

# Financial Deregulation, Capital Drainage, and Agricultural Labor Productivity: Evidence from County-level Analysis in China

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## Introduction

China has made great progress in rural transformation, contributing to global Sustainable Development Goals (SDGs) for 2030.

- **Food Security ("Zero Huger", SDG2):** Agricultural output grew at 5.4% a year, five times the population growth rate of 1% (NBS 2023; FAOSS 2021).
- **Rural Income ("Zero Poverty", SDG1):** Rapid rural income growth, elimination of absolute poverty, and increased off-farm employment opportunities.

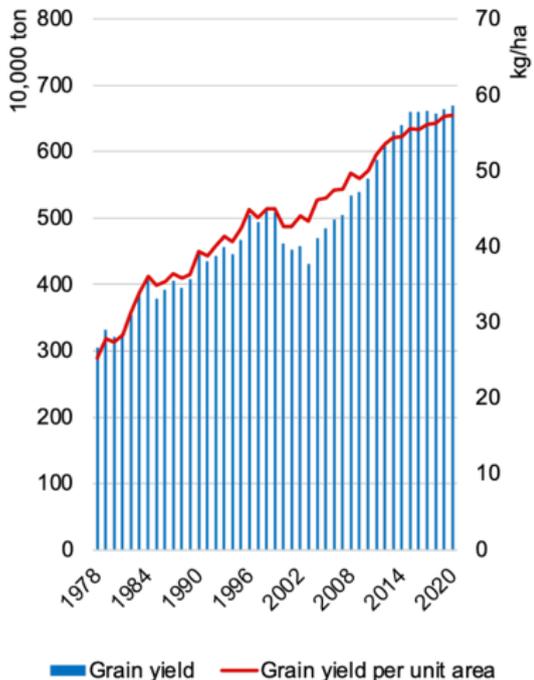
Institutional reforms in land, labor, and financial markets have been critical to enhancing agricultural labor productivity (ALP).

- **Land and Labor Markets:** HRS reform in land market (Lin 1992, Liu et al., 2021) and Hukou reform in labor market (Pu et al., 2018).
- **Financial Markets:** Financial reforms have improved resource allocation efficiency in rural China (Levine and Zervos, 1998; Gatti and Love, 2008; Guirkinger and Boucher, 2008; Brown et al., 2012).

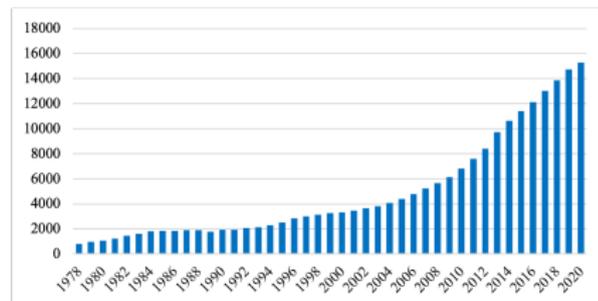
However, disparities in ALP persist due to resource misallocation and rigid land institutions.

# Introduction

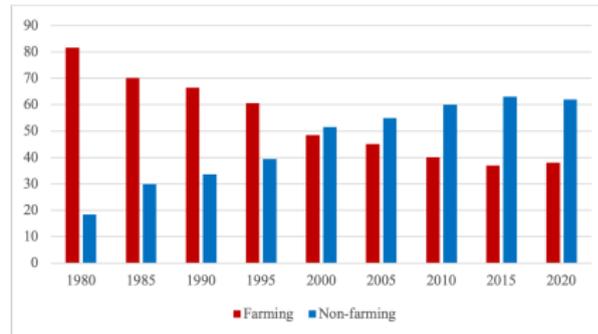
## Grain yield in China



## Rural per capita disposable income



## Sources of farmers' income (%)



# Introduction

We investigate the impact of financial reforms on ALP in rural China, through

- Modeling mechanism: financial reforms influence farmers' investment decisions, altering capital investment in agriculture
- Distinguishing the role of capital/land reallocation in affecting ALP from technological progress/efficiency improvement

We utilize the Postal Saving Bank of China (PSBC) reform as a natural experiment, focusing on

- A generalized (staggered) difference-in-difference (DiD) approach, plus GMM and 2SLS, to establish causality
- Generalized regression forestry (GRF) to explore heterogeneous effects across farms of different sizes (Athey et al., 2019)

We construct the agricultural production account for

- a balanced panel of 1,474 rural counties for the 1993-2016 period

## Contribution

We elucidates a novel mechanism by which financial reforms affect ALP, apart from evaluating productivity impacts (Demyanyk et al., 2007; Midrigan and Xu, 2014; Buera and Moll, 2015; Leblebicioglu and Weinberger, 2021)

- Integrates farmers' asset-choice decisions into the Solow model to analyze the impact of financial reform on investment reallocation

We detect capital drainage effects stemming from the PSBC reform in rural China

- **Market Penetration:** Expansion of PSBC branches across regions (Beck et al., 2010; Rice and Strahan, 2010)
- **Bank de-centralization:** Authorization of PSBC branches to offer loan services (Wang et al., 2014; Shi, 2011)

We demonstrate that rural financial reforms may discourage land consolidation, particularly for large landholders.

- Reduce marginal returns to land consolidation due to capital drainage effects.

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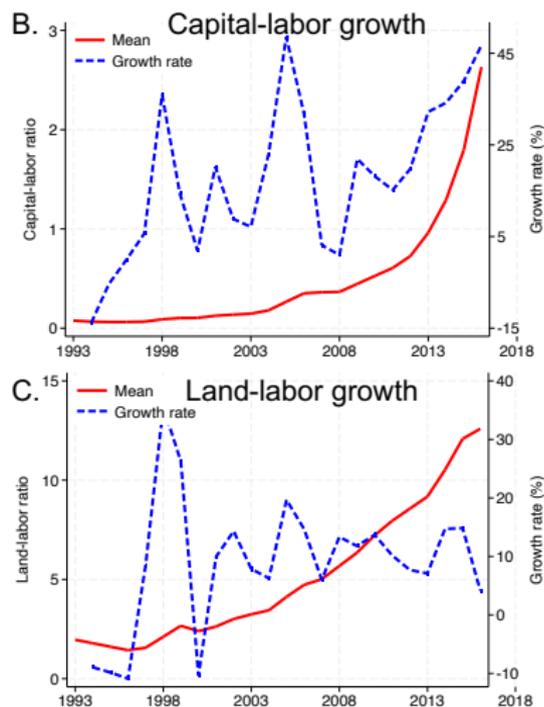
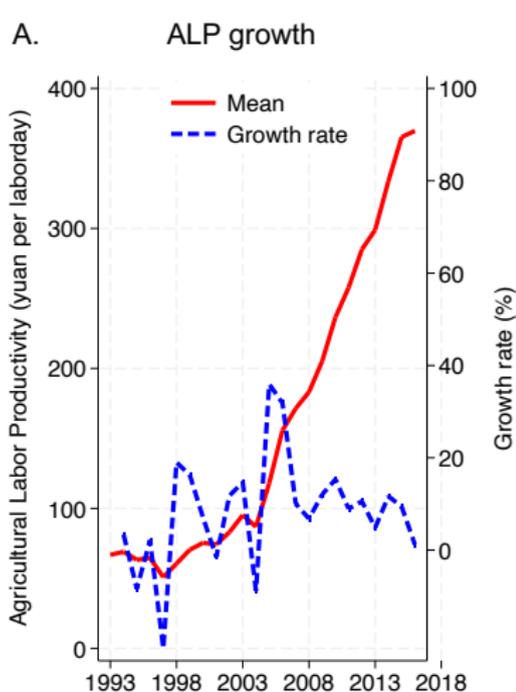
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# Background: Agricultural Production and Labor Productivity in China



Source: the county-level agricultural production accounts in China (Sheng et al., 2025).

## Background: Rural Financial Development

### Timeline for the PSBC reform

| PRC Postal Law<br>(Cornerstone)  | Interim<br>Measures  | State Council<br>Reform   | CBRC<br>Approval  | PSBC<br>Founded  |
|--|--|---|---|--|
| Since 1986,<br>revised 2006  | 2004   | 2005  | Dec 2006  | Mar 2007   |
| <i>Legal basis for<br/>postal finance</i>  | <i>CBRC regulates<br/>postal savings</i>   | <i>Mandate to<br/>create PSBC</i>   | <i>PSBC establishment<br/>approved</i>  | <i>Bank officially<br/>launched</i>  |
| → Established the<br>right for postal<br>services to offer<br>savings and<br>remittance, laying<br>the foundation for<br>PSBC. | → Brought<br>postal savings<br>under bank<br>supervision,<br>introducing<br>modern banking<br>regulations. | → Official<br>government<br>decision to<br>separate postal<br>and financial<br>services,<br>launching the<br>setup of PSBC. | → Regulatory<br>authorities gave<br>formal approval to<br>establish PSBC as a<br>commercial bank. | → Postal Savings<br>Bank of China<br>Limited started<br>operations as a<br>regulated commercial<br>bank. |

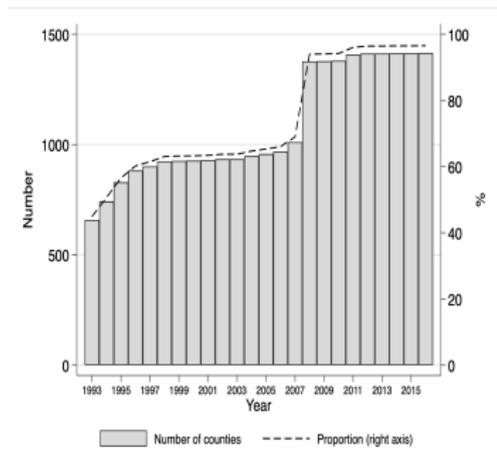
The PSBC reform is aligning with the entire rural financial reform.

- Extend new branches since the early 1990s, and then enable retail and corporate lending activities in 2006 and 2007.
- Hold a national network of 39,707 outlets (70% located in rural China), with 660 million customers and 13.6 trillion saving deposit.

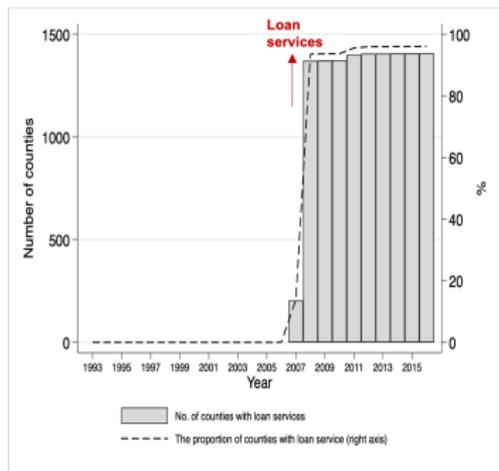
## Background: the PSBC Reform - open branch and bank loan

- Reallocated 0.6–1.6 trillion yuan per year of rural savings to non-agriculture or urban areas.

**The number and proportion of PSBC branches across counties**



**The number and proportion of PSBC branches providing loan service**



Note: Before 1993, 634 rural counties had self-operated PSBC branches. Between 1993 and 2016, an additional 774 counties open new branches. The remaining 57 counties with no branches primarily distribute in Tibet, Qinghai, and Yunnan, set up branches after 2016.

# Literature Review: Financial Reform and Economic Development

Internationally,

- Whether and how "finance creates productivity" has long been discussed (Levine and Zervos, 1998; Andrews and Cingano, 2014; Bravo-Biosca et al., 2016).
- Most of them focus on the non-agricultural or broader economy (Brandt and Zhu, 2000, 2007; Song et al., 2011; Chava et al., 2013; Moll, 2014).

Domestically,

- China's financial structure does not give sufficient support to rural areas (Wang and He, 2019; Luo and Li, 2023).
- Rural financial reforms may positively affect the local economy (Ma et al., 2020; Song et al., 2023).

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## Theoretical Framework: Model Setting

- Agricultural income comes from two sources: **agricultural production** and **financial asset investment**

Agricultural production takes the form of a Cobb-Douglas function:

$$y = Aa^\alpha k^\beta l^\gamma$$

where  $y$  is agricultural output,  $A > 0$  is TFP,  $a, k, l$  are land, capital and labor inputs, and input price is  $\omega = [q, r, w]$  and output price is  $p$ .

- The financial asset payoff matrix is

$$Tr \in \mathbb{R}^{S \times J},$$

where  $tr_{sj}$  is the payoff of asset  $j$  in state  $s$ , and asset holdings  $h = [h_1, \dots, h_J] \in \mathbb{R}^J$  have linear marginal acquisition costs  $v'h$ , where  $v = [v_1, \dots, v_J]$ .

- The agent minimizes total costs:

$$\min_{a,k,l,h} \left\{ c(w, y) + v'h \mid z_s \leq py + Tr_s \cdot h, y = Aa^\alpha k^\beta l^\gamma, \forall s \right\}.$$

## Theoretical Framework: Farms' Optimization

- The full optimization problem is:

$$\min_h \left\{ qa + rk + w_l l + v' h \mid z_s \leq py + Tr_s \cdot h, y = Aa^\alpha k^\beta l^\gamma, \forall s \right\}.$$

- The Lagrangian is:

$$\mathcal{L} = qa + rk + w_l l + v' h + \sum_s \mu_s [z_s - py - Tr_s \cdot h],$$

where  $\mu_s \geq 0$  are Lagrange multipliers. FOCs are:

$$\frac{\partial \mathcal{L}}{\partial y} = \frac{\partial c(w, y)}{\partial y} - p \sum_s \mu_s = 0 \implies \frac{p}{1+r} = p \sum_s \mu_s \implies \sum_s \mu_s = \frac{1}{1+r},$$

$$\frac{\partial \mathcal{L}}{\partial h_j} = v_j - \sum_s \mu_s tr_{sj} = 0 \implies v_j = \sum_s \mu_s tr_{sj}, \quad \forall j,$$

$$\frac{\partial \mathcal{L}}{\partial \mu_s} = z_s - py - Tr_s \cdot h \leq 0, \quad \mu_s [z_s - py - Tr_s \cdot h] = 0, \quad \mu_s \geq 0, \quad \forall s.$$

## Theoretical Framework: Two Propositions

- A decline in financial assets' acquiring costs ( $v_j = \frac{tr_{sj}}{1+r}$ ) implies an increase in  $r$ , since:

$$\frac{\partial v_j}{\partial r} = -\frac{tr_{sj}}{(1+r)^2} < 0.$$

Rewrite the production function:

$$\frac{y}{l} = A \left(\frac{a}{l}\right)^\alpha \left(\frac{k}{l}\right)^\beta.$$

- **Return to Capital-Labor Ratio:** A decline in  $v_j$  increases  $r$ , reducing  $\frac{k}{l}$ , which increases  $\left(\frac{k}{l}\right)^{\beta-1}$ , thus increasing  $\frac{\partial(y/l)}{\partial(k/l)}$ .

$$\frac{\partial(y/l)}{\partial(k/l)} = A \left(\frac{\alpha w_l}{\gamma q}\right)^\alpha \beta \left(\frac{\beta w_l}{\gamma r}\right)^{\beta-1}.$$

- **Return to Land-Labor Ratio:** A higher  $r$  (from lower  $v_j$ ) reduces  $k$ , lowering  $\frac{\beta w_l}{\gamma r}$ , which decreases  $\frac{\partial(y/l)}{\partial(a/l)}$ .

$$\frac{\partial(y/l)}{\partial(a/l)} = A\alpha \left(\frac{\alpha w_l}{\gamma q}\right)^{\alpha-1} \left(\frac{\beta w_l}{\gamma r}\right)^\beta.$$

## Theoretical Framework: Heterogeneous Effect on Different Sized Farms

Farms are distributed over a fixed land allocation  $\theta \in [\theta_{\min}, \theta_{\max}]$ , with probability density function  $f(\theta)$  satisfying  $\int_{\theta_{\min}}^{\theta_{\max}} f(\theta) d\theta = 1$ . The marginal return to  $\frac{k}{l}$  is:

$$\frac{\partial(y/l)}{\partial(k/l)}(\theta) = A\theta^\alpha \beta \left( \frac{\beta w_l}{\gamma r} \right)^{\beta-1}.$$

The increase in  $\frac{\partial(y/l)}{\partial(k/l)}$  is larger for large farms due to the  $\theta^\alpha$  term, amplifying the effect of the decline in  $v_j$ .

$$\frac{\partial(y/l)}{\partial(k/l)}(\theta) = A\theta^\alpha \beta \left( \frac{\beta w_l}{\gamma r'} \right)^{\beta-1}.$$

The decline in returns to land is larger for large farms, as  $\theta^{\alpha-1}$  is smaller for higher  $\theta$ .

$$\frac{\partial(y/l)}{\partial(a/l)}(\theta) = A\alpha\theta^{\alpha-1} \left( \frac{\beta w_l}{\gamma r'} \right)^\beta.$$

# Empirical Specification: Average Treatment Effects

Baseline empirical model specification is:

$$\ln y_{ct} = b_0 \ln k_{ct} + c_0 \ln z_{ct} + \alpha R_{ct} + \beta R_{ct} \ln k_{ct} + \gamma R_{ct} \ln z_{ct} + u_c + v_t + \varepsilon_{ct}$$

Elasticity of capital (land) intensity before PSBC reform

Fixed effects

$$R_{ct} = BY_{ct} \times LS_{ct}$$

BY(continuous): the number of years since the first PSBC branch was established.

LS(dummy): whether the PSBC branch is allowed to providing the loan services

Main interests: technology progress, capital accumulation or land consolidation

- $y$  - agricultural labor productivity (or  $y/l$ )
- $k$  - capital-labor ratio (or  $k/l$ )
- $z$  - land-labor ratio (or  $a/l$ )
- $R$  - a continuous variables measuring the PSBC reform

## Identification Problem

the PSBC reform might not be randomly assigned across counties:

- We use the Neighborhood Matching Technique (PS match).
- Covariates include Industrial GDP, Fiscal expenditure, and Fiscal income.
- The parallel trend tests are conducted (Imbens, 2015).

There are potential omitted variables (i.e. macroeconomic policies) and reverse causality problem.

- TWFE model with the control of weather conditions, macroeconomic shocks etc.
- The general method of moment (GMM) technique following Arellano and Bond (1991); Blundell and Bond (1998); Wooldridge (2001), and the two stage least square (2SLS) with on a shift-share IV.
- The endogeneity test has been conducted (Lars Peter, 1982).

## Other Econometric Issues

The potential “negative weight” problem:

- Borusyak et al. (2021); De Chaisemartin and d’Haultfoeuille (2020); Goodman-Bacon (2021).
- We use the difference-in-difference estimation developed by Gardner (2022) with multiple time periods.

The heterogeneity effects in treatment across countries and over time.

- Cumulative impact over time/Cross-lagged summation.
- Eventual analyses.

High correlation between capital-labor and land-labor

A series of robustness checks:

- Other measurement of PSBC reform: dummy variable; split the two reforms
- Sub-sample of poverty counties or bread-ban counties
- The impact of the PSBC on off-farm employment.

## Empirical Specification: GRF for Marginal Impacts

**Generalized Random Forest (GRF):** A non-parametric estimation method designed to assess the heterogeneous ATEs (Athey et al., 2019).

We use GRF to analyze and compare how marginal returns to capital and land deepening change alongside agricultural operations scales increase.

- Capital-labor ratio (or  $k/l$ )
- Land-labor ratio (or  $a/l$ )

Following the tree-like structure of the grouping set, we maximize the heterogeneity of target parameters.

$$\max[\Delta(C_1, C_2) : n_{C_1}, n_{C_2}/n_p^2(\hat{\theta}_{C_1}(J) - \hat{\theta}_{C_2}(J))^2]$$

This quantifies the heterogeneous role of capital drainage in affecting agricultural operations of different scales (Carter et al., 2019).

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## Data Source

We construct agricultural production account data

- 1,474 agricultural counties for the 1993-2016 period.

Agricultural inputs and outputs estimation follows Ball et al. (2010):

- **Agricultural value-added output:** total agricultural output value minus total costs of intermediate inputs, deflated by the agricultural PPI.
- **Capital input:** capital services from capital stocks by using the PIM method, including non-residential building and structures, transportation vehicles and other machinery and equipment.
- **Land input:** land services, estimated by using the land rental in real term. A hedonic approach has been adopted.
- **Labor input:** hours worked, and quality adjustment has been made by using the wage of rural labors segregated by different sub-sectors.

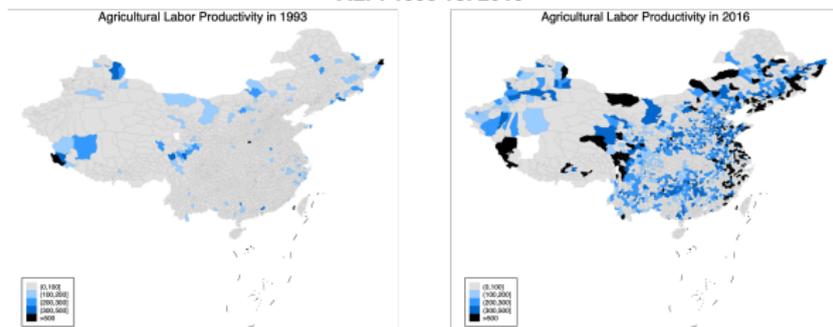
Measures of the PSBC reform

- A dummy variable for branches to provide loans (Beck et al., 2010)
- A continuous variable for years since first branch is established (Wang et al., 2014)

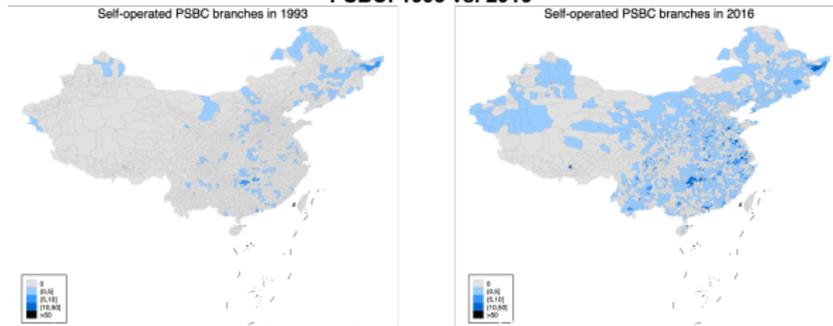
# Data Source

## ALP and PSBC branch distribution: 1993 vs. 2016

### ALP: 1993 vs. 2016



### PSBC: 1993 vs. 2016





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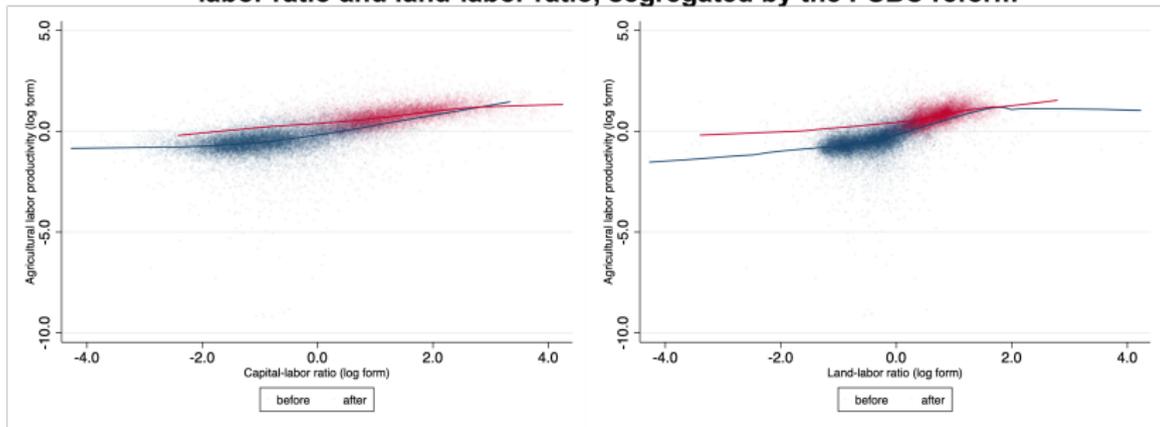
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# Empirical Results

- Pre-requisite Tests
- Impact of PSBC reforms on ALP
- Regression forestry tree: Marginal Impact Analysis
- Robustness checks

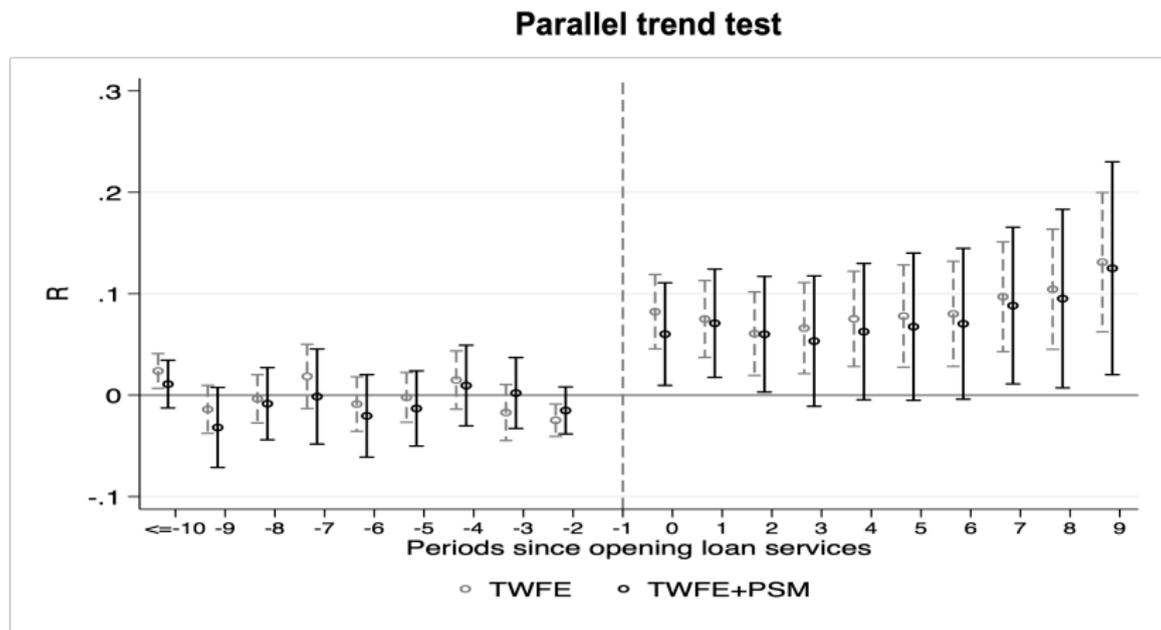
## Empirical Results: Preliminary Tests

**Scatter and LOWESS smoothed regression between ALP and capital-labor ratio and land-labor ratio, segregated by the PSBC reform**



Note: The red line (dots) represents the relationship for the counties that have implemented the PSBC reforms while the the blue line (dots) represents the relationship for the counties that have not. We use the lowess smoothed regression to fit the dots.

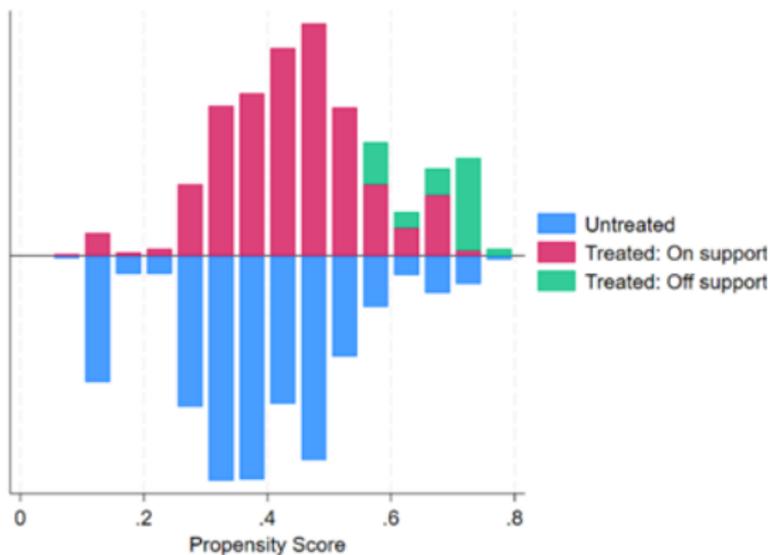
## Empirical Results: Parallel trend Test



Note: we use 9 periods lags and 10 periods leads in this parallel trend test. The estimators can be obtained from the following regression:

$$\Delta \ln l_{ct} = \sum_{j=-10, j \neq -1}^9 \alpha_j \Delta 1\{t - t_R^0 = j\} + b \Delta \ln k_{ct} + c \Delta \ln z_{ct} + \beta \Delta (R_{ct} \times \ln k_{ct}) + \gamma \Delta (R_{ct} \times \ln z_{ct}) + \Delta \nu_t + \Delta \epsilon_{ct}$$

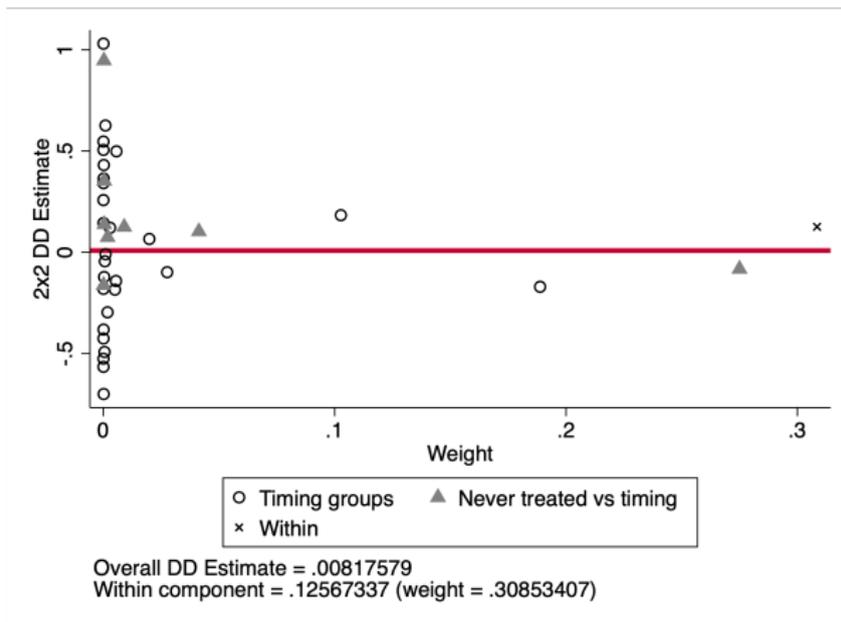
## Empirical Results: Common Support Test



Note: We compare the distribution of two groups based on the PSM match.

# Empirical Results: Negative Weight Test

## Goodman-Bacon Test for “Negative Weights”



Note: the estimate contain a weighted sum of 12,333 ATTS, where 7013 receive a positive weight (57%) and 5320 receive a negative weights (43%).

The sum of the positive weights is 4.578, while the sum of the negative weights is -3.578.

The null hypothesis that the estimated coefficient is comparable with a DGP is rejected at 1%.

# Empirical Results

- Pre-requisite Tests
- Impact of PSBC reforms on ALP
  - ALP effects: technology progress vs. capital/land deepening
  - Capital draining effects vs. return to capital investment
- Regression Forestry Tree: Marginal Impact Analysis
- Robustness checks

# Empirical Results: Impact of PSBC reforms on ALP

|                           | TWFE                 | TWFE                 | TWFE+PSM             | SYS-GMM+PSM         |
|---------------------------|----------------------|----------------------|----------------------|---------------------|
|                           | (1)                  | (2)                  | (3)                  | (4)                 |
| R                         | 0.071***<br>(0.019)  | 0.071***<br>(0.019)  | 0.080***<br>(0.028)  | 0.116**<br>(0.052)  |
| Capital-labor ratio (log) | 0.047***<br>(0.012)  | 0.048***<br>(0.012)  | 0.044**<br>(0.019)   | 0.064**<br>(0.037)  |
| Land-labor ratio (log)    | 0.333***<br>(0.028)  | 0.331***<br>(0.029)  | 0.320***<br>(0.041)  | 0.330**<br>(0.079)  |
| R×capital-labor (log)     | 0.031***<br>(0.008)  | 0.031***<br>(0.008)  | 0.022**<br>(0.011)   | 0.045***<br>(0.019) |
| R×land-labor (log)        | -0.042***<br>(0.007) | -0.042***<br>(0.007) | -0.043***<br>(0.010) | -0.079**<br>(0.022) |
| Self-fiscal (log)         | -<br>(0.017)         | -0.016<br>(0.017)    | 0.002<br>(0.028)     | 0.135**<br>(0.052)  |
| GDP (log)                 | -<br>(0.074)         | 0.057<br>(0.074)     | -0.048<br>(0.123)    | 0.105***<br>(0.045) |
| Rainfall (log)            | -<br>(0.015)         | -0.009<br>(0.015)    | -0.008<br>(0.025)    | -0.034<br>(0.045)   |
| Constant                  | 4.285***<br>(0.042)  | 3.698***<br>(0.862)  | 4.914***<br>(1.435)  | 3.588***<br>(0.712) |
| County fixed effect       | Y                    | Y                    | Y                    | Y                   |
| Year fixed effect         | Y                    | Y                    | Y                    | Y                   |
| R-squared                 | 0.78                 | 0.78                 | 0.77                 |                     |
| Difference-in-Hansen test | -                    | -                    | -                    | 0.000               |
| Number of instruments     | -                    | -                    | -                    | 282                 |
| Observations              | 35160                | 35160                | 15384                | 14102               |

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→ Capital-labor ratio and land-labor ratio takes up nearly 40% .

## Empirical Results: Impact of PSBC reforms on ALP

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| R                         | 0.071***<br>(0.019)  | 0.071***<br>(0.019)  | 0.080***<br>(0.028)  | 0.116**<br>(0.052)  | → Increasing agricultural productivity     |
| Capital-labor ratio (log) | 0.047***<br>(0.012)  | 0.048***<br>(0.012)  | 0.044**<br>(0.019)   | 0.064**<br>(0.037)  |  |
| Land-labor ratio (log)    | 0.333***<br>(0.028)  | 0.331***<br>(0.029)  | 0.320***<br>(0.041)  | 0.330**<br>(0.079)  | ↗ Increasing returns to capital deepening  |
| R×capital-labor (log)     | 0.031***<br>(0.008)  | 0.031***<br>(0.008)  | 0.022**<br>(0.011)   | 0.045***<br>(0.019) |  |
| R×land-labor (log)        | -0.042***<br>(0.007) | -0.042***<br>(0.007) | -0.043***<br>(0.010) | -0.079**<br>(0.022) | ↘ Decreasing returns to land consolidation |
| Self-fiscal (log)         | -                    | -0.016<br>(0.017)    | 0.002<br>(0.028)     | 0.135**<br>(0.052)  |  |
| GDP (log)                 | -                    | 0.057<br>(0.074)     | -0.048<br>(0.123)    | 0.105***<br>(0.045) |  |
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| County fixed effect       | Y                    | Y                    | Y                    | Y                   |  |
| Year fixed effect         | Y                    | Y                    | Y                    | Y                   |  |
| R-squared                 | 0.78                 | 0.78                 | 0.77                 |                     |  |
| Difference-in-Hansen test | -                    | -                    | -                    | 0.000               |  |
| Number of instruments     | -                    | -                    | -                    | 282                 |  |
| Observations              | 35160                | 35160                | 15384                | 14102               |  |

## Empirical Results: Impact of PSBC reforms on ALP

### Estimated impact of the PSBC reform for “negative weights”: TWFE vs. Gardner

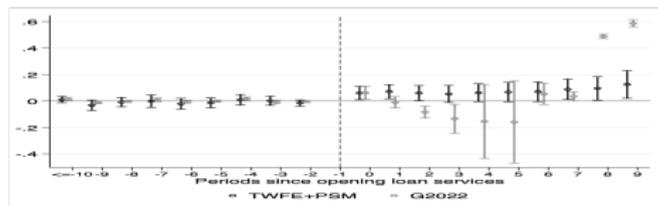
| Panel A. | R               | Std. err | t/z   | Num. of Obs. |
|----------|-----------------|----------|-------|--------------|
| TWFE     | 0.071           | 0.019    | 3.81  | 35160        |
| G2021    | -0.002          | 0.031    | -0.06 |              |
| Panel B. | R×capital-labor | Std. err | t/z   |              |
| TWFE     | 0.031           | 0.008    | 4.17  |              |
| G2021    | 0.017           | 0.008    | 2.22  |              |
| Panel C. | R×land-labor    | Std. err | t/z   |              |
| TWFE     | -0.042          | 0.007    | -5.95 |              |
| G2021    | -0.026          | 0.013    | -1.95 |              |

Note: TWFE refers to the traditional two-way fixed effect approach. G2022 estimator is developed by Gardner (2022). Both control the factors that may affect agricultural TFP.

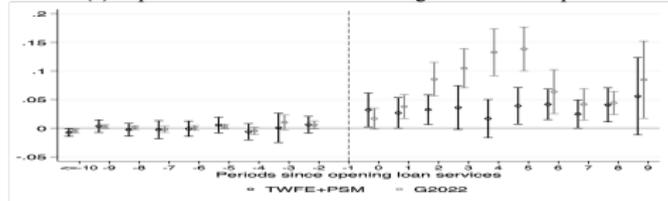
# Empirical Results: Impact of PSBC reforms on ALP

## Event analysis of PSBC reform impact

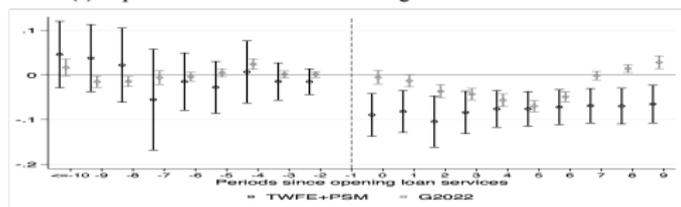
(a) Impact of the PSBC reform on ALP



(b) Impact of the PSBC reform on marginal return to capital-labor ratio



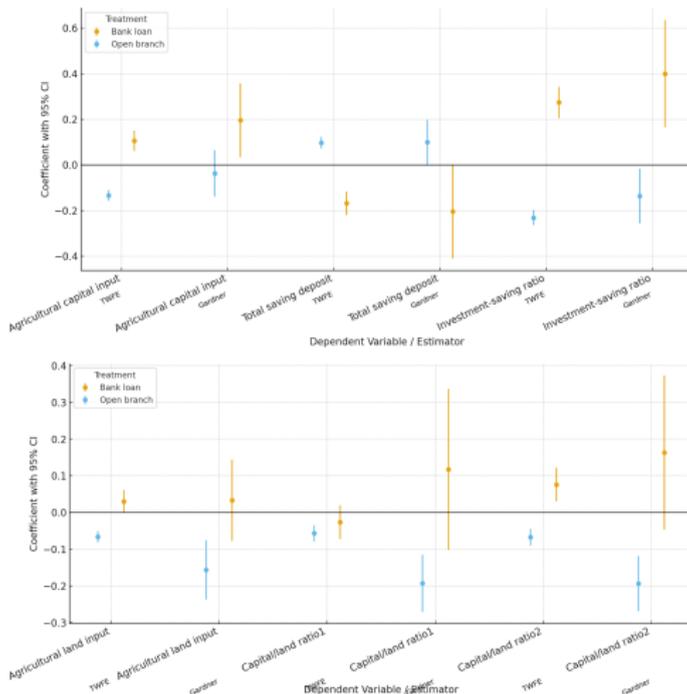
(c) Impact of the PSBC reform on marginal return to land-labor ratio



# Empirical Results

- Pre-requisite Tests
- Impact of PSBC reforms on ALP
- Regression forestry tree: Marginal Impact Analysis
  - Capital draining effects: agricultural investment, bank deposit and land usage
  - Heterogeneous effect by farm size: capital reallocation and land consolidation
- Robustness checks

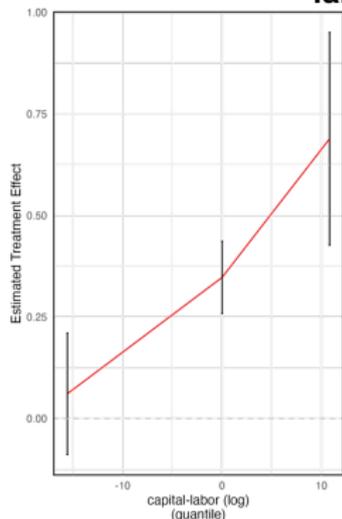
# Empirical Results: Impact on agricultural investment, bank deposit and land input



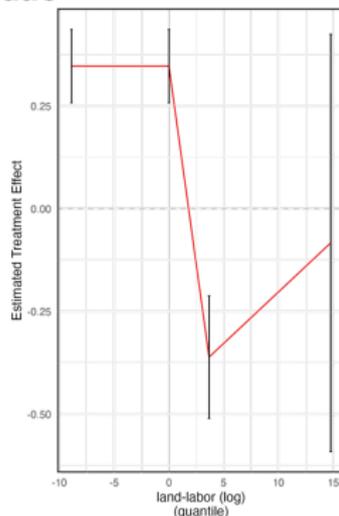
Note: Panel A: estimated coefficients of PSBC branch openings and loan authorization from TWRE and Gardner models. In Panel A, Models (1)-(2) pertain to agricultural capital inputs, (3)-(4) to total savings deposits, and (5)-(6) to the capital/savings ratio. Panel B: estimated coefficients for land use

# Empirical Results: GRF for marginal impact analysis

## Generalized Random Forest Results: capital-labor vs. land-labor ratio



(a) Capital-labor ratio



(b) Land-labor ratio

Note: The black line show the 95% confidence interval and the red point represents the estimated treatment effect. For the figure (a), the black lines represent the effect holding the capital-land labor at 0%, 25% (50%, 75%), and 100% quantile respectively. For the figure (b), the black line represent the effect holding the land-labor ratio at 0%, 25% (50%), 75% and 100% quantile respectively.

# Empirical Results

- Preliminary Tests
- Impact of PSBC reforms on agricultural productivity
- Regression forestry approach: Marginal Impact Analysis
- Robustness checks

## Empirical Results: Robustness Checks

Using two alternative measures of PSBC reforms:

- The dummy for a branch is authorized the loan business.
- The dummy for openness of new branches.

Avoiding the correlation between physical capital-labor ratio and land-labor ratio.

- The correlation is 0.67.
- Construct the ratio between land and physical capital to replace the land-labor ratio.

Restrict the sample to the bread-ban counties and the poverty counties.

Others will be done:

- The counterfactual exercise (e.g., 2003 land reform).
- Restrict sample to counties with more arable land, rural population, etc.

# Empirical Results: Robustness Checks

## Robustness Check Results

|                           | Open a new branch   |                     | Authorize loan business |                      | Loan business with continuous measure |                      | poverty county       | Bread-ban county     |
|---------------------------|---------------------|---------------------|-------------------------|----------------------|---------------------------------------|----------------------|----------------------|----------------------|
|                           | TWFE<br>(1)         | TWFE+PSM<br>(2)     | TWFE<br>(3)             | TWFE+PSM<br>(4)      | TWFE<br>(5)                           | TWFE+PSM<br>(6)      | TWFE+PSM<br>(7)      | TWFE+PSM<br>(8)      |
| R                         | -0.082<br>(0.074)   | -0.089<br>(0.075)   | 0.201***<br>(0.053)     | 0.182**<br>(0.090)   | 0.071***<br>(0.019)                   | 0.080***<br>(0.028)  | 0.072*<br>(0.039)    | 0.062*<br>(0.035)    |
| Capital-labor ratio (log) | 0.089***<br>(0.017) | 0.092***<br>(0.017) | 0.045***<br>(0.012)     | 0.044**<br>(0.019)   | 0.048***<br>(0.012)                   | 0.044**<br>(0.019)   | 0.047*<br>(0.027)    | 0.046**<br>(0.022)   |
| Land-labor ratio (log)    | 0.234***<br>(0.038) | 0.234***<br>(0.038) | 0.329***<br>(0.028)     | 0.325***<br>(0.040)  | 0.331***<br>(0.029)                   | 0.320***<br>(0.041)  | 0.322***<br>(0.057)  | 0.296***<br>(0.050)  |
| R×capital-labor (log)     | -0.044**<br>(0.018) | -0.046**<br>(0.018) | 0.095***<br>(0.022)     | 0.058*<br>(0.033)    | 0.032***<br>(0.009)                   | 0.023*<br>(0.013)    | 0.013<br>(0.013)     | 0.012<br>(0.017)     |
| R×land-labor (log)        | 0.024<br>(0.037)    | 0.027<br>(0.037)    | -0.109***<br>(0.019)    | -0.115***<br>(0.030) | -0.042***<br>(0.007)                  | -0.043***<br>(0.010) | -0.045***<br>(0.016) | -0.035***<br>(0.012) |
| Constant                  | 2.326***<br>(0.822) | 2.345***<br>(0.825) | 3.703***<br>(0.861)     | 4.919***<br>(1.441)  | 3.698***<br>(0.862)                   | 4.914***<br>(1.435)  | 4.097***<br>(0.868)  | 2.756***<br>(0.679)  |
| Controls                  | Y                   | Y                   | Y                       | Y                    | Y                                     | Y                    | Y                    | Y                    |
| County fixed effect       | Y                   | Y                   | Y                       | Y                    | Y                                     | Y                    | Y                    | Y                    |
| Year fixed effect         | Y                   | Y                   | Y                       | Y                    | Y                                     | Y                    | Y                    | Y                    |
| R-squared                 | 0.64                | 0.64                | 0.78                    | 0.77                 | 0.78                                  | 0.77                 | 0.76                 | 0.82                 |
| Observations              | 20510               | 20216               | 35160                   | 15384                | 35160                                 | 15384                | 6480                 | 5520                 |

## Empirical Results: Robustness Checks

Examining the impact of PSBC reform on agricultural labor input and off-farm employment:

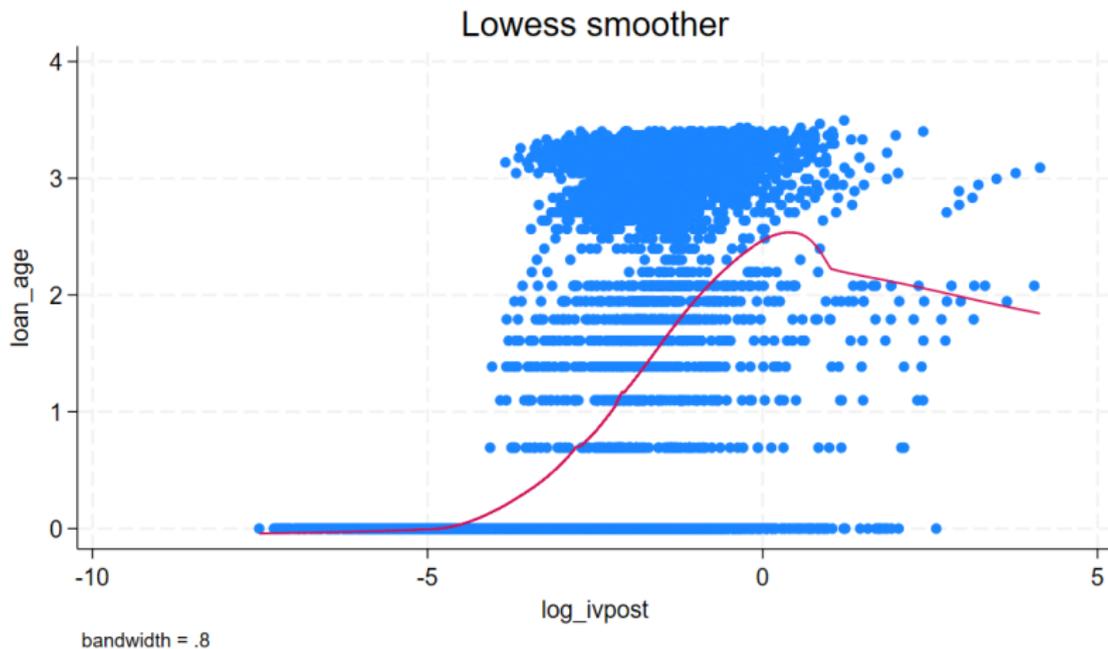
- agricultural labor input
- the ratio of off-farm employment in rural sector
- the ratio of secondary and tertiary employment in total

Introducing the shift-share IV to identify the PSBC reform based on the 2SLS model.

- **Share component:** distance (km) from its geometric centroid to the nearest motorway access point in 1992.
- **Shift component:** postal service per capita and its growth at the provincial level.
- **other IVs:** lagged price for capital and land inputs.

The endogeneity test has been carried out to make the test.

# Empirical Results: Robustness Checks



1 Introduction

2 Background

3 Theory, Model and Method

4 Data Source

5 Empirical Results

6 Conclusions

## Conclusions

This paper examines the role of the PSBC reform in affecting ALP in rural China through technological progress and capital/land deepening.

- A 1% increase in the PSBC reform generates around 11.6% increase in agricultural TFP
- there could be capital drainage effects negatively affecting capital deepening in agricultural production.

With the rigid land institution, the capital drainage effects could reduce the marginal returns to land consolidation.

- The relative larger agricultural operation suffer more from the capital drainage effects.

The findings underscore the potential side-effect of rural financial reforms in generating resource misallocation between agriculture and non-agriculture.

# Questions and Comments

Please contact the author for the full paper if you are interested in.  
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## Empirical Method

Assume that agricultural production function takes the form of a Cobb-Douglas function:

$$Y = AK^bZ^cL^\theta$$

Take the first order condition leading to

$$\ln y = a + b \ln k + c \ln z$$

where ALP is decomposed into three components:

- Technology progress (TFP) affects (a)
- Physical capital accumulation affects (k)
- Land consolidation affects (z)

Let  $R$  represents the shocks caused by the PSBC reform:

$$\ln y = R \ln y(1) + (1 - R) \ln y(0)$$

## Empirical Results: GRF for marginal impact analysis

Generalized Random Forest (GRF) method proposed by Athey et al. (2019) is a non-parametric estimation method designed to assess the heterogeneity of treatment effects.

We use GRF to analyze and compare the marginal impact of the reform by quantiles.

- Physical capital-labor ratio
- Land-labor ratio

Following the goal of the tree-like structure of the grouping set, we maximize the heterogeneity of target parameters.

$$\max[\Delta(C_1, C_2) : n_{C_1}, n_{C_2}/n_P^2(\hat{\theta}_{C_1}(J) - \hat{\theta}_{C_2}(J))^2]$$

Referring to the interpretations in Carter et al. (2019), we can quantify the impact patterns of heterogeneity across capital-labor and land-labor dimensions.