

Article

How Rural Industrial Integration Affects Sustainable Farmers' Income Growth and Agricultural Modernization in China

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Abstract

Promoting rural industrial integration (RII) is crucial for achieving rural revitalization and agricultural modernization. To empirically evaluate the impact of China's Rural Industrial Integration Demonstration Park (RIIDP) policy, this study treated the RIIDP policy as a natural experiment, and implemented a staggered difference-in-differences model (DID) to examine the policy's effects on agricultural modernization and farmers' income. The empirical findings demonstrate statistically significant positive impacts of the policy on farmers' income, yielding an average annual increase of 2.1% (equivalent to 234 CNY) per capita and the income-increasing effect has sustained dynamic characteristics. The mechanism analysis reveals that the policy promotes the upgrading of agricultural industries and the improvement of production methods, realizing agricultural modernization and sustainable income growth. Heterogeneity analysis uncovers nuanced spatial and socioeconomic variations in policy effectiveness. The income-increasing effects prove particularly pronounced in counties characterized by lower educational level and greater fiscal capacity. Regional analysis further identifies stronger treatment effects in western and northeastern regions compared to eastern and central regions, suggesting diminishing marginal returns in more developed areas. This study provides empirical evidence on the efficacy of a major rural policy, which is conducive to achieving sustainable rural economic development. The findings provide practical guidance for agricultural transition economies seeking to advance agricultural modernization and increase farmers' income.

Keywords: rural industrial integration; farmers' income; agricultural modernization; policy effect; sustainable rural economic development



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1. Introduction

As a fundamental underpinning for attaining comprehensive rural revitalization and common prosperity, the sustainable growth of farmers' income has emerged as a critical task imperative in China's modernization agenda [1,2]. In the past decade, Chinese farmers' income has experienced rapid increase. From 2013 to 2023, the per capita disposable income of rural residents rose from 9430 CNY to 21,691 CNY, with an average annual growth rate of 8.69% (source: National Bureau of Statistics, <https://www.stats.gov.cn/sj/>). Driven by the 78.1% growth in agricultural output value, this income growth has delivered tangible benefits to rural households, yet its long-term sustainability is increasingly challenged by

the structural transformation of the national economy and the accelerated evolution of urban–rural relations [3]. These systemic constraints manifest as three interrelated challenges: diminishing income growth momentum, persistent concentration of low-income populations, and escalating regional income disparities [4,5]. These challenges are not exclusive to China, but reflect a common developmental dilemma for many developing countries: how to foster the sustainable transformation of traditional smallholder-based agrarian economies amid rapid urbanization and industrialization. Thus, it is imperative to explore new growth paths and drivers to ensure the sustainable growth of farmers' income.

Rural industrial integration (RII) has been recognized as a critical pathway to promote the sustainable socioeconomic development of rural areas, with extensive practices being implemented globally [6–10]. Since 2015, the Chinese government has prioritized RII as a strategic policy to address structural challenges in rural industrial development [11]. This approach is designed to pursue three objectives: diversifying sustainable income-generation channels for rural households, establishing a modern agricultural system, and developing a distinctive agricultural modernization pathway [12,13]. Characterized by technological convergence, factor agglomeration, and market interconnectivity, this organizational innovation has demonstrated transformative potential in restructuring industrial frameworks, overcoming spatial constraints, and optimizing production modalities [14], which are essential for building a sustainable rural economic development model.

Current research on RII can be roughly categorized into three main strands. Firstly, the connotations and conceptual definition of RII have been discussed. Most scholars define RII as a process of organic integration of agricultural production, agricultural product processing and agriculture-related services [8,15]. Other discussions, from industrial chain integration, hold that RII encompasses both the vertical integration of the entire agricultural industrial chain and the horizontal integration of multi-form and multi-sector compound operation, and it serves as a bond of an interest linkage mechanism [16–18]. Secondly, the development level of RII has been measured from a macro perspective. At present, the mainstream idea to build a relevant evaluation index system. Hao et al. (2023) measured the level of RII across China and analyzed the temporal variation trend [19]. Bao et al. (2024) investigated the spatio-temporal differentiation of RII within the Inner Mongolia counties in China [11]. Thirdly, the economic benefits of RII, especially its role in rural development and farmers' income, have attracted the attention of scholars, but the conclusions are clearly divided. A substantial body of empirical evidence supports the view that RII generates positive effects. For example, it has improved agricultural employment quality [20], directly increased farmers' disposable income [21], stimulated rural consumption demand [7], and narrowed the urban–rural income gap by promoting inclusive growth [22]. However, another line of research contends that the effectiveness of RII may encounter significant challenges [23,24]. Scholars have offered several explanations for this observed divergence in outcomes. Some attribute it to inadequate benefit-sharing mechanisms, which hinder smallholders from capturing value-added gains [25]. Others highlight a mismatch between integration models and local industrial foundations [26], or point to insufficient complementary investments and financial support from local governments [27].

Although the existing research has made significant progress in both the theoretical and empirical domains, there are critical limitations. Firstly, the existing literature on the impact of RII on farmers' income is characterized by mixed evidence and divided conclusions, indicating that a scholarly consensus remains elusive. Secondly, most existing studies measure the generalized RII development level by constructing an evaluation index system and explore its impact on farmers' income, with few assessing the effect of specific RII policies. Thirdly, most of the current studies are analyzed with provinces and cities as spatial units, which may mask regional differences. In conclusion, there is a lack of

comprehensive research conducted from a county-level perspective and even fewer studies assess the effect of specific rural industrial development policies. To address the limitations and provide more conclusive evidence, this study introduces key innovations in three areas: First, it aims to expand the research on the economic effects of RII by evaluating the specific policy effects of the RIIDP policy, highlighting new evidence from RIIDPs in enhancing agricultural modernization and farmers' income. Second, in research design, we construct a novel ten-year panel dataset covering 1430 Chinese counties and treat the RIIDP policy as a quasi-natural experiment. This approach enables identification of the RIIDP policy's effect, accounts for its phased rollout, and enables the analysis of dynamic treatment paths and effect heterogeneity. Third, from an analytical perspective, we shift the focus from provincial or municipal levels to the county level. The county is the fundamental administrative unit for implementing rural development policies in China. It captures local variations in resource endowments, industrial structure, and policy execution and it aligns with the scale at which the RIIDP policy is designated and operates. Provincial-/municipal-level data averages out significant disparities in resource endowments, fiscal capacity, and industrial bases across counties. County-level analysis enables the identification of such heterogeneous effects, allowing for a more precise matching between policy intervention and its observed outcomes. Furthermore, we systematically examine the heterogeneity of policy effects across geographical regions and socioeconomic dimensions. This provides mechanistic and contextual explanations for why and under what conditions the policy is effective.

2. Policy Background, Theoretical Analysis and Research Hypotheses

2.1. Policy Background

The Central Rural Work Conference held in December 2014 formally advocated introducing modern industrial frameworks such as supply chains and value chains into agricultural systems to facilitate cross-sector integration among primary, secondary, and tertiary industries. This declaration marked the inaugural articulation of tri-sector integration as a national rural policy. Subsequently, the 2015 *Central No. 1 Document* became the first policy blueprint to explicitly mandate “advancing rural tri-sector convergence to enhance farm household incomes.”. Complementing this directive, the State Council General Office issued the *Guiding Opinions on Promoting Rural Tri-Sector Integration* in the same year, establishing efficiency enhancement, income growth, and rural prosperity as core implementation objectives. In the following nine years, the *Central No. 1 Document* has consistently emphasized industrial integration as a pivotal strategy for optimizing agricultural supply systems, diversifying agricultural functions, expanding income-generation avenues, and operationalizing rural revitalization initiatives [11]. To accelerate the integration of the primary, secondary and tertiary industries in rural areas, the National Development and Reform Commission, working jointly with six other departments, issued the *Implementation Plan for Developing National Rural Industrial Integration Development Demonstration Parks* in 2017. The main goal was to establish 300 demonstrative RIIDPs by 2020, achieving multi-pattern integration and multi-type demonstration. Subsequently, 374 county-level units were designated for RIIDPs in 2017, 2019, and 2021 [7]. The construction and operation of RIIDPs rely on the joint input of public fiscal investment and private social capital, with the NDRC and local finance departments setting clear investment standards: the total central investment received by each RIIDP during the construction phase shall not exceed 40 million yuan (approximately 5.8 million US dollars), which will be allocated over two years, and local governments match fiscal funds in a ratio of no less than 1:1, which is mainly used for the construction of public infrastructure and public service platforms in the parks. The geographical locations of the national RIIDPs are shown in Figure 1.

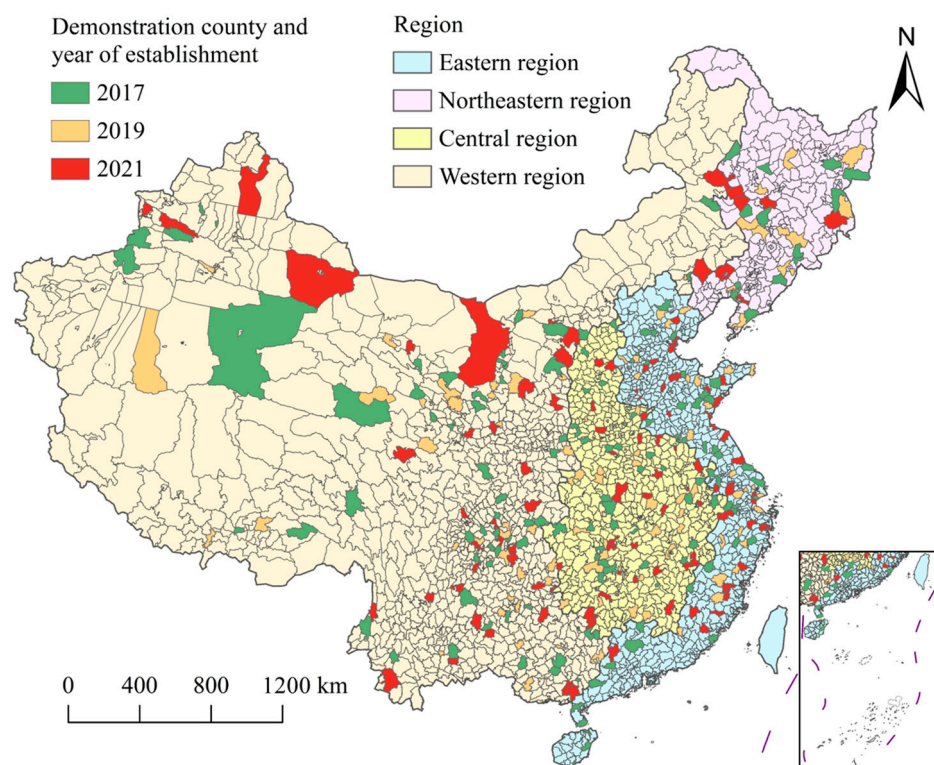


Figure 1. Spatial distribution of national RIIDPs in China (the eastern region includes Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan; the central region includes Shanxi, Anhui, Jiangxi, Henan, Hubei, and Hunan; the western region includes Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang; the northeastern region includes Liaoning, Jilin, and Heilongjiang).

Types of RIIDP mainly fall into four categories: the industrial chain extension type, the internal integration type, the multi-functional expansion type and the technology penetration type. (1) Industrial chain extension type. This mode is the core form of vertical integration of the agricultural industry chain in RIIDPs. Taking characteristic agricultural products as the core, agricultural enterprises in the park extend upstream and downstream of the industrial chain, integrating agricultural primary production with secondary processing and tertiary circulation and sales. For example, in the Shouguang RIIDP (Shandong Province), agricultural leading enterprises and cooperatives drive small farmers to carry out standardized vegetable planting and extend the industrial chain to vegetable deep processing and online sales, which is a typical practice of this mode in RIIDPs. The core value of this mode is to help farmers capture the value-added benefits of the downstream industrial chain, which is the main path for the RIIDP policy to realize an increase in farmers' income. (2) Multi-functional expansion type. This mode is the main form of horizontal integration in RIIDPs. Based on agricultural resource endowments, the enterprises in the park integrate agriculture with rural tourism, cultural creativity, health care and other industries, and develop composite formats such as agritourism, pick-your-own farms, rural homestays and agricultural cultural parks. This mode is mainly distributed in RIIDPs close to central cities or with unique ecological and cultural resources. It can enhance the efficiency of resource utilization, give rise to new business forms, and increase effective supply to meet peoples' diverse demands. (3) Internal integration type. Taking agricultural advantageous resources as the foundation, family farms and cooperatives in the park connect planting, breeding, fishery and other sub-industries of agriculture, and construct a circular industrial system such as "pig–biogas–rice", "pig–biogas–vegetables" and "planting–breeding–processing–energy recycling". This mode can save production

costs, improve resource utilization efficiency and produce positive environmental externalities. For example, the Chifeng RIIDP (Inner Mongolia Autonomous Region) takes corn planting and beef cattle breeding as the core, and constructs a circular industrial chain of “corn planting → beef cattle breeding → manure biogas production → organic fertilizer recycling to corn fields”, which is a typical application of this mode in major grain-producing areas and ecological protection key areas. (4) Technology penetration type. The enterprises in the park adopt advanced information technology, internet technology and agricultural production technology to improve agricultural production and transaction efficiency. The most representative practice is the popularization of agricultural e-commerce in RIIDPs—agricultural leading enterprises and cooperatives build online sales platforms to connect small farmers with the big market, which is the main embodiment of the technology penetration type in RIIDPs.

2.2. Theoretical Analysis and Research Hypotheses

2.2.1. The Effect of RIIDPs on Agricultural Modernization and Farmers' Income

The RIIDP policy exerts its influence on agricultural systems via a multi-level transmission mechanism: policy intervention → agricultural modernization → function enhancement → increase of farmers' income (Figure 2). Fundamentally, agricultural modernization is a transformative shift from traditional to modern, high-efficiency agricultural models, featuring industrial structural upgrading, technological advancement and productivity gains [17]. It represents a systemic upgrade of the entire agricultural industrial chain rather than fragmented improvements to individual production links, breaking the constraints of traditional agriculture, which is limited to primary production, low in value-added gains and highly vulnerable to market and natural risks [18,28].

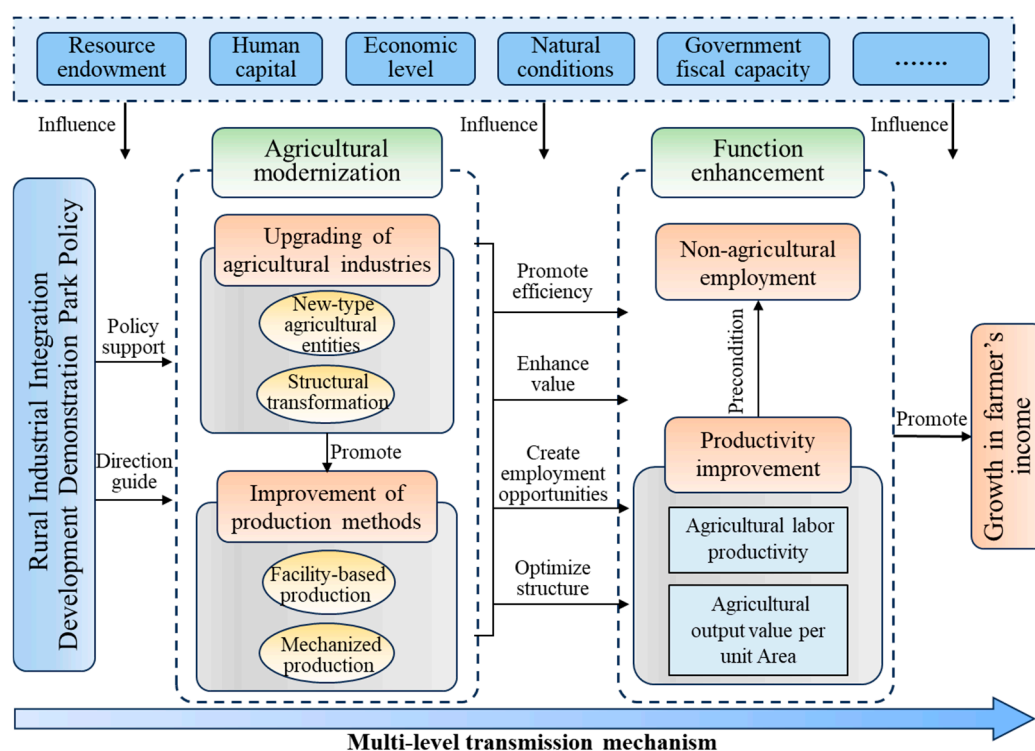


Figure 2. Multi-level transmission mechanism of RIIDP effects.

In advancing agricultural industrial upgrading, the RIIDP policy drives agriculture's vertical extension into upstream and downstream sectors, fostering an integrated development model of agriculture combined with secondary and tertiary industries, which aligns

with the industrial structure diversification requirement of agricultural modernization. It enables local agricultural product processing and the development of agriculture-related services, helping rural economies capture more value-added benefits previously lost to external downstream sectors, boosting rural economic value-creation capacity, enhancing risk diversification through industrial diversification and expanding agriculture's economic functions [16]. In optimizing production methods, the RIIDP policy accelerates the adoption of mechanization and facility-based agriculture [29,30], realizing capital and technology substitution for traditional manual labor, improving agricultural resource utilization efficiency, cutting production costs [31] and driving agriculture's shift from an extensive, factor-input-dependent model to an intensive, efficiency-driven one [32] (Figure 2).

Building on this mechanism, agricultural modernization boosts farmers' income through two paths: production-efficiency-driven agricultural income growth and non-agricultural employment-driven wages or asset income growth. First, RIIDPs address traditional agriculture's flaws of insufficient capital, low value-added outputs and concentrated risks [33,34] via industrial restructuring and cultivating new agricultural business entities [17,35,36], forming a full industrial chain that broadens market opportunities, enhances value-added benefits and strengthens risk resistance [17,36], while creating non-agricultural jobs to absorb surplus rural labor [37]. New agricultural entities provide advanced technologies [10,17] and facilitate large-scale production and modern technology adoption [29], and farmers gain higher benefits via interest linkage mechanisms through employment and asset transfer [10]. Second, RIIDPs tackle small-scale farmers' low adoption of advanced technologies [6,34] by promoting modern production technologies and patterns. Mechanization reduces unit input and costs [29,31], improves resource efficiency [27,32], liberates rural labor for non-agricultural sectors and increases wage income [38], while facility-based production enhances resource utilization efficiency and agricultural disaster resistance [30].

Based on the above analysis, we propose the following hypotheses:

Hypothesis 1: *RIIDPs significantly improve agricultural modernization.*

Hypothesis 1a: *RIIDPs significantly improve the upgrading of agricultural industry.*

Hypothesis 1b: *RIIDPs significantly promote the improvement of production methods.*

Hypothesis 2: *RIIDPs significantly promote the growth of farmers' income.*

2.2.2. Theoretical Basis for Heterogeneity Effects

China's regional development imbalance is a prominent reality. Existing studies have confirmed that regional resource endowments and development bases significantly affect farmers' income [1,39]. Such differences also directly affect the implementation path and effect of the RIIDP policy. Drawing on theories of regional development and institutional economics, the policy's effectiveness will vary systematically with geographical region, human-capital endowment, and local government fiscal capacity.

Firstly, regional heterogeneity is anticipated due to pronounced disparities in developmental stages, factor endowments, and agricultural structures across China. Agricultural modernization exhibits substantial regional variation within the country. Eastern and central regions generally demonstrate higher levels of mechanization, greater industrial diversification, and better market access. The eastern region benefits from industrial agglomeration and urban–rural integration, which provide farmers with more diverse non-agricultural income channels. The central region serves as a major agricultural production base with a solid foundation in crop cultivation, though industrial extension remains relatively underdeveloped. In contrast, the western and northeastern regions remain dominated by traditional agricultural practices, operate from a lower baseline of

modernization [33], and rely heavily on agriculture with relatively backward production methods, resulting in a strong latent demand for industrial upgrading [5]. These structural differences are likely to generate divergent marginal returns for RIIDPs across regions.

Secondly, as the primary agents of agricultural production, human capital shapes farmers' capacity to adopt modern technologies and participate in industrial integration [40]. However, within the context of policy-driven industrial integration that creates diversified, often mid-skill employment opportunities, its moderating role may be nuanced. In areas with lower educational attainment, RIIDP may provide crucial access to new forms of non-agricultural employment that were previously unavailable, thereby producing a pronounced income effect. Conversely, in areas with higher human capital, the policy's marginal effect tends to be more limited, either because comparable opportunities already exist or because the local workforce shows a stronger orientation toward industries requiring more advanced skills.

Thirdly, government fiscal capacity constitutes a critical enabling condition for effective policy implementation. A successful RIIDP depends on complementary public investments in infrastructure, industrial guidance, and sustained policy support [21,41]. Counties with stronger fiscal capacities are better positioned to supply these essential public goods, execute the policy more effectively, leverage matching funds, and attract private investment, all of which could amplify the treatment effect of the intervention.

Hypothesis 3a: *The income-increasing effect of RIIDPs is more significant in the western and northeastern regions.*

Hypothesis 3b: *The income-increasing effect of RIIDPs is more significant in lower-human-capital areas.*

Hypothesis 3c: *The income-increasing effect of RIIDPs is more significant in stronger-fiscal-capacity areas.*

3. Data and Methods

3.1. Data Sources and Processing

The data sources for this paper are as follows: First, the lists of counties created by the National Rural Industry Integration Development Demonstration Park policy and the lists of pilot counties in which individuals can return to their hometown to start a business are from the official website of the National Development and Reform Commission (<https://www.ndrc.gov.cn>). The lists of national-level poverty counties and demonstration counties for rural tourism are from the website of the Ministry of Agriculture and Rural Affairs (<https://www.moa.gov.cn>). The lists of e-commerce demonstration counties in rural areas are from the Ministry of Commerce (<https://www.mofcom.gov.cn>). The lists of integrated urban–rural transportation demonstration counties are from the Ministry of Transport (<https://www.mot.gov.cn>). The level of digital finance is derived from the county-level Digital Inclusive Finance Index compiled by Peking University (<https://idf.pku.edu.cn/index.htm>, accessed on 23 February 2025). Second, the data on the per capita disposable income of rural residents and the level of counties economic development mainly come from the *China County Statistical Yearbook* (County and City Volume), the *China County (City) Socio-Economic Statistical Yearbook*, as well as the CSMAR economic research county database (<https://data.csmar.com>, accessed on 23 February 2025). Third, the demographic characteristics data, such as the average number of years of education per county, are from the County-Level Data of the 2010 *National Population Census* released by the Sixth National Population Census in 2010. Lastly, the number of new enterprises is from the National Enterprise Credit Information Publicity System database (<https://www.gsxt>).

gov.cn). Interpolation methods were employed to supplement a small amount of missing data and the samples with significant data gaps were excluded. Ultimately, the panel data covers 1430 counties from 2013 to 2022, resulting in a total of 14,300 observations.

3.2. Variable Definitions

3.2.1. Explained Variable

Rural residents' income is the core variable examined in this study. This paper employs the per capita disposable income of rural residents as the index for the explanatory variable. Taking 2013 as the base period, the income was balanced using the consumer price index of each province to eliminate changes caused by the long-term trend, and the natural logarithm was further taken.

3.2.2. Explanatory Variable

To advance tri-industry integration in rural regions, the National Development and Reform Commission selected three batches of counties for the establishment of RIIDPs at the end of 2017, in June 2019, and in March 2021, respectively. The recognition of these demonstration park counties was completed in 2019, 2020, and 2022. Therefore, counties selected for RIIDPs were used as a proxy variable for the policy, with the years of establishment set as 2018, 2019, and 2021. Specifically, if a county was designated as a demonstration park county in a given year, the variable was assigned a value of 1 for that year and the following years; otherwise, the value was 0.

3.2.3. Control Variables

The effects of policy implementation are often influenced by numerous external factors. To enhance the accuracy of model estimation, some non-model variables need to be controlled. Following the previous literature [17,21] and considering data availability, the variables concerning economic development, human capital and government power were incorporated as control variables. Detailed descriptions of these variables are presented in Table 1.

Table 1. Descriptive statistics of main variables.

Variable	Variable Description	Obs.	Mean	SD
Panel A: The counties not selected as rural industry integration development demonstration counties				
Rural famers' income	Per capita disposable income of rural residents (10,000 CNY)	12,170	12,442.39	5141.25
RIIDP	Whether the county was selected as a rural industry integration development demonstration county: Yes = 1, No = 0	12,170	0	0
Economic development	GDP/population (10,000 CNY)	12,170	41,750.91	30,001.80
Share of secondary industry	Secondary industry value/GDP (%)	12,170	0.403	0.145
Share of tertiary industry	Tertiary industry value/GDP (%)	12,170	0.418	0.108
Government financial capacity	General public budget expenditure/GDP (%)	12,170	0.269	0.194
Financial level	Financial institution loan balance/GDP (%)	12,170	0.792	0.437
Savings level	Residents' savings deposits/population (CNY/person)	12,170	31,910.67	17,205.78
Population density	Population/region area (%)	12,170	0.032	0.033
Human capital	The number of students in secondary schools/population (%)	12,170	0.054	0.017

Table 1. Cont.

Variable	Variable Description	Obs.	Mean	SD
Panel B: The counties selected as rural industry integration development demonstration counties				
Rural farmers' income	Per capita disposable income of rural residents (10,000 CNY)	2130	13,508.95	5220.029
RIIDP	Whether the county was selected as a rural industry integration development demonstration county: Yes = 1, No = 0	2130	1	1
Economic development	GDP/population (10,000 CNY)	2130	45,774.29	30,702.94
Share of secondary industry	Secondary industry value/GDP (%)	2130	0.411	0.137
Share of tertiary industry	Tertiary industry value/GDP (%)	2130	0.408	0.094
Government financial capacity	General public budget expenditure/GDP (%)	2130	0.224	0.149
Financial level	Financial institution loan balance/GDP (%)	2130	0.793	0.419
Savings level	Residents' savings deposits/population (CNY/person)	2130	32,967.77	18,130.57
Population density	Population/region area (%)	2130	0.032	0.023
Human capital	The number of students in secondary schools/population (%)	2130	0.053	0.016
Mechanism variables				
Agricultural industrial structure	Total output value in agricultural services/total output value of agriculture (%)	6203	0.056	0.076
New enterprises	Number of newly established agriculture-related enterprises (count)	14,300	3530.25	3307.58
Facility-based production	Area of facility agriculture (ha)	13,905	1579.76	4220
Mechanized production	Total agricultural machinery power (10,000 kW)	14,157	49.44	44.45
Agricultural labor productivity	Total output value in agriculture/number of agricultural labor (10,000 CNY/person)	5459	5.76	10.46
Agricultural output value per unit area	Total output value in agriculture/cropland area (10,000 CNY/1000 ha.)	4412	0.835	1.335
Non-agricultural employment	1-the amount of agricultural labor/the amount of rural labor	3581	0.456	0.175

Notes: To ensure meaningful descriptive statistics, the variables for rural farmers' income, economic development level, savings level, number of new enterprises, total agricultural machinery power, and area of facility agriculture, are presented in their original values. However, in the subsequent regression analysis, the logarithmic transformation of these variables was applied.

3.2.4. Mechanism Variables

This study holds that the impact of RIIDPs on agricultural systems manifests through a multi-level transmission mechanism, progressing along the pathway of "RII → agricultural modernization → function enhancement → farmers' income growth". Agricultural modernization is the core intermediary of this mechanism, which is divided into two measurable dimensions in this study: agricultural industrial upgrading and agricultural production method improvement. Agricultural industrial upgrading is reflected in the optimization of agricultural industrial structure and the cultivation of new agricultural operation entities (new enterprises), which realizes value-added outputs of agricultural products by extending the industrial chain and enriching industrial forms; agricultural production method improvement is embodied in the popularization of mechanized production and facility-based production, which improves agricultural production efficiency by reducing production costs and optimizing resource allocation.

Upgrading of agricultural industries. This study characterized the upgrading status of the agricultural industrial structure from the changes in the agricultural production structure and the number of new agricultural enterprises. Industrial structure transformation was measured by the ratio of total output value in agricultural services to the

total output value of agriculture. New enterprises were measured by the logarithm of the total number of newly registered enterprises and individual businesses in agriculture and related industries within each county for the year [42].

Agricultural production methods. This study examined two aspects, mechanized production and facility-based production. The level of mechanized production was measured by the logarithm of total agricultural machinery power, and the level of facility-based production was measured by the logarithm of the area of facility agriculture.

Agricultural productivity. This study described the status of agricultural production efficiency from the aspects of per capita agricultural output value and per land output value. The level of agricultural labor productivity was measured by the ratio of agricultural product added value to the amount of agricultural labor. Agricultural output value per unit area was measured by the ratio of total output value in agriculture to cropland area.

The non-agricultural employment of farmers was measured by the ratio of the non-agricultural labor force to rural labor force.

3.3. Model Specification

3.3.1. Staggered Difference-in-Differences (DID) Model

RIIDP selection is a top-down, centralized process led by the National Development and Reform Commission (NDRC). As clarified in the *Implementation Plan for Developing National Rural Industrial Integration Demonstration Parks* (National Development and Reform Commission, 2017), RIIDP selection follows explicit, publicly available criteria, which cannot be influenced by the outcomes of the policy itself. This design guarantees quasi-randomness in treatment assignment. The criteria were publicly issued in policy documents (NDRC, 2017) and applied consistently across 31 provinces. Counties had no discretion to manipulate their characteristics or choose to participate based on unobservable growth potential, they could only apply passively according to pre-defined rules. The final list was determined by multi-level expert evaluation and central review, not by local economic performance or income growth expectations. To empirically assess the income-increasing effects of RIIDPs, this paper uses the establishment of RIIDPs as a quasi-natural experiment. The counties with demonstration parks were selected as the treatment group, while others serve as the control group. Given that the establishment of demonstration parks was rolled out in a phased manner, this paper employs a staggered difference-in-differences (DID) model to assess the policy's effect on farmers' income. The baseline regression model is constructed as follows [43,44]:

$$\ln(\text{Income}_{it}) = \alpha_1 + \beta_1 \text{Policy}_{it} + \gamma_{1n} X_{it} + \delta_t + \mu_i + \varepsilon_{it} \quad (1)$$

Here, $\ln(\text{Income}_{it})$ denotes the logarithm of the per capita disposable income of rural residents, i and t denote the county and year, respectively, Policy_{it} denotes the core explanatory variable concerned in this study, representing the RIIDP. X_{it} is the control variable that affects farmers' income, including economic development level, industrial structure, government size, financial development level, savings level, population density, education level and other variables. β_1 is the most concerned coefficient in this paper, representing the influence of policy on farmers' income. If $\beta_1 > 0$, this implies that the policy contributes positively to income growth; otherwise, it has a negative effect. γ_{1n} is a coefficient matrix of control variables; ε_{it} is a random interference term; δ_t is the fixed effect of time; μ_i is the fixed effect of each county (county-level), used to control the effects of environmental factors that do not change over time at the county level and the same macro-impact factors that affect all counties; α_1 is a constant term. To address potential correlations in idiosyncratic shocks within the same county, this paper clusters standard errors at the county level.

Equation (1) preliminary estimates the effect of the policy on farmers' income. Here, it is important to note that the selection of demonstration parks may be related to the basic characteristics of county-level industrial integration. These factors may change over time and have an impact on farmers' income. Therefore, to mitigate potential selection bias, on the basis of Equation (1), further controlled the total output value of agriculture of each county in 2016, whether it is a national-level poverty-stricken county, whether it is a pilot demonstration county and the interaction item of time trends [45], in order to control the original characteristics that affect whether a county is selected as a demonstration park for the integrated development of its industries [46,47]. Additionally, to control the provincial-level policy effects that change over time, interaction terms between provinces and years are included in the model. The specific model is set as follows:

$$\ln(\text{Income}_{it}) = \alpha_2 + \beta_2 \text{Policy}_{it} + \gamma_{2n} X_{it} + [X_j f(t)]' \theta + \delta_t + \mu_i + \lambda_{\text{province}} \delta_t + \varepsilon_{it} \quad (2)$$

Here, X_j denotes the characteristics of the county, including the total output value of the agriculture of each county in 2016, whether it is a national-level poor county, and whether it is a pilot demonstration county for industrial integration. $f(t)$ denotes the time trends. $\lambda_{\text{province}}$ denotes the fixed effect of province. β_2 is the effect of policy on farmers' income. γ_{2n} is a coefficient matrix of control variables. The other symbols have the same meaning as in Equation (1).

To further examine the channels through which RIIDPs contribute to increasing farmers' income, based on Equation (2), the model for mechanism analysis is set as follows:

$$M_{it} = \alpha_3 + \beta_3 \text{Policy}_{it} + \gamma_{3n} X_{it} + [X_j f(t)]' \theta + \delta_t + \mu_i + \lambda_{\text{province}} \delta_t + \varepsilon_{it} \quad (3)$$

Here, M_{it} are mechanism variables, and other symbols have the same meaning as Equation (2).

3.3.2. Parallel Trend Test

The DID estimation requires that the parallel trends assumption be satisfied first. This means that prior to the implementation of the RIIDP policy, there should be no significant differences or trends in income between the treatment group and control group. If farmer income in the treatment group had a relatively obvious changing trend before the policy, and this trend did not change with the implementation of the policy, then the change in income may primarily be driven by pre-existing disparities between the treatment group and control group. This paper employs an event study approach to construct the following dynamic model for examining the policy's dynamic effects [48].

$$\ln(\text{Income}_{it}) = \alpha_3 + \sum_{k=-5}^{-1} \eta_k A_k + \sum_{k=0}^4 \phi_k B_k + \gamma_{3n} X_{it} + [X_j f(t)]' \theta + \delta_t + \mu_i + \lambda_{\text{province}} \delta_t + \varepsilon_{it} \quad (4)$$

Here, A_k and B_k denote the dummy variables in the k years before and after the policy respectively, in which the fifth year and all pre-policy periods are merged into a single five-year pre-policy window. η_k and ϕ_k denote the income differences of rural residents in the k years before and after the policy between the counties where an RIIDP was established and the counties where a demonstration park was not established. All other variables retain the same definitions as in the baseline Equation (2).

4. Results

4.1. The Effect of RIIDP on the per Capita Disposable Income of Rural Residents

4.1.1. Results of Benchmark Regression

Table 2 shows the benchmark regression results for the effect of RIIDP on farmer income. Column (1) shows the results in the absence of the control variables. The coefficient of the policy is 0.010, significant at the 5% level, indicating that the policy has a positive effect on the per capita disposable income of rural residents. In column (2), adding the county-level control variables, and the result remains positively significant at the 1% level. Column (3) further includes interaction terms for the selection criteria of the demonstration parks and time trends on the basis of column (2), with the policy's coefficient rising to 0.022 and remaining significant at the 1% level. Column (4) controls the interaction of province and year fixed effects on the basis of column (3), with the core coefficient still significantly positive at the 1% level. According to the results, the policy's coefficient is positive and significant, demonstrating that the RIIDP policy has considerably increased the per capita disposable income of rural residents. The increase in the estimated coefficient from column (1) to columns (3)–(4) suggests that simpler models may have been downwardly biased, as they did not fully account for differential pre-trends correlated with the policy's selection criteria. The saturated model in column (4), which flexibly controls for these factors, provides our preferred and most credible estimate of the policy's causal effect. Based on column (4), holding other conditions constant, an RIIDP leads to an annual average increase of 2.10% in the per capita income of farmers in the selected counties.

Table 2. Benchmark regression results.

Variable	Per Capita Disposable Income of Rural Residents			
	(1)	(2)	(3)	(4)
RIIDP	0.010 ** (0.005)	0.011 *** (0.004)	0.022 *** (0.003)	0.021 *** (0.003)
Constant	9.361 *** (0.000)	8.063 *** (0.079)	8.606 *** (0.064)	8.866 *** (0.076)
Control variables	No	Yes	Yes	Yes
County characteristics × time trends	No	No	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Province × year fixed effects	No	No	No	Yes
Observations	14,300	14,300	14,300	14,300
Adjusted R ²	0.985	0.987	0.990	0.994

Notes: (a) *** and ** indicate significance levels of 1% and 5%, respectively; (b) the values in parentheses represent county-level clustered robust standard errors; (c) county characteristics include the total output value of agriculture in 2016; (d) policy selection variables include whether the county is a poverty county and whether it is a pilot demonstration county for RIIDP. The following tables are the same.

4.1.2. Result of Parallel Trend Test

The year before the policy implementation (2017) is set as a reference point, and the coefficients and their 95% confidence interval trends are presented in Figure 3. The dynamic time effects show no significant difference from zero before the demonstration parks' establishment and the coefficients show a stable trend, which indicates that there is no significant difference in income trends between the treatment and control groups before the policy. Thus, the assumption of parallel trends is satisfied. After the policy was implemented, the effect on farmer income exhibits an inverted-U dynamic trend characterized by an initial increase followed by a decrease. Notably, in the fourth

post-policy year, the coefficient remains significantly above zero, suggesting a sustained and statistically significant positive influence on the per capita disposable income of rural residents.

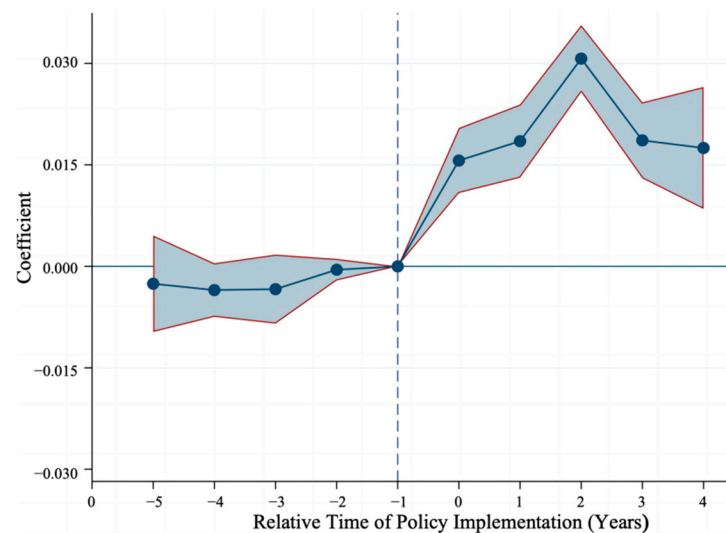


Figure 3. Results of the parallel trend test.

4.1.3. Robustness Tests

To verify the reliability of the baseline findings, this study implements a set of robustness tests. It includes screening sub-sample regression, controlling for the interaction terms of characteristic variables and time dummy variables, excluding the influence of other policies in the same period, excluding the influence of expected factors, employing a propensity-score-matching DID model, conducting placebo tests, and excluding heterogeneous treatment effects.

I. Firstly, counties that did not pass the assessment certification were excluded; 74 counties were excluded. To eliminate the influence of these counties on the baseline results, the regression was re-conducted after removing the counties that did not pass the assessment. As shown in column (1) of Table 3, the result remains substantially unchanged. Second, the data from municipalities directly under the central government were removed. Due to the significant differences in administrative divisions between municipalities and other cities, the county-level administrative areas in municipalities may have better economic development and resource advantages. After excluding all county samples under the municipalities, the effect of the policy was re-estimated. The result in column (2) of Table 3 is unchanged, indicating the robustness of the benchmark regression results.

II. To mitigate potential selection bias arising from non-random assignment of counties for the RIIDPs, the benchmark regression controlled the interaction terms between county characteristics and selection criteria with time trends. However, another approach exists in the literature [45], which controls the interaction terms between county characteristics and selection criteria with time dummy variables. As shown in column (3) of Table 3, the core coefficient remains robust across specifications.

III. We considered other county-level policies that may impact the per capita disposable income of rural residents during the study period, such as whether the county belonged to the e-commerce demonstration counties, the National Rural Tourism Demonstration Counties, Integrated Urban–Rural Transportation Demonstration Counties, and the Return-to-hometown Entrepreneurship Pilot Counties. This paper further controlled for these policies and the level of digital finance in each county based on the benchmark regression.

As shown in column (4) of Table 3, the result remains consistent with that in the benchmark regression, indicating that the conclusions of this paper are not influenced by other policies.

Table 3. Robustness test results 1.

Variables	Per Capita Disposable Income of Rural Residents			
	(1)	(2)	(3)	(4)
	Exclude Non-Certified Counties	Exclude Municipalities	Control for Interaction Terms	Exclude Other-Policy Interference
RIIDP	0.020 *** (0.003)	0.021 *** (0.003)	0.022 *** (0.003)	0.021 *** (0.003)
E-commerce pilot counties				0.003 ** (0.002)
Rural tourism integration pilot counties				0.008 (0.008)
Returnee entrepreneurship pilot counties				0.000 (0.003)
Urban–rural transport integration pilot counties				−0.002 (0.004)
County digital finance				0.052 *** (0.013)
Constant	8.865 *** (0.076)	8.865 *** (0.077)	8.832 *** (0.073)	9.054 *** (0.075)
Control variables	Yes	Yes	Yes	Yes
County characteristics × time trends	Yes	Yes	No	Yes
County characteristics × year fixed effects	No	No	Yes	No
County fixed effects	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes
Province × year fixed effects	Yes	Yes	Yes	Yes
Observations	14,300	14,040	14,300	11,957
Adjusted R ²	0.994	0.994	0.994	0.995

Notes: *** and ** indicate significance levels of 1% and 5%, respectively.

IV. To quantify the cumulative effect of multiple pilot policies, this paper constructs a core indicator covering five types of county-level rural revitalization pilots highly relevant to RIIDPs. This indicator is a discrete variable ranging from 0 to 5, with higher values indicating more overlapping pilot policies in a county. The regression result, shown in column (1) of Table 4, shows that the RIIDP policy maintains a stable and significant increasing effect. After controlling for the number of multiple pilots, the coefficient of the RIIDP policy is 0.018, slightly lower than the baseline coefficient but still highly significant. This indicates that RIIDPs' income-increasing effect is not driven by the superposition of other pilot policies and retains a robust effect even under in a cumulative policy context.

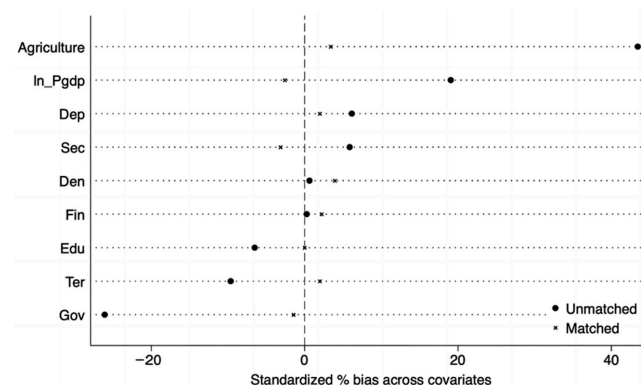
V. Some counties had already undertaken preparations before being selected for RIIDP development, such as infrastructure construction and investment in machinery and equipment, which may influence the per capita disposable income of rural residents. This paper included a dummy variable before the policy (Pre1) in the regression model to control this “anticipation effect”. The regression result, shown in column (2) of Table 4, indicates that the result is still significant and positive, while the coefficient for the prior policy year (Pre1) is not significant.

Table 4. Robustness test results 2.

Variables	Per Capita Disposable Income of Rural Residents		
	(1)	(2)	(3)
	Marginal Returns of Multiple Pilot Policies	Exclude Anticipatory Factors	PSM-DID
RIIDP	0.018 *** (0.004)	0.022 *** (0.003)	0.020 *** (0.003)
Pre-policy Dummy Variable		0.002 (0.002)	
Constant	8.976 *** (0.070)	8.866 *** (0.076)	8.842 *** (0.169)
Control Variables	Yes	Yes	Yes
County Characteristics × Time trends	Yes	Yes	Yes
County Characteristics × Year Fixed Effects	No	No	No
County Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Province × Year Fixed Effects	Yes	Yes	Yes
Observations	13,578	14,300	13,327
Adjusted R ²	0.994	0.994	0.994

Notes: *** indicates significance levels of 1%.

VI. There may be systematic differences between counties selected for RIIDPs and those that were not, making the treatment and control groups incomparable. This paper applied a propensity-score-matching difference-in-differences (PSM-DID) model to alleviate the potential impact of these systematic biases. First, based on control variables like total agricultural output value, economic development level and industrial structure for the counties selected as the demonstration parks in 2016, a Logit model was used to estimate the probability of each county being selected. Then, using the propensity scores, the 1:1 nearest-neighbor matching method matched the treatment with the control group year-by-year. As shown in Figure 4, the balance analysis indicates that the standardized deviation of the matching variables is significantly smaller than that of the unmatched variables. Furthermore, the landing points were relatively scattered before matching and concentrated around 0 after matching, basically meeting the criterion of less than 10%. This proves that after adopting the PSM-DID method, the matching deviation has indeed decreased. Finally, Equation (2) was re-estimated using the matched samples. As shown in column (3) of Table 4, the results are unchanged, further verifying the robustness of the benchmark regression results.

**Figure 4.** Balance test result.

VII. To address potential estimation biases caused by unobserved time-varying factors or omitted variables, this paper adopts a placebo test [49]. Specifically, 213 counties were randomly selected from the entire sample (matching the number of the treatment group) to serve as counties for RIIDPs. For each selected county, a random year from 2013 to 2022 was designated as the implementation year, forming a pseudo-treatment group. While the remaining counties were treated as the control group. Since the pseudo-treatment group was generated randomly, If the observed income-increasing effect of an RIIDP was driven by unobserved factors rather than the policy itself, arbitrary “false policy assignments” would also yield spurious significant effects. Otherwise, it should have no significant effect on the per capita disposable income of rural residents. Thus, the coefficient is expected to be approximately zero.

Figure 5 displays the distribution of the policy coefficients from 1000 repetitions of randomly generated demonstration park counties. The distribution of the placebo coefficients is centered on zero, and our actual estimated coefficient (0.021) falls far outside this distribution, allowing us to reject the null hypothesis that our result is due to chance ($p < 0.01$), which indicates that the benchmark regression results are not influenced by omitted variables or random factors. Thus, the conclusions are robust.

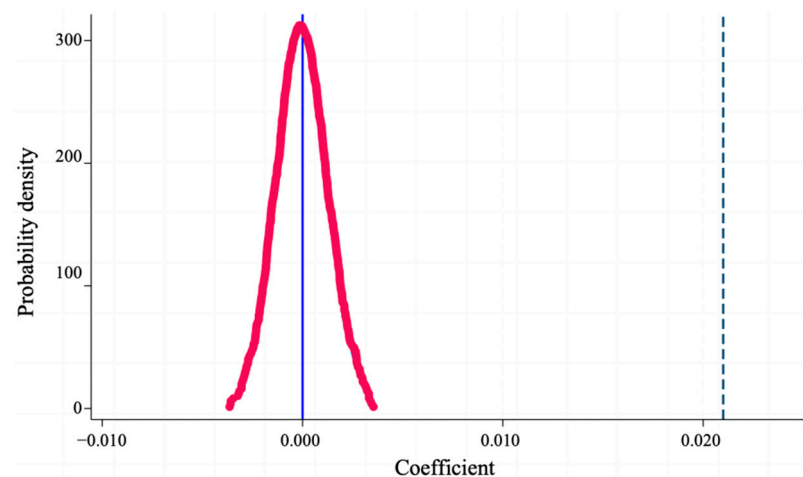


Figure 5. Placebo test result.

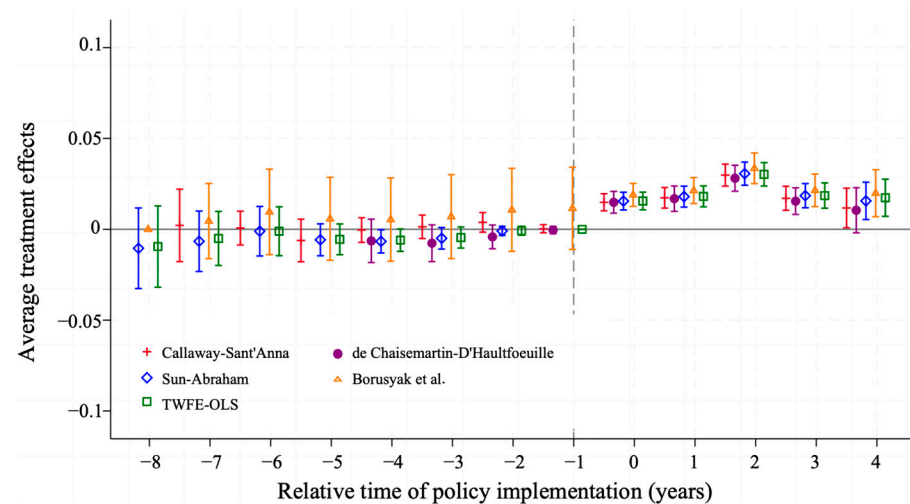
VIII. According to Goodman-Bacon (2021) [50], the coefficients are weighted averages of treatment effects for samples treated at each time point. However, treatment effect heterogeneity and negative weights may bias the results.

In this paper, a Bacon decomposition was performed to calculate the coefficient values and weights for each group [50]. The overall estimators can be decomposed into three groups: (1) “Treated counties versus untreated counties”; (2) “Earlier-treated counties versus later-treated counties”; (3) “Later-treated counties versus earlier-treated counties”. As shown in Table 5, the overall coefficient is 0.022, with the third group accounting for only 4% of the weight. Therefore, the results obtained by the two-way fixed effects model are unbiased, and the benchmark conclusions are robust.

To further explore the dynamic treatment effects of the staggered difference-in-differences (DID) methodology, this paper employed four types of “heterogeneity-robust” estimators: group–period average treatment effects [43], imputation estimators [51], stacked regression estimators [52], and the approach by de Chaisemartin and D’Haultfoeuille (2020) [53]. The results of these re-estimations are illustrated in Figure 6. After excluding heterogeneity in treatment effects, the dynamic treatment effects of the policy are basically consistent with the parallel trend results obtained by the two-way fixed effects estimation, further confirming the robustness of the basic conclusions.

Table 5. Goodman-Bacon decomposition.

Group	Coefficient	Weight
Using “never-treated” group as control group	0.010	0.893
Using “not-yet-treated” group as control group	0.189	0.067
Using “earlier-treated” group as control group	0.019	0.040
TWFE-estimated average treatment effect	0.022	/

**Figure 6.** Dynamic treatment effects on Per capita disposable income of rural residents [43,51–53].

4.2. Effects of RIIDPs on Agricultural Modernization

The impact of RIIDPs on agricultural modernization is shown in Table 6. Column (1)–(2) focus on the agricultural industries. In column (1), the policy’s coefficient is 0.041 ($p < 0.05$), indicating that the RIIDP policy promotes the development of new agricultural enterprises. Notably, the policy’s coefficient for agricultural industrial structure (Table 6, column (2)) is positive but statistically insignificant ($\beta = 0.006$, $p > 0.1$), indicating that the RIIDP policy does not promote a significant transformation of the agricultural industrial structure; this directly contradicts Hypothesis 1a. Furthermore, columns (3) and (4) examine the production methods. In column (3), the result is 0.171 ($p < 0.05$), and in column (4) it is 0.116 ($p < 0.01$). These results mean that the policy significantly boosts facility agriculture area and farm mechanization, suggesting that there is substantial transformation and improvement in agricultural production methods due to RIIDPs.

This paper further analyzed the effects of RIIDPs on agricultural productivity and farmer non-agricultural employment, with the results in Table 7. Shown in column (1) and column (2), the policy has a positive and significant impact on labor productivity and output per unit area, indicating a notable boost in agricultural productivity. In column (3), the policy’s coefficient regarding farmer non-agricultural employment is 0.034, which is statistically significant ($p < 0.01$), highlighting the policy’s effectiveness in facilitating farmers’ transition from agricultural to non-agricultural sectors.

Table 6. Effects on agricultural modernization.

Variables	Agricultural Industries		Production Methods	
	(1)	(2)	(3)	(4)
	New Agricultural Enterprises	Agricultural Industrial Structure	Area of Facility Agriculture	Total Power of Farm Machinery
RIIDP	0.041 ** (0.018)	0.006 (0.004)	0.171 ** (0.081)	0.116 *** (0.036)
Control variables	Yes	Yes	Yes	Yes
County characteristics × time trends	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Province × year fixed effects	Yes	Yes	Yes	Yes
Observations	14,300	6195	13,905	14,152
Adjusted R ²	0.945	0.838	0.774	0.914

Notes: *** and ** indicate significance levels of 1% and 5%, respectively.

Table 7. Effects on agricultural productivity and non-agricultural employment.

Variables	(1)	(2)	(3)
	Agricultural Labor Productivity	Agricultural Output Value per Unit Area	Non-Agricultural Employment
RIIDP	1.157 *** (0.345)	0.092 * (0.054)	0.034 *** (0.008)
Control variables	Yes	Yes	Yes
County characteristics × time trends	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Province × year fixed effects	Yes	Yes	Yes
Observations	5428	4353	3569
Adjusted R ²	0.886	0.883	0.934

Note: (a) Notes: *** and * indicate significance levels of 1% and 10%, respectively; (b) The reduction in observations is due to the data availability constraints of the county-level agricultural labor productivity and non-agricultural employment ratio indicators.

4.3. The Spatial Heterogeneity of the Effect of RIIDPs on Increasing per Capita Disposable Income of Rural Residents

Based on the national administrative divisions, this article divided the entire country into four regions: the eastern region, the central region, the western region, and the northeastern region. As shown in Table 8, the coefficient of the policy in the eastern region is 0.012, which is statistically significant at the 10% level. In the central, western and northeast regions, the coefficients of the policy are 0.016, 0.028 and 0.058 respectively, and all are significant at the 1% level. The results mean that the policy has positively impacted the per capita disposable income of rural residents across all regions, allowing them to benefit from agricultural modernization. Notably, the income-increasing effect is more pronounced in the western and northeastern regions than in the eastern and central regions, which is conducive to achieving balanced internal development in rural areas.

Table 8. Spatial heterogeneity of policy effects.

Variables	Per Capita Disposable Income of Rural Residents			
	(1)	(2)	(3)	(4)
	Eastern Region	Central Region	Western Region	Northeastern Region
RIIDP	0.012 * (0.006)	0.016 *** (0.004)	0.028 *** (0.005)	0.058 *** (0.010)
Control variables	Yes	Yes	Yes	Yes
County characteristics × Time trends	Yes	Yes	Yes	Yes
County fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Province × year fixed effects	Yes	Yes	Yes	Yes
Observations	4580	4810	4580	330
Adjusted R ²	0.993	0.994	0.992	0.990

Notes: *** and * indicate significance levels of 1% and 10%, respectively.

4.4. The Impacts of Human Capital and Government Financial Capacity on RIIDP Effect

This paper examines the influence of human capital level and government financial capacity on the income-increasing effect of RIIDPs, and the results are shown in Table 9. As for the human capital, the average years of education in a county are used as the representative of the level of human capital, and the interaction term between the average years of education and the variable of RIIDP presence is included in the regression. As shown in column (1) of Table 9, the coefficient of the interaction term is significantly negative ($\beta = -0.009$, $p < 0.1$), suggesting that the effect of the RIIDP policy on boosting rural per capita disposable income is stronger and more significant in counties with lower human capital levels. As for government financial capacity, the ratio of general public budget expenditures to local GDP is used as the representative of the level of government financial capacity, and the interaction term between the government financial capacity and the variable of RIIDP presence is included in the regression. As shown in column (2) of Table 9, the coefficient of the interaction term is significantly positive ($\beta = 0.013$, $p < 0.01$), indicating that RIIDPs have a more pronounced income-increasing effect in counties with greater government financial capacity.

Table 9. The heterogeneous responses of policy effects to human capital and government financial capacity.

Variables	(1)	(2)
	Per Capita Disposable Income of Rural Residents	Per Capita Disposable Income of Rural Residents
RIIDP	0.094 ** (0.039)	0.016 *** (0.004)
RIIDP × human capital	−0.009 * (0.005)	
RIIDP × government financial capacity		0.013 *** (0.005)
Control variables	Yes	Yes
County characteristics × time trends	Yes	Yes

Table 9. Cont.

Variables	(1)	(2)
	Per Capita Disposable Income of Rural Residents	Per Capita Disposable Income of Rural Residents
County fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Province $\times$ year fixed effects	Yes	Yes
Observations	13,100	14,300
Adjusted R ²	0.994	0.994

Notes: ***, ** and * indicate significance levels of 1%, 5% and 10%, respectively.

5. Discussions

5.1. The Impact of the RIIDP Policy on Increasing Farmers' Incomes

The empirical results indicate that the RIIDP drives a statistically significant 2.1% annual increase in the per capita disposable income of rural residents. Specifically, in counties without a designated RIIDP, the average annual income per farmer was CNY 11,157. Following a designation as a demonstration parks county, the projected annual increase in per capita farmer income reaches approximately CNY 234 (2.1%* 11,157). The dynamic effect test shows that the income-increasing effect persists for at least four years after policy implementation; assuming the policy's effect persists, the cumulative income increase over 5 years would reach 1170 CNY per capita—equivalent to 12.4% of the average rural income of a typical rural household in 2013 (9430 CNY). This cumulative effect aligns with the policy's goal of sustainable rural development. This finding is consistent with the conclusions of many existing studies [21], who emphasized the critical role of effective technological and institutional changes in boosting farmers' income and agricultural productivity. The policy's demonstrated effectiveness underscores its potential as a strategic instrument for advancing sustainable rural development and achieving sustainable economic transformation in similar contexts. However, some studies have reached a different conclusion. Tabo-Ojong and Dureti (2023) found that RII had no significant effect on farmers' income in the absence of a well-established mechanism for linking interests [25]. Another study has shown that whether the effect of agricultural integration on farmers' income is a significant increase depends on the level and scale of the rural industrial park [17].

This paper also reveals a spatial heterogeneity and a trend of the effect of RIIDPs on farmer income increase of western region > northeastern region > eastern region > central region (Table 8). This regional disparity is likely to be related to the natural and social conditions of the region. Firstly, the natural conditions for agricultural production in the western region is worse than that in the eastern and central regions, with poorer and relatively backward production technology, resulting in a lower production efficiency than in the eastern and central regions. Following RIIDP implementation, improvements in technology could effectively enhance production efficiency, leading to a marginally higher policy effect compared to the eastern and central regions [1]. Secondly, the modernization level of agricultural production in the western and northeastern regions is lower than that in the eastern and central regions. After the implementation of the policies, the development of new production entities will also bring higher marginal benefits. Thirdly, farmers in the western and northeastern regions of China are more dependent on agriculture, and thus experience stronger income-increasing effects from RIIDPs, while the eastern and central regions, with their more diversified industrial bases, show lower marginal returns from such integration [6]. Nevertheless, we acknowledge that this spatial pattern could also reflect other factors. For instance, the policy may have been implemented with greater

intensity, complementary support, or adapted more effectively to local contexts in these regions. While we have included province-year fixed effect controls for broad provincial-level shocks, we cannot fully rule out region-specific, time-varying confounders related to implementation quality.

However, our result differs from a previous study which found that the trend of the effect of the RIIDP policy on farmers' incomes is western region > central region > eastern region [39]. The possible reason is that we only considered the impact of RIIDPs in the counties where they were implemented, while the previous study took into account the influence of policy spillover effects, which might lead to changes in spatial heterogeneity [39]. Another important reason might be that regional differences in resources and assets affect the realization of policy effects [21].

5.2. The Transmission Mechanism of RIIDP Effects

This paper constructs the effect mechanism of RIIDPs on the agricultural system, which is manifested as a multi-level transmission mechanism of "RIIDP → agricultural modernization → functional enhancement → farmers' incomes increase" (Figure 2). Based on this framework, the effects of RIIDPs on agricultural modernization and the increase in farmers' incomes are quantitatively measured (Table 6), while the impact of agricultural modernization on functional improvement and the impact of functional improvement on farmer income increase are not quantitative measurements, considering the potential endogeneity issues of the variables [54]. Thus, here, we combine the existing literature and theoretical frameworks to focus on discussing the mechanism by which the RIIDP policy achieves income growth for farmers through agricultural modernization.

5.2.1. The Mechanism of the Improvement of Production Methods

As for production methods, quantitative analysis reveals that RIIDPs significantly promote mechanized and facility-based agricultural production, aligning with global evidence from other countries [9]. Consequently, improved production methods can enhance resource utilization efficiency and reduce costs, which generate direct economic benefits and increase farmer incomes [15,32]. Additional benefits have also been verified in other studies. For example, the mechanization of production leads to increased production efficiency, which can prompt the transfer of labor from traditional agricultural sectors to higher-value-added non-agricultural industries [55,56], which will increase farmers' non-agricultural income. Furthermore, technological progress such as agricultural mechanization is conducive to the transfer of rural land and increases the asset income of farmers [57]. As another example, facility agriculture may enhance the quality of agricultural products and increase the diversity of product supply, thereby improving the economic benefits of agriculture [17,58].

5.2.2. The Mechanism of the Improvement and Upgrading of Agricultural Industries

As for upgrading of agricultural industries, the effects of RII on the agricultural production structure and the development of new agricultural entities vary. Empirical analysis shows that RIIDPs significantly promote the development of new-type agricultural operation entities (Table 6). Compared with traditional small-scale agriculture, new-type agricultural enterprises have obvious advantages in the application and promotion of modern technologies, the integration of agricultural resources, and large-scale production, thus playing a connecting role between traditional agriculture and modern agriculture [10]. Specifically, the entry of agricultural enterprises enhances the income-increasing effect through several synergistic channels. Firstly, new-type agricultural operation entities usually engage in diversified operations that include traditional agricultural production [59], which lead to the creation of secondary and tertiary industry in rural sectors such as

the tourism, catering, and processing industries [60], thereby increasing the added-value output of rural industries. Secondly, new agricultural entities with abundant capital and advanced production concepts and technologies, such as agricultural enterprises and agricultural cooperatives, effectively integrate various production resources and provide advanced production technologies, which contribute to the improvement of production efficiency, increasing farmers' income [10,35]. Furthermore, the bridging role of new-type agricultural operation entities may help establish a mechanism for linking interests, which brings various benefits to farmers [35]. For example, by establishing "enterprise + farmers" cooperative profit mechanisms the connection between farmers and the downstream agricultural product processing industry is realized, enabling farmers to increase non-productive income in the form of wage income and asset income [35,61,62]. However, contrary to expectations from previous studies [20,63], our findings provide no significant evidence supporting the hypothesis that RIIDPs lead to structural transformation, suggesting that the impact of RIIDPs on industrial upgrading is not uniform across all dimensions. The core reasons for this are summarized in three aspects. Firstly, the measurement of agricultural industrial structure in this study focuses on "service integration", which is a narrow dimension of industrial upgrading. The empirical variable of agricultural industrial structure in this paper is defined as the ratio of agricultural service output value to total agricultural output value, which only measures the integration level of agriculture and the tertiary service industry. However, agricultural industrial upgrading driven by RIIDPs is reflected more in the vertical integration of the industrial chain and the horizontal integration of agricultural internal sub-industries. The new agricultural enterprises cultivated by RIIDPs are mainly engaged in agricultural product processing, standardized planting or breeding bases, and agricultural production material supply. Secondly, new agricultural enterprises are in the cultivation stage, and the industrial structure transformation has a time-lag effect. The RIIDP policy's support for new agricultural enterprises is mainly reflected in lowering the entry threshold, and the newly established agricultural enterprises are mostly small and medium-sized micro-enterprises in the initial stage of operation. These enterprises focus on stabilizing production and expanding the primary product market in the short term, and have not yet formed the capacity to drive large-scale transformation of the regional agricultural industrial structure through industrial chain extension and industrial form innovation. Agricultural industrial structure transformation is a long-term process involving factor reallocation, institutional adaptation and market cultivation [40]. The significant growth of new agricultural enterprises is the precursor condition of industrial structure transformation, and the structural effect will gradually emerge with the maturity of enterprise operation and the agglomeration of the industrial chain. Thirdly, there is a phenomenon of emphasizing hardware facilities while neglecting industrial linkages. According to the *Implementation Plan for Developing National Rural Industrial Integration Development Demonstration Parks* (NDRC, 2017) and local supporting policies, RIIDPs' funding support clearly prioritizes hardware infrastructure construction, which focus on standardized planting or breeding bases, agricultural product processing workshops, cold chain logistics warehouses, and rural road hardening; these inputs directly lower the entry threshold for new agricultural enterprises but do not directly promote industrial chain integration or structural transformation. New enterprises can obtain standardized workshops, advanced machinery, and cold chain facilities at low rent or with subsidies, making it more cost-effective to engage in primary production and simple processing than to invest in industrial chain extension. Most new agricultural enterprises in rural areas are small and medium-sized micro-enterprises with weak self-financing capacity. Without continuous policy subsidies for industrial linkages, they struggle to establish stable

upstream and downstream cooperative relationships, let alone drive regional industrial structure transformation.

5.2.3. The Impacts of Human Capital and Government Financial Capacity on RIIDP Effects

This paper quantitatively reveals that government financial capacity and human capital have an impact on the implementation effect of RII. As for government financial capacity, it plays a crucial role in enhancing the effectiveness of RII. On the one hand, targeted governmental investments in agricultural infrastructure and mechanization are crucial for ensuring the success of agricultural policy implementation [21,41]. This reliance is clearly demonstrated in a Chinese context, where the establishment of demonstration parks predominantly depends on public funding to upgrade infrastructure, cultivate conducive investment ecosystems, and mobilize private capital [38]. Such government-led financial commitments serve as a catalyst for attracting subsequent social investments [64,65].

As for human capital, it appears to be inversely correlated with the magnitude of policy impacts in this study, suggesting that the policy effect is more prominent in areas with lower educational levels. Generally, it is believed that the higher the level of education, the more conducive it is to the production efficiency of agriculture and farmers' income [40]. Specifically, under normal circumstances, farmers with a higher level of education have more employment opportunities, which in turn leads to higher incomes, while the situation is the opposite for those with a lower level of education. However, this relationship has changed due to policy intervention. After the RIIDP policy was implemented, due to the horizontal and vertical development of industries, more job opportunities have emerged. These jobs generated by industrial integration often require reliable labor with practical skills, but not necessarily a high-level formal education. This policy-driven expansion of the local labor demand for mid- to low-skill non-farm jobs provides a new, significant income-earning avenue specifically for individuals whose educational attainment previously limited their opportunities in the pre-existing local economy. This finding suggests that the returns for RII are diminishing in regions where non-agricultural opportunities are already well-established [66].

The above discussion results indicate that policy intervention has a moderating effect on the impact of the original influencing factors on agricultural production efficiency. Therefore, when considering areas for the implementation of RIIDPs, we should not only take into account the local economic development conditions and resource endowments, but also consider the local human-capital situation and government financial capacity, in order to achieve the maximum overall benefit.

5.2.4. Heterogeneity and Moderating Effects

This paper constructs the effect mechanism of RII on the agricultural system, which is manifested as a multi-level transmission mechanism of "RII → agricultural modernization → functional enhancement → farmers' incomes increase". The heterogeneity and moderating effects further validate the internal logic of this mechanism:

The finding of stronger effects in the western and northeastern regions directly supports the logic of diminishing marginal returns applied to agricultural modernization. In these regions, characterized by lower initial levels of mechanization, facility agriculture, and integrated agro-industries, RII's promotion of industrial upgrading and production method improvement experienced a greater productivity "shock" and structural transformation from the policy, as the marginal contribution of these paths to income growth is higher.

Human capital and government financial capacity regulate the mechanism's operation efficiency. On the one hand, RII optimizes the matching between agricultural modern-

ization paths and human capital by creating low-threshold participation channels, which successfully create non-agricultural employment opportunities that are accessible to laborers with a relatively lower education level, thereby realizing significant income growth for this group. On the other hand, government financial capacity provides resource support for agricultural modernization and facilitates the public investments necessary for the “improvement of production methods” and the “upgrading of agricultural industries”, accelerating the transformation of RII into income growth.

In sum, these heterogeneous results show that the pathway from RII to income growth is most effective in regions with greater modernization potential, for farmers with access to newly created jobs, and where local governments possess the capacity to implement the vision.

5.3. Policy Implications

As our results show, RIIDPs promote agricultural modernization and increases farmers' incomes. Thus, this paper concludes with the following policy implications, which cover both targeted strategies for China's rural revitalization and referential insights for other developing countries facing similar rural development dilemmas.

5.3.1. Implications for China's Rural Revitalization

According to our findings, this paper concludes with the following policy implications. Firstly, the government should continue to promote the establishment of RIIDPs and fully leverage their demonstration and leading roles to construct a modern industrial system that integrates agriculture with secondary and tertiary industries. The government could select a subset of counties in each geographical region (eastern, central, western, northeastern) to continue deepening the policy, with the core goal of tracking long-term effects. Build a dynamic monitoring system covering key indicators: long-term income growth trends of farmers, structural transformation of agricultural industries, non-agricultural employment quality, and fiscal expenditure sustainability. Conduct mid-term evaluations for continued pilot counties, focusing on the policy's income-increasing effects, and adjusting implementation measures in a timely manner. Secondly, the government should promote agricultural mechanization and large-scale production, cultivate diversified integration entities and accelerate the adjustment of agricultural industrial structures. Encourage more enterprises to enter rural areas and guide industrial agglomeration, extend agricultural industrial chains, expand the multi-functionality of agriculture, and vigorously develop new industries and business forms in agriculture, such as facility agriculture. Lastly, adhere to localized and innovative development. It is noteworthy that RIIDPs exhibit significant regional heterogeneity in enhancing farmers' income; strategies should be based on county-level resource endowments, location advantages, industrial foundations, and functional positioning. Scientific planning for “one county, one policy” is needed to explore diverse, local-characteristic-aligned industrial integration models. More policy support should be provided to less-educated regions and to the western and northeastern regions. Additionally, local governments should increase financial support, innovate financing mechanisms for RIIDPs, and attract more financial and social capital to participate in RIIDP.

5.3.2. Implications for Other Developing Countries

Firstly, for developing countries with dominant smallholder agriculture, they can learn from China's experience of cultivating new agricultural business entities (e.g., agricultural cooperatives and leading enterprises) to build interest linkage mechanisms between smallholders and industrial chains. Instead of directly replicating large-scale demonstration parks, they can develop decentralized, community-based integration modes (e.g., village-level agro-processing workshops and rural tourism clusters) to lower the threshold

for smallholders to participate in industrial upgrading [8]. Secondly, similarly to China's counties with low educational levels achieving significant income growth through RII, developing countries with low rural human-capital stocks should avoid overly technology-intensive integration paths. They should focus on promoting labor-friendly and low-threshold technologies (e.g., small-scale mechanization and basic facility agriculture) and carry out targeted vocational training for rural laborers [10,67]. Thirdly, for developing countries with prominent rural regional development disparities, they can learn from China's practice of prioritizing policy support for underdeveloped regions (western and northeastern China). They can allocate more industrial integration resources to remote rural areas with single agricultural structures and avoid the excessive concentration of resources in economically developed rural areas to prevent the expansion of regional income gaps.

5.4. Limitations and Future Work

Although this paper provides empirical evidence that RIIDPs promote agricultural modernization and farmer income growth, there are still some limitations that need to be further improved in the future. Firstly, this paper fails to analyze the income-increasing effects of different RIIDP models, such as the social service-driven model, the technology-driven model, and the social capital-driven model, which may mask or blur the true effects of the policies. Secondly, agricultural modernization is a multi-dimensional concept encompassing not only industrial structure upgrading and production method improvement but also institutional innovation, sustainable development, and technological popularization. Constrained by data availability and measurement feasibility, this study only selected two observable dimensions to proxy agricultural modernization. This narrow measurement may fail to capture the full connotation of agricultural modernization, leading to potential deviations in the mechanism analysis. Thirdly, there may be spatial spillover effects of RIIDPs which are not analyzed in this paper. Fourthly, while this study verifies the core mechanism of agricultural modernization, RIIDPs may also affect farmers' incomes through other channels such as land transfer institutional innovation or inter-industry technological spillover. Due to the focus on the policy's micro-transmission paths at the county level, these alternative mechanisms are not fully explored here and warrant further investigation in future research. Furthermore, the lack of micro employment data prevents us from further distinguishing the seasonal or long-term nature of the non-agricultural jobs created by the policy, and this is a key direction for future research. We plan to conduct in-depth field investigations and micro surveys of pilot RIIDPs and their surrounding rural households in subsequent studies. With more detailed micro employment and household income data, we will further empirically verify the employment characteristics of the non-agricultural jobs driven by the RIIDP policy and their impact on the long-term stability of rural residents' income growth.

6. Conclusions

This paper examined the effect of RIIDPs on the sustainable income growth of farmers, which is conducive to a scientific and comprehensive understanding of the relationship between the RIIDP policy and farmer income, and provides empirical evidence for further increasing farmer income. Based on the panel data of 1430 counties in China from 2013 to 2022, this paper employed a staggered difference-in-differences (DID) model to evaluate the income-increasing effect and mechanisms of the RIIDP policy.

The findings reveal that, firstly, the RIIDP policy has generated statistically significant sustainable income-enhancing effects for farmers, resulting in a 2.10% growth in income (234 CNY per year). Mechanism analysis confirms that this outcome stems from the dual drivers of agricultural industrial upgrading and the modernization of production

methods. Secondly, the policy effects exhibit pronounced spatial and socioeconomic heterogeneity. The western and northeastern regions demonstrated stronger income growth effects compared to eastern and central regions, indicating diminishing marginal returns in more developed areas. Notably, counties with lower educational attainment, yet stronger financial capacity, exhibited heightened policy responsiveness, underscoring the moderating role of local resource endowments. Thirdly, this paper provides empirical evidence for optimizing sustainable rural development strategies. Policymakers should prioritize differentiated regional support mechanisms, allocating greater resources to the underdeveloped central and western regions, while establishing dynamic evaluation frameworks to address evolving policy demands. These findings emphasize that RIIDPs require not only horizontal industrial coordination but also vertical policy adaptation tailored to regional developmental gradients, which helps improve the efficiency, sustainability, and scalability of RIIDP implementation. This study not only provides empirical support for rural revitalization in China, but also offers policy design and evaluation methods that can be referred to for other developing countries facing challenges in agricultural transformation and increasing farmers' income.

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Abbreviations

The following abbreviations are used in this manuscript:

RII	Rural industrial integration
RIIDP	Rural industrial integration demonstration park

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