of land dispute
  - 56% identified the major source of all land disputes was incorrect land records.
- Program averts manual manipulation of records
  - Improves ability to verify/uphold rights and lowers risk of expropriation (Hornbeck 2010)
  - Improves tenure security for **owners** and **cultivators**
- Risk of expropriation ↓ (Besley and Ghatak 2009) ⇨
  - Lease market participation by landowners
  - Investment incentives of owner-cultivators and tenants (Jacoby and Mansuri 2008 ReStud)

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# 2) Low cost / centralized land transactions

- ▶ Prior: 42% of farm households rank the land records as the worst of all government departments
    - ▶ 64% describe the system as lacking transparency
    - ▶ 82% report having to pay a bribe at some point to obtain land record services
- ▶ Program reduces average time required to complete transactions from 2 months to 45 minutes (Gonzales 2016).

- ▶ Transaction costs ↓ (Besley and Ghatak 2009) ⇨
    - ▶ Land Sale Market / Inheritance Transactions
    - ▶ Ownership records for collateral ⇨ Credit market

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# Predictions

1. Landowning households increase market participation through land leasing and/or sales
2. Landowning households reduce participation in land cultivation
3. Access to leased land increases for cultivating households
4. Land is reallocated toward households with higher TFP

▶ At the aggregate market level, dispersion in MPL will go down
▶ Aggregate productivity may improve

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# Data

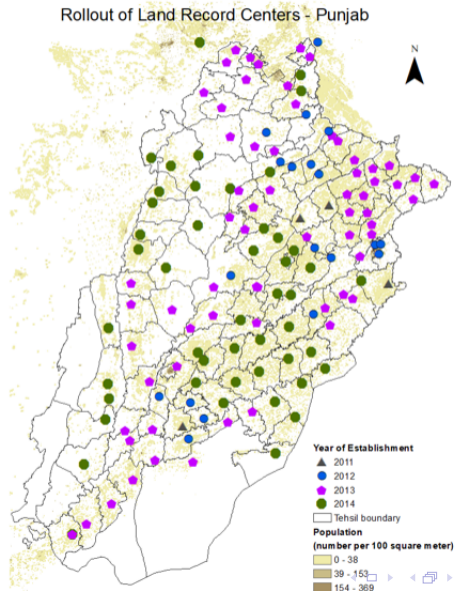- Household Integrated Expenditure Surveys (2005, 2007, 2011, 2013, 2015)
  - Demographic
  - Land ownership
  - Agricultural information
- Cross-sectional data from Punjab Committee on Status of Women survey

Rollout of Land Record Centers - Punjab

# Program Rollout

# Identification Strategy

- District-level timing DD—using variation in **timing** and **degree of treatment**

$$y_{idt} = \beta_0 + \beta_1 ProgramIntensity_{dt} + X'_{idt}\Psi + \mu_d + \eta_t + \mu_d \times t + \varepsilon_{idt}, \quad (1)$$

- $ProgramIntensity_{dt}$: share of subdistricts in a district $d$ with a service center
- $y_{idt}$: outcome for household $i$ in district $d$ and year $t$.
- $\mu_d$ and $\eta_t$: district and year fixed effects respectively
- $\mu_d \times t$: district specific trends
- $X_{dt}$: vector of household level controls: age/age-sq, gender and education of head
- Wild bootstrap clustering at district level

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# Balance Checks for Pre-program Characteristics

Table: Balance Test for Program Start

| Outcome | Prior Level | | Prior Change | |
| | F-stat (1) | p-value (2) | F-stat (3) | p-value (4) |
|---|---|---|---|---|
| Landowners Renting out | 0.476 | 0.674 | 0.303 | 0.802 |
| Landowners' Ag. participation | 0.956 | 0.428 | 1.647 | 0.262 |
| Farmsize (acres) | 0.569 | 0.623 | 0.379 | 0.739 |
| Acres Rented in | 0.885 | 0.447 | 0.211 | 0.851 |
| Population (mm) | 0.431 | 0.698 | 0.259 | 0.850 |
| Unemployment | 0.381 | 0.759 | 1.143 | 0.339 |
| NDVI | 1.143 | 0.611 | 0.429 | 0.844 |
| Soil Quality Index | 2.468 | 0.101 | | |

# Balance Checks—Intensity after start

Table: Balance Tests for Program Progress after start

| Outcome | Prior Level | | Prior Change | |
|---|---|---|---|---|
| | Coefficient | p-value | Coefficient | p-value |
| Landowners Renting out | 0.019 | 0.779 | 0.025 | 0.896 |
| Landowners' Ag. participation | -0.014 | 0.859 | -0.739 | 0.031 |
| Farmsize (acres) | 0.019 | 0.830 | -0.019 | 0.944 |
| Acres Rented in | -0.081 | 0.411 | -0.040 | 0.389 |
| Population | 0.014 | 0.848 | 0.006 | 0.980 |
| Unemployment | 0.147 | 0.032 | 0.059 | 0.073 |
| F-stat of joint significance | | 1.305 | | 0.978 |
| p-value | | 0.126 | | 0.278 |

# Results—Rental Market

# Results

### Table: Program Effect on Market Participation by Landowners

|  | Own Agland (Y/N) (1) | Agland Purch. (Y/N) (2) | Agland Sold (Y/N) (3) | Agland Rentout (Y/N) (4) |
|---|---|---|---|---|
| Program Intensity | 0.002 | 0.001 | -0.002 | 0.061** |
|  | (0.030) | (0.003) | (0.006) | (0.027) |
|  | [0.954] | [0.821] | [0.707] | [0.0327] |
| Observations | 19,067 | 7,584 | 7,584 | 7,597 |
| Mean Dep., Pre-program | 0.420 | 0.006 | 0.010 | 0.219 |
| Sample Households | All Rural | All Landowning | All Landowning | All Landowning |

*Notes:* Program Intensity is at the district-year level and measures the share of subdistricts with where the program is operational. All regressions include district and year fixed effects with standard errors clustered at the district level in parentheses. Wild cluster bootstarped p-values reported in brackets
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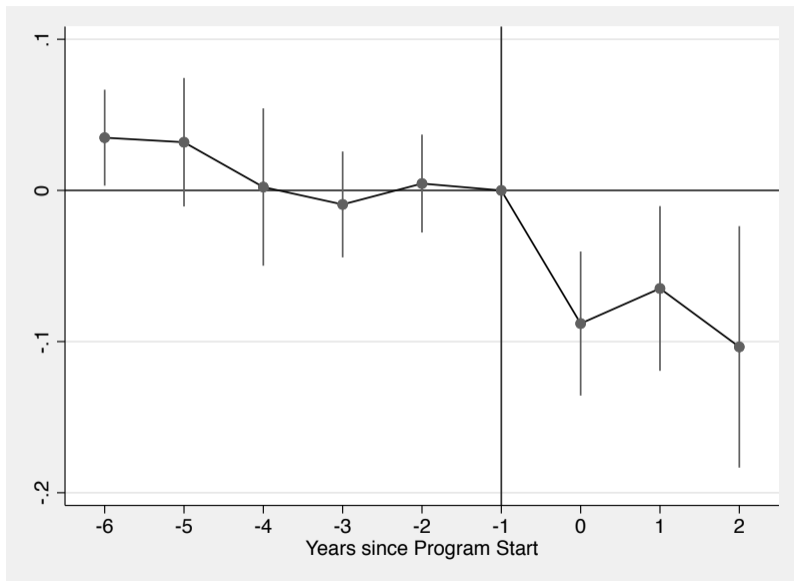*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

# Results—Agricultural Participation

# Discussion of land market effects

- 28% increase in rate of leasing out among landowners
- 12% more likely to quit agriculture
- Structure of land ownership does not change
    - Land rental and sale markets possible substitutes
    - Land sales correlated with income / holdings
    - Lack of insurance / savings / credit markets instruments (Rosensweig and Wolpin 1993)
    - Land is a dominant, indivisible asset

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- Structure of land ownership does not change
  - Land rental and sale markets possible substitutes
  - Land sales correlated with income / holdings
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  - Land is a dominant, indivisible asset

# Discussion of land market effects

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### Table: Program Effect on Agricultural Operation

|  | Rented (1) | Sharecropped (2) | Owned (3) | Total Cultivated (4) |
|---|---|---|---|---|
| Program Intensity | 0.925** | 0.084 | 0.731 | 1.110** |
|  | (0.433) | (0.255) | (0.697) | (0.452) |
|  | [0.0351] | [0.797] | [0.320] | [0.0151] |
| Observations | 7,256 | 7,256 | 7,256 | 7,256 |
| Mean Dep., Pre-program | 1.648 | 0.686 | 5.423 | 7.055 |

*Notes:* Rent area corresponds to area under fixed cash rent contracts and S/C refers to area under sharecropping contracts. Farm size is total operational farm area including owned land. Program Intensity is at the district-year level and measures the share of subdistricts with where the program is operational. All regressions include district and year fixed effects with standard errors clustered at the district level in parentheses. Wild cluster bootstarped p-vallues reported in brackets.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

# Market Effects—consistent with improved allocative efficiency

Table: Land re-allocated to higher productivity farmers

|                                      | Land (1)   | MPL (2)      |
|--------------------------------------|------------|--------------|
| Program Intensity                    | 0.050      | 0.154        |
|                                      | (0.089)    | (0.099)      |
|                                      | [0.579]    | [0.134]      |
|                                      |            |              |
| TFP Quartile 2 x Program Intensity   | 0.081      | -0.081*      |
|                                      | (0.074)    | (0.044)      |
|                                      | [0.273]    | [0.0716]     |
|                                      |            |              |
| TFP Quartile 3 x Program Intensity   | 0.096      | -0.130**     |
|                                      | (0.064)    | (0.054)      |
|                                      | [0.139]    | [0.0202]     |
|                                      |            |              |
| TFP Quartile 4 x Program Intensity   | 0.244**    | -0.244***    |
|                                      | (0.102)    | (0.059)      |
|                                      | [0.0281]   | [0.000200]   |
|                                      |            |              |
| Observations                         | 7,256      | 7,256        |

*Notes:* All regressions include district and year fixed effects, household level controls, and district level linear trends with standard errors clustered at the district level. Wild cluster bootstarped p-values reported in brackets.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

# Market / Scale Effects—consistent with improved production

Table: Program Effect on Farm Production

|  | Total Output (1) | Output per acre (2) | Profit per acre (3) |
|---|---|---|---|
| Program Intensity | 90.439*** | 3.216 | 3.906 |
|  | (32.719) | (5.270) | (4.249) |
|  | [0.0109] | [0.550] | [0.378] |
| Observations | 7,256 | 7,256 | 7,256 |
| Mean Dep., Pre-program | 156.338 | 25.611 | 15.514 |

*Notes:* All regressions include district and year fixed effects, household level controls, and ditrict level linear trends with standard errors clustered at the district level. Wild cluster bootstarped p-values reported in brackets.
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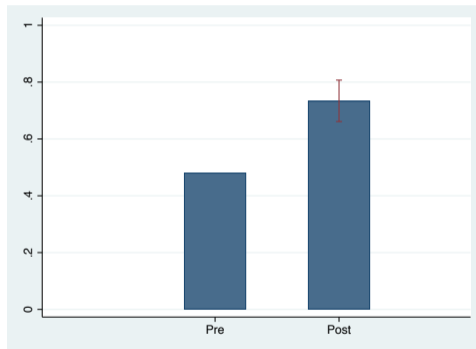
# Aggregate production from Remote Sensing Data

Table: Program Effect on Agricultural Production

|              | (1)          | (2)          |
|--------------|--------------|--------------|
| Post Program | $0.093^{**}$ | $0.093^{**}$ |
|              | (0.040)      | (0.041)      |
| Observations | 1,792        | 1,792        |
| Linear Trend | District     | Sub-district |

*Notes:* Regressions are at subdistrict-year level. All regressions include subdistrict and year fixed effects with standard errors clustered at the subdistrict level.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

# Mechanisms—Title Ownership

# Robustness

- ▶ Placebo program has no effects
- ▶ Traditional timing DD (Goodman-bacon 2018)
- ▶ Stacked DD (Deshpande & Li 2018)
- ▶ Alternation specifications
  - ▶ Parsimonious
  - ▶ Added macroeconomic controls
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# Conclusion

- ▶ Contexts with institutional constraints and informal markets

  - ▶ Formalization / computerization of transactions can relieve market frictions
  - ▶ Relieve constraints on state capacity
  - ▶ Effects similar to more extensive reforms targeting rental market directly

- ▶ Novel micro evidence supporting that land market frictions barrier to farming scale and productivity in developing contexts

  - ▶ Institutional changes or aggressive reforms not necessary to ease market frictions.

# Conclusion

- Previous computerization of land records in AP (India) find effects on credit market access in urban areas (Deninger and Goyal 2012)

  - Demonstrate sizeable effects on rural land markets

  - Reallocation of land ➔ Agricultural productivity (Increase in output $>>$ WB Program costs)

  - Reallocation of labor ➔ Structural change, urbanization, total aggregate TFP