

The causal and moderating effects of land titling on optimizing farm households' income structure

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Abstract: The new round of rural land titling is one of the tasks in deepening rural property rights system reform. Its relationship with farmers' income structure impacts the establishment of a long-term mechanism for increasing farmers' incomes and the achievement of the goal of common prosperity. This paper utilizes panel data from China Family Panel Survey (CFPS) conducted from 2014 to 2022, along with a staggered difference-in-differences (DID) model, to examine the direct effects and moderating mechanisms of land rights confirmation on farm households' income structure. The findings indicate that land titling enhances the concentration of farm households' incomes and optimizes their income structure. The moderating effect analysis reveals that families with members working away from home strengthen the positive impact of rights confirmation on income stability. Therefore, this study provides empirical evidence and policy recommendations for consolidating and expanding the achievements of land titling, improving the rural property rights system, and broadening channels for increasing farmers' incomes.

1. Introduction

Land tenure insecurity is a widespread and significant global issue. Since the 1980s, land tenure certification initiatives led by the World Bank have swept across developing countries as a powerful institutional mechanism for mobilizing rural capital and fostering economic growth^[1]. However, the effectiveness of these policies depends closely on the institutional environment, government implementation capacity, and prevailing property rights practices.

Upholding collective ownership of land, China has continuously clarified and strengthened farmers' land property rights through the household contract responsibility system with remuneration linked to output and separation of rural land ownership rights, contract rights, and management rights^[2]. In 2013, China launched a new round of certification and registration for rural contracted land rights, initiating province-wide pilot programs in 2014 aimed at granting farmers more comprehensive and stable land rights and improving their income levels. China's land reform has not only boosted farmers' enthusiasm but also avoided the risk of land loss caused by privatization.

Given that Chinese farmers' incomes have long been highly dependent on agricultural operations,

resulting in relatively weak resilience to external shocks, whether land titling can optimize the income structure has become a key issue. Regarding the economic effects of land titling, existing literature primarily focuses on how it promotes land transfer^[3,4], labor non-agricultural migration^[5], and alleviation of credit constraints^[6], while examining its impact on farmers' income levels^[7]. However, there is a lack of investigation into the extent of income structure optimization and the boundary conditions of policy effects. Therefore, the marginal contributions of this study are as follows: (1) Using the Herfindahl-Hirschman Index (H) to measure farmers' income concentration and examining the impact of land titling on income structure optimization; (2) Introducing a moderating effect model to identify moderating variables and boundary conditions influencing policy effects. Based on these, we utilize 2014-2022 panel data from CHPS and employ a staggered DID model to identify the causal and moderating effect of land titling on income structure optimization.

2. Theoretical Analysis and Research Hypothesis

2.1. Direct Effect

Land rights certification facilitates land transfer, promotes the shift of labor from agriculture to non-agricultural sectors, and alleviates credit constraints. While reducing agricultural operational income, it significantly increases wage and property incomes. This structural transformation represents an optimization process that aligns with the laws of economic development.

The growth in wage income stems from the shift of labor from low-productivity agricultural sectors to high-productivity non-agricultural sectors, which inherently reflects economic structural upgrading and Pareto improvement. The increase in property income signifies the activation of rural assets and the genuine realization of farmers' property rights, which is a systemic benefit resulting from land's transformation from a single production resource into a multifunctional capital. Although agricultural operational income may decline due to the withdrawal of part-time and small-scale farmers from direct farming activities, the concentration of land among a few specialized large-scale farmers coupled with sustained capital investment may be fostering a more efficient and competitive modern agricultural system. Consequently, the growth rates of wage and property incomes are likely to exceed the decline in operational income, leading to net growth in household total income.

More importantly, this structural change helps enhance the economic resilience of farm households. Compared to agricultural operating income, which is highly dependent on weather conditions, price fluctuations, and market risks, wage income and land rental income are generally more stable and predictable. Consequently, concentrating income sources on non-agricultural earnings enables households to diversify risks more effectively and reasonably, thereby helping to mitigate consumption volatility^[8,9]. Hence, Hypothesis 1 is proposed:

H1: Land titling optimizes farm households' income structure.

2.2. Moderating Effect of Migrant Employment

The legal confirmation of land rights formalizes farmers' land contact rights, alleviates concerns of migrant families about losing their land rights, and reduces the opportunity cost of labor migration. For households already working away from home, this process enables them to confidently lease idle land to professional operators, thereby securing stable wage income while expanding their property revenue through land rent. After land titling, migrant households exhibit greater specialization in labor division and shift their income sources toward non-agricultural earnings. Migrant workers focus their human capital accumulation on non-agricultural sectors to earn higher wages, while local workers leverage comparative advantages to transition from agricultural production to rental income generation or engage in small-scale specialty business, breaking their reliance on agricultural income

alone. Meanwhile, land transfer facilitated by rights confirmation allows migrant households to transfer partial agricultural risks to large-scale operators while using rental income to mitigate total income volatility, enhancing income structure stability. Thus, Hypothesis 2 is proposed:

H2: When family members work away from home, land titling will enhance its impact on improving income structure.

3. Research Design

3.1. Variable Selection

3.1.1. Dependent Variable

This study employs H from industrial organization theory to measure the degree of optimization in farm households' income structure and use it as the dependent variable. The calculation formula is:

$$H = \sum_{i=1}^n s_i^2 \quad (1)$$

Here, s_i denotes the proportion of income from category i relative to total household income (Totinc), while n represents the number of income sources. This study identifies three income sources: operating income (Opeinc), wage income (Waginc), and property income (Proinc). The value of H ranges from 0 to 1, with higher values indicating greater concentration of income sources.

3.1.2. Core Explanatory Variables

The core explanatory variable of this study is whether land rights confirmation has been implemented (Titling), with the year when each province launched a new round of province-wide pilot programs for land titling serving as the policy reference point. The first batch of province-wide pilots began in 2014, covering Shandong, Anhui, and Sichuan; Jiangsu, Jiangxi, Hubei, Hunan, Gansu, Ningxia, Jilin, Henan, and Guizhou were added in 2015; Hebei, Shanxi, Inner Mongolia, Liaoning, Heilongjiang, Zhejiang, Fujian, Guangxi, Chongqing, and Yunnan were included in 2016; and the program was fully rolled out across all remaining provinces in 2017.

3.1.3. Control Variables

This study selects control variables that reflect household head's characteristics and family characteristics. At the household head level, they include age (Age), gender (Gen), marital status (Mar), years of education (Edu), and health status (Hea); at the family level, they include population size (Hsize), number of houses (Housnum), total assets (Totass), and total liabilities (Totdeb). Specifically, Gen is a categorical variable assigned 1 for males and 0 for females; Mar is a categorical variable assigned 1 for married individuals and 0 for unmarried, divorced, or widowed individuals; Hea is a categorical variable ranging from very unhealthy to very healthy, with values from 1 to 5; all other variables are continuous.

3.1.4. Moderating Variables

The moderating variables in this study are migrant employment (Workout) and agricultural insurance coverage (Aipi). Workout is measured by whether any family members work away from home, assigned a value of 1 if present and 0 otherwise; Aipi is measured by provincial agricultural insurance premium revenues.

3.2. Model Construction

3.2.1. Staggered DID Model

The new round of land rights confirmation has been implemented progressively in overlapping phases across different regions and time periods, constituting a classic quasi-natural experiment. Therefore, this study employs a staggered DID model to examine the causal effects of land rights confirmation on various household incomes, with the model constructed as follows:

$$H_{ijt} = \beta_0 + \beta_1 \cdot \text{Titling}_{jt} + \gamma' X_{ijt} + \mu_i + \lambda_t + \epsilon_{ijt} \quad (2)$$

Where H_{ijt} represents the optimization level of income structure for household i in province j during year t ; Titling_{jt} is a dummy variable for the new round of land titling, it takes 1 if province j completes land certification in year t , otherwise 0; β_1 is the net policy effect coefficient, reflecting the causal impact of land titling on income structure; X_{ijt} is the control variable vector, comprising household head's characteristics and family endowments; μ_i and λ_t represent provincial and time fixed effects respectively; ϵ_{ijt} is the random error term.

3.2.2. Moderating Effect Model

To clarify the boundary conditions and enhancement pathways for policy effects of land titling, this paper establishes the following moderating effect model:

$$H_{ijt} = \beta_0 + \beta_1 \cdot \text{Titling}_{jt} + \beta_2 M_{ijt} + \beta_3 \text{Titling}_{jt} M_{ijt} + \gamma' X_{ijt} + \mu_i + \lambda_t + \epsilon_{ijt} \quad (3)$$

Where M_{ijt} is the moderating variable; $\text{Titling}_{jt} M_{ijt}$ denotes the interaction term between the land titling and the moderating variable; β_3 captures the marginal effect of the moderating variable on policy outcomes.

3.3. Data Sources and Descriptive Statistics

Except for agricultural insurance premium income which originates from Yearbook of China's Insurance, all other data are derived from CFPS. The descriptive statistical results are presented in Table 1. Household income sources exhibit a high degree of concentration overall, with significant variations in income structures among different households. There are substantial differences in total household income across households; wage income constitutes the primary source of income, while operation and property incomes account for a small proportion.

Table1: Descriptive statistics.

Variables	Sample size	Mean	SD	Min	Max
H	20145	0.7901	0.2905	0	1
Totinc	20145	10.5472	1.1515	6.9856	12.7367
Opeinc	20145	4.9318	4.4803	0	11.6877
Waginc	20145	7.8301	4.5929	0	12.2061
Proinc	20145	1.3530	2.9808	0	9.9035
Titling	20145	0.5290	0.4992	0	1
Age	20145	47.1352	15.9693	17	80
Gen	20145	0.5013	0.5000	0	1
Mar	20145	2.0676	0.8165	1	5

Edu	20145	6.8701	4.5273	0	16
Hea	20145	4.1712	1.7712	1	7
Hsize	20145	4.2255	2.0113	1	10
Housnum	20145	1.1898	0.4531	1	3
Totass	20145	12.0822	1.2687	8.0067	14.8558
Totdeb	20145	0.3808	1.9506	0	11.2898
Workout	20145	0.7529	0.4313	0	1
Aipi	20145	7.3547	0.7000	6.0886	806611

4. Empirical Analysis

4.1. Benchmark Regression

The optimization of income structure constitutes the essence of high-quality growth in farmers' earnings, fundamentally involving rational concentration of income sources, risk diversification, and sustainable growth rather than mere expansion of total income. To examine the causal effect of land rights certification on optimizing household income structures, we conducted a staggered DID regression (Table 2). The Titling coefficient is statistically significant at the 1% level, indicating that land titling significantly increased income concentration. This finding is highly consistent with China's dual economic transformation characteristics and validates H1.

Table 2: Benchmark regression.

Variables	H
Titling	0.0302*** (0.0091)
Control variables	Yes
Province fixed	Yes
Year fixed	Yes
Cons	1.0411*** (0.0316)
Obs	20145
R ²	0.0440

Note: *p<10%, **p<5%, ***p<1%; standard errors are shown in parentheses, the same below.

4.2. Robustness Test

4.2.1. Parallel Trend Test

A fundamental prerequisite for effectively identifying causal effects using staggered DID models is the parallel trends assumption. This study employs event study methodology to conduct a pre-trend test on the dynamic effects of the new round of land titling (Figure 1). The results demonstrate that coefficients before policy implementation are not statistically significant, with 95% confidence intervals containing 0, indicating that the parallel trends assumption are satisfied.

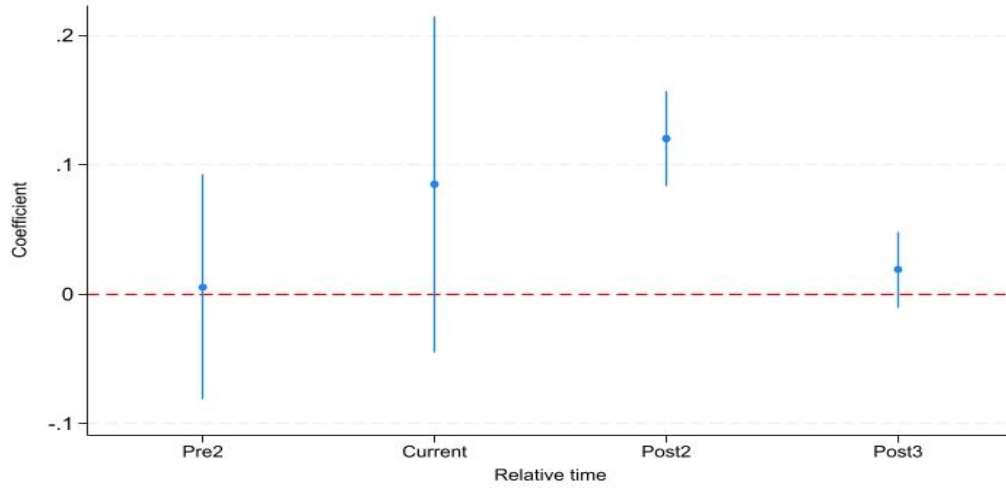


Figure 1: Parallel trend test.

4.2.2. Placebo Test

The benchmark regression model faces unobserved heterogeneity at the household level, common shocks at the village level, and false correlations induced by time trends. To address these issues, this study introduces a treatment group with randomly assigned simulated land tenure status and conducts 500 regressions. The kernel density plot (Figure 2) demonstrates that the pseudo-policy effect is not significant, confirming the robustness of the benchmark regression results.

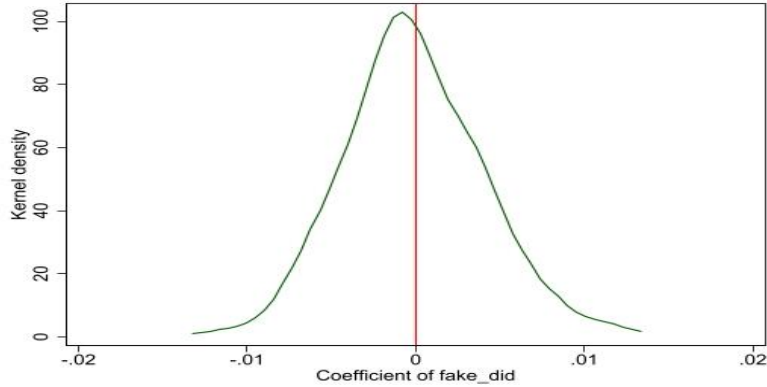


Figure 2: Placebo test.

4.3. Moderating Effect Test

To further clarify the boundary conditions and implementation pathways for the income-enhancing effects of land titling, this study conducts a moderating effect test, with results presented in Table 3. The coefficient of Titling is significantly positive at the 1% level, demonstrating that land certification significantly increases household income concentration. The coefficient of Workout is also significantly positive at the 1% level, indicating that migrant employment itself serves as a primary driver of income concentration. The interaction term coefficient is significantly positive at the 5% level, suggesting that family members working away from home substantially enhances the positive impact of land titling on improving income structure. Therefore, H2 is proved.

Table 3: Moderating effect test.

Variables	(1) H
Titling	0.0322*** (0.0086)
Workout	0.1418*** (0.0090)
Titling_Workout	0.0343** (0.0134)
Control variables	Yes
Province fixed	Yes
Year fixed	Yes
Cons	1.0685*** (0.0319)
Obs	20145
R ²	0.0949

5. Conclusions

Based on the panel data of CFPS from 2014 to 2022, this study employs a staggered DID model to identify the causal effects and mechanisms of the new round of rural land titling on household income structures. The conclusions are as follows: (1) Land titling significantly enhances total household income and increases income concentration and stability; (2) Migrant labor among family members substantially amplifies the income structure optimization effect of land titling.

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