Beyond the Farm: How Agricultural Cooperatives Reshape Rural Labor Allocation and Income

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Abstract

This paper studies how agricultural cooperatives reshape rural households' labor allocation and income composition by improving farm marketing. Using a rich household-level panel data from a county from 2013 to 2019, we exploit staggered adoption of cooperative membership and implement a difference-in-differences design to identify causal effects. We find that joining a cooperative increases both farm and off-farm income by 19 percent and 22 percent, respectively, indicating that cooperatives complement rather than crowd out off-farm activities. On the farm side, cooperative participation raises agricultural profits without increasing production expenditures, consistent with improvements in marketing efficiency and stronger bargaining power in output markets. These gains are larger for households in remote and poorly connected areas and in villages with higher cooperative participation intensity. On the off-farm side, cooperative members increase both the duration of off-farm work and off-farm wage rates, reflecting adjustments along both the quantity and quality margins of employment. We further document that cooperative development is associated with greater clustering of off-farm employment destinations within villages, consistent with network-based information diffusion and improved job matching. The results highlight the broader role of agricultural institutions in alleviating market and information frictions and in accelerating rural structural transformation.

Keywords: Agricultural cooperatives; Labor allocation; Market access; Information frictions.

JEL Codes: J43; O13; Q12.

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1 Introduction

Rural households in developing economies allocate labor between agricultural production and off-farm employment under tight time and liquidity constraints (Saba et al., 2022; De la O Campos et al., 2025). While deeper integration into agricultural product markets can raise farm income by improving access to buyers and output prices, agricultural production and marketing are highly time-intensive and directly compete with off-farm work opportunities (Rathi, 2022; Li et al., 2025). As off-farm employment has become an increasingly important source of income growth and risk diversification, changes in the organization and returns to agricultural activities may therefore have first-order effects on households' engagement in off-farm labor markets (Christiaensen and Martin, 2018; Banerjee et al., 2021). Understanding how agricultural institutions reshape this trade-off is central to evaluating their broader welfare consequences.

Agricultural cooperatives are a prominent institutional arrangement that directly reshapes how smallholder farmers organize production and access agricultural markets. By coordinating sales (Fulton and Giannakas, 2013; Agbo et al., 2015), pooling resources (Pennerstorfer and Weiss, 2013; Mérel et al., 2015), and strengthening farmers' bargaining power (Bontems and Fulton, 2009; Liang and Hendrikse, 2016), cooperatives are designed to raise returns to agricultural activities and reduce individual marketing frictions (Agbo et al., 2015; Ma and Abdulai, 2016; Pitts et al., 2025). A large empirical literature documents positive effects of cooperative memberships on agricultural productivity and farm income (Verhofstadt and Maertens, 2014; Liu et al., 2017; Mojo et al., 2017; Wossen et al., 2017; Ma et al., 2018; Zhong et al., 2023; Pitts et al., 2025). However, by focusing primarily on agricultural outcomes, this literature largely abstracts from households' labor allocation decisions. As a result, we know little about whether and why cooperative-induced improvements in agricultural commercialization affect labor allocation in off-farm sectors, or how changes in agricultural returns translate into off-farm income.

In this paper, we exploit the rollout of agricultural cooperatives in rural China to address this gap by examining how cooperative participation affects both farm and off-farm incomes and by unpacking the mechanisms. We assemble a household-level administrative panel covering registered rural poor households in a city of Shaanxi Province from 2013 to 2019. The data are drawn from China's targeted poverty alleviation registration system and contain detailed information on house-

hold demographics and economic activities. Leveraging the variation in cooperative establishment and household participation, we implement a staggered difference-in-differences (DID) design to identify the causal effects of cooperative participation on farm and off-farm outcomes.

Our results show that agricultural cooperatives generate sizable income gains in both farm and off-farm sectors. On average, cooperative memberships increase per capita farm income by 19 percent and per capita off-farm income by 22 percent, indicating that improvements in agricultural organization and returns spill over into off-farm labor markets rather than crowd them out.

We further provide evidence on the mechanisms underlying these income gains. On the farm side, we find that farm profits increase without a corresponding rise in production expenditures. This pattern contrasts with several studies in which cooperatives encourage greater investment in farm inputs (Ma and Abdulai, 2018; Ma et al., 2018, 2022; Lin et al., 2022) and indicates that, in our setting, cooperative participation raises farm income mainly through improvements in output marketing rather than through increased input use.

Additional evidence reinforces this interpretation. Farm income effects are significantly larger for households in remote and poorly connected areas, and income gains rise with village-level cooperative participation intensity. These findings indicate that farm income rises through improved sales efficiency and bargaining outcomes rather than through expanded production.

On the off-farm side, we argue that the observed income gains arise through both indirect and direct channels associated with cooperative memberships. First, improvements in farm marketing reduce the time cost of agricultural sales, enabling households to reallocate labor away from farming-related activities toward off-farm employment. Consistent with this substitution mechanism, we find that cooperative members increase their off-farm working time by 1.86 months per year.

In addition to reallocating household labor, cooperatives also improve off-farm outcomes by alleviating information frictions. By coordinating collective sales and interacting with buyers and traders, cooperatives expose members to outside markets and generate information about off-farm employment opportunities and wages. This information further diffuses within the organization, improving job search and matching (Saroj et al., 2022; Ponce, 2023; Phan et al., 2025). Empirically, cooperative participation increases off-farm wage rates by 17.3 percent, with substantially larger gains among households in remote and poorly connected areas. Moreover, we find cooperative development is associated with greater clustering of off-farm employment destinations within

villages, consistent with the formation of local employment networks that facilitate information sharing about job opportunities and migration pathways.

Finally, we document substantial heterogeneity that sheds light on labor endowments and local complementarities. Income gains from cooperative memberships are negligible for the most vulnerable households but large for those with relatively better livelihoods. Farm income gains are more strongly linked to labor endowments, while off-farm income gains are concentrated among healthier and better-educated households. Moreover, we find cooperative effects are amplified in villages with stronger collective economies, underscoring complementarities between cooperatives and local industrial development and the importance of aligning cooperative promotion with household capabilities and local economic conditions.

This paper contributes directly to the long-standing debate on the welfare implications of agricultural cooperatives by providing new causal evidence on their income effects through both farm and off-farm channels. While the existing literature has largely focused on agricultural outcomes of cooperative participation, including productivity (Yang and Liu, 2012; Verhofstadt and Maertens, 2015; Wollni and Fischer, 2015; Ma and Abdulai, 2017; Mojo et al., 2017; Hao et al., 2018; S. et al., 2021), farm income and household consumption (Ma et al., 2018; Mishra et al., 2018; Hoken and Su, 2018; Ma and Abdulai, 2018; Ma and Wang, 2020; Candemir et al., 2021; Zemba et al., 2025), and risk sharing and management (Duguma Feyisa, 2016; Ma and Abdulai, 2017; Ahmed and Mesfin, 2017; Zhang et al., 2019; Franken et al., 2022; Sánchez-Navarro et al., 2024), we show that the effects of cooperative participation extend well beyond agriculture to substantially reshape households' engagement in off-farm activities. By explicitly accounting for households' joint decisions over farm production and off-farm labor supply, the paper offers a more comprehensive assessment of the welfare impacts of agricultural cooperatives.

This paper also uncovers and empirically validates the mechanisms through which cooperatives affect household incomes. A large literature documents strong linkages between agricultural and off-farm activities in developing economies, and often finds that income gains from agricultural institutions or reforms arise primarily through households reallocating labor away from agriculture toward off-farm employment (Odoh et al., 2019; Dagunga et al., 2020; Chari et al., 2021; Zhang et al., 2023; Li et al., 2024; Gai et al., 2025). We provide new evidence that this trade-off is not inevitable. By improving efficiency in agricultural production and sales rather than expanding labor

input, cooperatives relax time and liquidity constraints, enabling households to increase engagement in off-farm activities without reducing farm income.

More broadly, this paper speaks to a central question in development economics concerning the persistent productivity mismatch between agricultural and non-agricultural sectors in developing economies. Macro-level studies document that low aggregate productivity in developing countries is closely tied to the excessive concentration of labor in low-productivity agriculture (Restuccia et al., 2008; Lagakos and Waugh, 2013; Young, 2013; Gollin et al., 2014), reflecting subsistence constraints that generate severe sectoral misallocation and slow structural transformation (Hendricks and Schoellman, 2018; Bryan and Morten, 2019; Chari et al., 2021; Adamopoulos et al., 2022; Porzio et al., 2022). Our findings highlight a micro-institutional channel through which this misallocation can be mitigated, helping to bridge the productivity gap between sectors and to facilitate structural transformation.

To the best of our knowledge, the studies most closely related to ours on off-farm outcomes are Liu et al. (2017) and Zheng et al. (2023). Liu et al. (2017) examines land cooperatives that allocate agricultural land, which differ fundamentally from the marketing-oriented cooperatives we study. Zheng et al. (2023) documents associations between cooperative participation and off-farm employment but focuses on intra-household labor allocation, whereas we examine the broader income effects of cooperatives and the underlying mechanisms.

The remainder of the paper is organized as follows. Section 2 describes the institutional background of agricultural cooperatives in rural China. Section 3 introduces the data and outlines the empirical strategy. Section 4 presents the main results and examines the underlying mechanisms. Section 5 reports heterogeneity analyses. Section 6 concludes.

2 Background

2.1 Background of Agricultural Cooperatives

Agricultural cooperatives in rural China predate formal legislation but long operated without legal recognition or standardized governance. Before the mid-2000s, most cooperative-type organizations were informal, loosely regulated, and often embedded in village administrations or enterprise-led arrangements. To address these issues, China enacted its first Cooperative Law in 2006, defin-

ing cooperatives as voluntary, member-based economic organizations, restricting external capital participation, and requiring surplus distribution to be based primarily on members' transaction volumes rather than capital contributions. By providing a legal basis for fiscal subsidies, tax incentives, and financial support, the law spurred rapid nationwide expansion of cooperatives but also exposed substantial governance problems, including weak member participation, elite capture, and the proliferation of cooperatives that existed largely in name. In response, beginning around 2013 the central government strengthened regulatory oversight, standardized registration, and targeted "fake" cooperatives, culminating in a major legal revision in 2017. The amended law reinforced requirements for genuine member participation, enhanced financial transparency, tightened governance provisions, and formally introduced cooperative federations to facilitate scale economies in marketing, processing, and service provision.

In practice, agricultural cooperatives in China take several distinct organizational forms. Member-driven mutual-help cooperatives, the most prevalent type, are initiated and governed by farmers and primarily coordinate input purchases and collective sales to improve market access and bargaining power. Enterprise-led cooperatives are organized by agribusiness firms to standardize production and secure supply chains, with limited decision-making power for individual members. Elite-led cooperatives, typically initiated by village cadres or large farmers, feature centralized governance and often function as vehicles for accessing policy support and coordinating resources.

The cooperatives in our study region predominantly follow the member-driven mutual-help model, whose core role is to aggregate individual members' agricultural output, search for marketing channels on their behalf, and conduct collective sales. By pooling output and negotiating jointly with buyers, these cooperatives reduce marketing frictions and strengthen farmers' bargaining power in output markets. The distribution of agricultural cooperatives of 2019 in our sample city is shown in Figure 1.

2.2 Conceptual Framework

Within the institutional context described above, we conceptualize how agricultural cooperatives reshape households' labor allocation between farming and off-farm activities by jointly affecting production returns and household constraints. The central premise is that cooperatives modify both economic incentives in agricultural production and the time and information frictions governing

households' engagement with off-farm labor markets. In the sections that follow, we will provide empirical evidence to support these arguments.

Farm side. On the farm side, following their establishment, cooperatives can raise farm income by improving households' access to and participation in both input and output markets. Through collective organization, cooperatives may reduce transaction costs and facilitate the adoption of higher-quality or more productive inputs, affecting both the level and composition of agricultural input use (Ma and Abdulai, 2018; Zhang et al., 2020; Lin et al., 2022).

Beyond input use, cooperatives can also improve outcomes in output markets by coordinating sales, standardizing quality, and strengthening farmers' bargaining positions (Agbo et al., 2015; Pitts et al., 2025). Importantly, these mechanisms influence not only expected agricultural returns but also the predictability and time intensity of farm production and marketing. By reducing uncertainty and the time required to commercialize output, cooperatives can lower the opportunity cost of labor in agriculture, creating scope for households to reallocate labor across farm and off-farm activities. Consequently, farm income gains may arise through multiple margins, with their relative importance ultimately determined empirically.

Off-farm side. On the off-farm side, cooperatives may influence household income and labor allocation by reshaping both the opportunity cost of time and the information environment governing off-farm employment decisions. Indirectly, by reducing the time intensity and uncertainty associated with agricultural production and marketing, cooperatives relax household time constraints and lower the shadow cost of off-farm work, facilitating the reallocation of labor from agriculture to non-agricultural activities (Adamopoulos et al., 2022; Porzio et al., 2022).

In addition, we argue that cooperatives improve access to off-farm employment information through two distinct channels. First, by organizing collective sales and coordinating interactions with buyers, traders, processors, and logistics providers, cooperatives increase members' exposure to outside markets and non-local economic actors. These interactions can generate new information about employment opportunities, migration destinations, and prevailing wages beyond the village. Second, cooperative membership facilitates repeated interaction and information sharing within the organization, allowing employment-related information acquired by some members to diffuse to others. Through this internal transmission, cooperatives can improve job search and matching and expand access to higher-quality off-farm employment opportunities. As these information

flows accumulate, off-farm employment choices may become increasingly clustered within villages, reflecting the emergence of localized labor-market networks and path-dependent job search and migration patterns (Egger et al., 2022; Wang and Ruan, 2024).

3 Data and Empirical Strategy

3.1 Data and Descriptive Statistics

In this study, we focus on rural counties within a city in Shaanxi Province[1] and use administrative records on registered rural poor households to examine how participation in agricultural cooperatives affects households' labor supply and work activities.

The poverty registration system, established in 2013 as part of China's targeted poverty alleviation strategy, records detailed demographic and socioeconomic information for households officially identified as poor. Eligibility for inclusion is determined primarily by per capita income and asset holdings under nationally unified criteria. Once a household enters the registry, its information continues to be updated annually even if the household subsequently rises above the official poverty line, allowing us to track households over time and observe both persistent and transitory poverty. This administrative dataset has been used in several recent studies based on data from other provinces in China (Zhang et al., 2023; Qiu et al., 2024; Jin et al., 2025).

We use data from 2013 to 2019 for two reasons. First, following 2013, the establishment and operation of agricultural cooperatives became increasingly standardized as regulatory oversight and administrative enforcement were strengthened. Second, the sample region experienced a rapid expansion of agricultural cooperatives during this period. As shown in Figure 2, the cooperative participation rate in our sample increased from zero in 2013 to 26 percent in 2019.

Variable definitions and descriptive statistics are reported in Table 1. The table presents summary statistics for 2013 and 2019, documenting substantial improvements in household income, work activities, and living conditions along multiple dimensions over this period. While these descriptive patterns are informative, they may also reflect common time trends and other confounding factors. To identify the causal effects of cooperative participation, we therefore exploit the stag-

[1]Per the data provider's requirements and Chinese government regulations, the name and exact location of the city are kept confidential.

gered rollout of cooperatives across households and over time, controlling for a rich set of fixed effects in our empirical specifications.

3.2 Empirical Strategy

Our empirical strategy follows the framework of staggered DID:

$$y_{ijt} = \beta \cdot Coop_{ijt} + \mu_i + \theta_t + \gamma_j \times t + \varepsilon_{ijt} \tag{1}$$

where y_{ijt} denotes the outcome of interest for household i in village j at year t. The indicator $Coop_{ijt}$ equals one if household i participates in an agricultural cooperative in year t, and zero otherwise. μ_i captures household fixed effects, while θ_t denotes year fixed effects. To address concerns about village-level time-varying confounders, we additionally include village-specific linear time trends, $\gamma_j \times t$, which absorb differential village development trajectories over time. ε_{ijt} is an idiosyncratic error term. The coefficient β identifies the average treatment effect on the treated (ATT) of cooperative participation on household per capita income.

A key identification concern in this empirical design is non-random selection into cooperative membership. To assess the validity of the DID identification strategy, we rely on the pre-treatment parallel trends assumption conditional on the fixed effects included in equation (1). Specifically, we estimate the following event-study specification:

$$y_{ijt} = \sum_{k \neq -1} \beta_k \, D_{ijt}^{k} + \mu_i + \theta_t + \gamma_j \times t + \varepsilon_{ijt} \tag{2}$$

where D_{ijt}^{k} is an indicator equal to one if household i is k years away from its first cooperative participation in year t. The coefficients β_k capture the dynamic effects k years before and after participation, relative to the omitted baseline period $k = -1$. Insignificant estimates for pre-treatment periods ($k < 0$) provide support for the parallel trends assumption between treated and control households. In addition to the event-study analysis, we further discuss potential selection concerns in Section 4.

The traditional two-way fixed effects estimator in staggered adoption settings implicitly combines comparisons across cohorts treated at different times. Some of these comparisons are prob-

lematic because units that have already been treated may serve as controls for units treated later. When treatment effects are heterogeneous over time or across cohorts, the resulting TWFE estimate can be expressed as a non-convex weighted average of group–time average treatment effects, with some weights potentially negative (Goodman-Bacon, 2021). In such cases, the TWFE coefficient may be difficult to interpret. To address this concern, we implement robust DID and event-study estimators following Sun and Abraham (2021) in Section 4.

4 Main Results and Mechanism Analysis

4.1 Effects on Household Income

We begin by examining the average income effects of cooperative participation. Table 2 reports the baseline DID estimates. Column (1) and (2) present the effects on per capita farm income and off-farm income, respectively. We find that becoming a member of an agricultural cooperative increases per capita farm income by 19.2 percent, a magnitude comparable to existing evidence. For example, Ma and Abdulai (2017) and Hoken and Su (2018) show that apple and rice cooperatives in China raise members' incomes by 18.2 percent and 12.3 percent, respectively.

In Column (2), we find that cooperative participation increases per capita off-farm income by 21.8 percent, consistent with greater engagement in off-farm activities. While few studies directly estimate treatment effects on off-farm income, Liu et al. (2017) and Zheng et al. (2023) consistently document that membership in land and banana cooperatives is associated with a 20–30 percent higher likelihood of off-farm employment.

The baseline estimates indicate that joining a cooperative is associated with sizable and statistically significant gains in both farm and off-farm income. These findings are consistent with the dynamic effects shown in Figure 3, which presents event-study estimates across relative periods. Post-treatment effects for both income measures are positive and gradually strengthen over time. In addition, the estimates for pre-treatment periods are statistically insignificant, providing support for the parallel trends assumption and the validity of the DID identification strategy in this setting.

4.2 Mechanism Analysis of Farm Income

In this section, we investigate the mechanisms through which cooperative participation increases farm income. Guided by the conceptual framework in Section 2 and the related literature, we examine three candidate channels: agricultural input intensification, improved access to output markets, and enhanced bargaining power in agricultural sales.

Agricultural input use. We begin by testing whether the observed increase in farm income is driven by higher agricultural input use. If cooperatives raise farm income primarily by encouraging households to expand production or intensify input use, we would expect to observe a corresponding increase in agricultural expenditures.

To this end, we estimate the baseline DID specification using per capita farm expenditure as the outcome variable. The results are reported in Table 3. In Column (1), the estimated coefficient on cooperative participation is small in magnitude and statistically insignificant, indicating that joining a cooperative does not lead to higher spending on agricultural inputs. This pattern contrasts with much of the existing literature, which finds that cooperatives often encourage input use and technology adoption in China (Ma et al., 2018; Ma and Abdulai, 2018). These results rule out input intensification as the primary mechanism underlying the observed farm income gains, at least in our setting.

At the same time, Column (2) of Table 3 shows that cooperative participation significantly increases agricultural profit margins. Together with the absence of increased input expenditures, these results indicate that higher farm income arises not from greater input use but from improved efficiency and more favorable terms on the output side. Households are thus able to earn more from a given level of production, consistent with the role of cooperatives in coordinating sales, reducing transaction costs, and improving price realization.

Access to output markets. Given the increase in profit margins, we next examine whether cooperatives raise farm income by improving access to agricultural output markets. If cooperatives help households overcome market access constraints, their effects should be stronger for households facing higher transportation costs or weaker information connectivity (Jensen, 2007; Goyal, 2010; Aker, 2010).

To test this implication, we extend the baseline specification by interacting cooperative par-

ticipation with household- and village-level proxies for market access, including distance to trunk roads, household access to broadband internet, and the availability of regular public bus services connecting villages to the county seat. The results are reported in Column (1)–(3) of Table 4.

Consistent with the market access channel, farm income gains from cooperative participation are significantly larger for households located farther from trunk roads. Similarly, households without broadband internet access and those in villages lacking regular bus connections experience substantially stronger income effects. These patterns indicate that cooperatives disproportionately benefit households facing more severe physical and informational barriers to market participation.

The magnitudes of these interaction effects suggest that cooperatives effectively substitute for missing infrastructure by aggregating output, coordinating logistics, and reducing the fixed costs of market participation. By doing so, they enable geographically remote and poorly connected farmers to access downstream buyers and secure better prices than would be possible individually—an important channel for improving the functioning of rural agricultural markets (Dercon and Gollin, 2014; Deichmann et al., 2016; de Janvry and Sadoulet, 2020).

Bargaining power and collective participation. Finally, we examine whether cooperative participation enhances farmers' bargaining power in output markets, a channel that may play an important role in shaping farm income outcomes (Magruder, 2012; Abebaw and Haile, 2013). Because bargaining power is not directly observed in our data, we provide indirect evidence by testing whether the income effects of cooperative participation vary with the intensity of collective participation at the village level.

Specifically, we interact cooperative participation with the village-level cooperative participation rate. As shown in Column (4) of Table 4, the interaction term is positive and statistically significant, indicating that farm income gains from cooperative membership are larger in villages with higher overall participation. This pattern is consistent with a bargaining-power mechanism: as participation expands, cooperatives can better consolidate supply, standardize quality, and negotiate with downstream buyers, thereby securing more favorable terms of trade.

Importantly, this result points to local complementarities in cooperative participation. The benefits of membership are not purely individual but increase with the scale of collective engagement within the village. Such complementarities are difficult to reconcile with explanations based solely on individual-level input use or productivity shocks and instead underscore the central role of col-

lective organization in shaping agricultural market outcomes (Fischer and Qaim, 2012; Verhofstadt and Maertens, 2014).

4.3 Mechanism Analysis of Off-Farm Income

We now turn to the mechanisms underlying the increase in off-farm income following cooperative participation. Unlike farm income, which is primarily affected through output-market channels, off-farm income is shaped by households' labor allocation decisions and the returns to off-farm work. We argue that cooperatives raise off-farm income through two complementary channels: by freeing up labor for off-farm employment and by improving job matching through information sharing and employment networks.

Off-farm labor supply and wage rates. We begin by decomposing the increase in off-farm income into changes along the extensive and intensive margins of off-farm work. Specifically, off-farm income may rise either because households allocate more time to off-farm employment or because they obtain higher-paying off-farm jobs.

To examine these channels, we estimate the baseline DID specification using average off-farm working duration and off-farm wage rates as outcome variables. The results are reported in Table 5. We find that cooperative participation significantly increases off-farm working time by 1.86 months per year, indicating that households reallocate labor toward off-farm activities after joining a cooperative. This effect is slightly smaller than the estimates in Zheng et al. (2023), who find that cooperative membership increases off-farm working duration by more than two months per year.

At the same time, cooperative participation also leads to a significant increase in off-farm wage rates of 17.3 percent. Together with the rise in off-farm working time, this pattern indicates that gains in off-farm income operate along both margins. On the one hand, coordinated agricultural sales reduce the time households must devote to marketing their output, freeing up labor that can be reallocated to off-farm work. On the other hand, cooperative participation is associated with improved access to higher-paying off-farm jobs, pointing to gains in job quality beyond simple increases in hours worked.

Information exposure. We next examine whether the off-farm income gains from cooperative participation are larger for households facing more severe constraints in accessing external labor-

market information and mobility. Beyond internal information sharing, cooperatives may expand members' exposure to outside markets and non-local economic actors through activities such as coordinated sales, interactions with traders and buyers, and engagement with downstream firms. If cooperatives alleviate search frictions by improving access to external employment information, their effects should be particularly pronounced for households with weaker connections to outside information channels and limited mobility (Muto and Yamano, 2009; Aggarwal, 2018; Fujii and Shonchoy, 2020; Banerjee et al., 2020).

To test this implication, we augment the baseline specification by interacting cooperative participation with household- and village-level proxies for external connectivity, including distance to trunk roads, household access to broadband internet, and the availability of regular public bus services. The results are reported in Column (1)–(3) of Table 6.

Consistent with the information-friction channel, off-farm income gains from cooperative participation are significantly larger for households located farther from trunk roads, those without internet access, and those residing in villages without regular public transport connections. While these heterogeneous effects mirror patterns observed on the farm side, they operate through a distinct mechanism: cooperatives relax informational and mobility constraints in off-farm labor markets.

Employment networks. Finally, we provide direct evidence on the role of employment networks by examining whether cooperative participation reshapes village-level patterns of off-farm employment destinations. Distinct from external information exposure, this mechanism operates through internal information exchange within cooperatives, where employment-related knowledge acquired by some members is shared and diffused to others (Beaman, 2012; Bryan et al., 2014). If cooperative participation strengthens such network-based matching, we would expect households within the same village to be increasingly attracted to similar off-farm destinations with highest returns as participation expands.

To test this prediction, we first augment the baseline DID specification by interacting household cooperative participation with the village-level cooperative participation rate. As shown in Column (4) of Table 6, higher within-village participation intensity is associated with significantly larger off-farm income gains, consistent with the presence of network effects operating within cooperatives.

To provide more direct evidence, we follow Burchardi et al. (2019) and construct village-

level measures of off-farm employment destination province concentration, including the Herfindahl–Hirschman Index (HHI) and the share of the most common destination in each year. Specifically, for village j in year t, the HHI is defined as $\text{HHI}_{jt} = \sum_p s_{pjt}^2$, where s_{pjt} denotes the share of off-farm workers from village j who work in destination province p in year t. A higher HHI indicates that off-farm workers from the same village are more concentrated in a smaller set of destination provinces. As reported in Table 7, higher cooperative participation intensity is associated with significantly greater concentration of off-farm employment destinations within villages, consistent with the diffusion of employment information through internal cooperative networks. Consistent with this interpretation, the increase in off-farm wage rates documented in Table 5 provides complementary evidence in support of this mechanism.

4.4 Robustness Checks

Figure 3 presents the event-study estimates. We find no evidence of differential pre-treatment trends prior to treatment onset, providing support for the parallel trends assumption. In addition, we conduct three further robustness checks to assess the validity of our analysis.

Selection into cooperatives. Because participation in agricultural cooperatives is voluntary, self-selection into cooperative membership may generate systematic differences between treated and control households. We address this concern using two complementary approaches.

First, we compare pre-treatment demographic characteristics across treatment cohorts with different adoption timings and the never-treated households. The descriptive statistics are reported in Appendix Table B1. We focus on 2013, the year prior to any cooperative participation in the sample. Based on ANOVA tests, we fail to reject the null hypothesis that most characteristics are equal across groups, indicating that treated and control households are broadly comparable before treatment.

Second, we examine whether the demographic characteristics that differ significantly across groups are correlated with the decision to participate in cooperatives. As reported in Appendix Table B2, we regress the cooperative participation indicator on the characteristics that are significant at the 5 or 1 percent levels. We do not find statistically significant coefficients, suggesting that self-selection based on these observable characteristics is unlikely to be a major source of endogeneity.

Staggered DID. We address a key concern associated with two-way fixed effects estimators under staggered adoption where heterogeneous treatment effects across cohorts and over time can induce implicit negative weighting and bias the estimated average effect. Following Sun and Abraham (2021), we re-estimate the average treatment effect on the treated using a group–time average treatment effects framework. Appendix Figure C1 and C2 show that our baseline results are robust under this approach, with no evidence of substantial heterogeneity across groups with different treatment timings.

Confounding policies. Because our panel spans the period of China's Poverty Alleviation Campaign, we explicitly account for potential confounding effects from contemporaneous policies. In particular, we control for three major poverty alleviation programs implemented in the study area: resettlement programs, industry-based poverty alleviation initiatives, and financial support policies.

We argue that these confounding policies are unlikely to drive the estimated effects of cooperative participation for three reasons. First, as shown in Appendix Table D1, the coverage of each of the three policies is below 5 percent in our sample, and the overlap between cooperative participation and any of these policies is less than 1 percent. This limited exposure suggests that confounding policy effects are unlikely to substantially bias our estimates. Second, we explicitly control for these three policies by including corresponding indicator variables in the baseline regression. As reported in Appendix Table D2, the estimated effects of cooperative participation remain largely unchanged. Third, we re-estimate the treatment effects after excluding all observations affected by any of the three policies. The results in Appendix Table D3 show no changes in the estimated coefficients.

Spillovers. A potential concern in our setting is the presence of spillover effects from treated to untreated households, particularly when off-farm employment-related information is transmitted through social networks. Existing studies document such spillovers in contexts where information diffuses across individuals or groups (Baird et al., 2019). If cooperative members share off-farm job opportunities with non-members through daily interactions, the DID framework may partially contaminate the control group. In this case, the estimated treatment effects would be biased toward zero, leading to an underestimation of the true impacts of cooperative participation on off-farm income and labor supply.

We provide two pieces of evidence suggesting that spillover effects are limited in our setting. First, we augment the baseline DID specification by including two interaction terms, $Coop_{ijt} \times share_{it}$ and $(1 - Coop_{ijt}) \times share_{it}$. As reported in Appendix Table E1, the coefficient on $Coop_{ijt} \times share_{it}$ captures the role of information networks among cooperative members and is comparable in magnitude to the estimates in Column (4) of Table 6. In contrast, the coefficient on $(1 - Coop_{ijt}) \times share_{it}$ reflects potential spillover effects on non-members and is statistically insignificant. This pattern suggests that the diffusion of off-farm employment information to non-members is limited, indicating that spillover effects are weak.

Second, we re-estimate the destination-clustering regressions separately for cooperative members and non-members. As reported in Appendix Table E2, the increase in employment-destination concentration is driven entirely by cooperative members. We find no evidence that within-village participation intensity affects destination clustering among non-members, further indicating that spillover effects are limited.

5 Heterogeneity Analysis

To conclude the empirical analysis, this section examines who benefits most from cooperative participation and under what conditions, with an emphasis on the distributional and welfare implications of our findings. We analyze heterogeneity by poverty status, household human capital, and village industrial development.

5.1 Poverty Status and Human Capital

Household capacity is likely to shape both the ability to participate in agricultural cooperatives and the extent to which such participation translates into income gains. We first examine heterogeneity by poverty status, using administrative classifications that reflect decreasing levels of deprivation: Wubao households, Dibao households, other registered poor households not receiving aids, and non-poor households. These categories capture systematic differences in labor endowments, health conditions, and reliance on transfers, providing a natural lens through which to assess the distributional consequences of cooperative participation.

Table 8 reports heterogeneous treatment effects along this poverty gradient. For Wubao house-

holds, the estimated effects of cooperative participation on both per capita farm and off-farm income are small and statistically insignificant. In contrast, cooperative participation generates sizable and statistically significant income gains for Dibao households, other poor households not receiving aids, and non-poor households. For these groups, joining a cooperative increases income in both agricultural and off-farm activities by economically meaningful amounts.

These patterns suggest that agricultural cooperatives are not primarily an instrument for the ultra-poor. Effective participation in cooperative production and marketing requires a minimum level of labor availability, health, and market engagement. Wubao households, by definition, face severe capacity constraints and are often unable to take advantage of cooperative services even when formally enrolled. By contrast, Dibao households and other registered poor households can be characterized as economically active but market-constrained. For these households, cooperative participation relaxes binding constraints and yields large marginal income gains, consistent with Imami et al. (2026).

Similar capacity-based patterns also emerge when we examine heterogeneity along household human capital dimensions. Table 9 shows that labor endowments, health status, and education systematically shape the income effects of cooperative participation. For farm income, households with more working-age members experience significantly larger gains, while health and education play a limited role, indicating that labor availability is the primary constraint in agricultural production. By contrast, off-farm income gains depend not only on labor endowments but also on health and educational attainment. Households with poorer health or lower literacy benefit substantially less from cooperative participation, even when labor is available.

5.2 Village Industrial Development

The effectiveness of agricultural cooperatives likely depends not only on household characteristics but also on the broader village-level economic environment in which they operate. Cooperatives do not function in isolation; their capacity to coordinate production, organize marketing, and facilitate labor reallocation may be amplified or constrained by local industrial and collective economic conditions. To examine this dimension of heterogeneity, we analyze whether the effects of cooperative participation vary with the level of village industrial development.

As a parsimonious and policy-relevant proxy for local development, we use village collective eco-

nomic income, which captures the strength of village-level collective organizations and the extent of market-oriented economic activity. Table 10 reports the results. Column (1) and (2) present the effects on per capita farm income and off-farm income, respectively. The interaction between cooperative participation and village collective economic income is positive and statistically significant for both outcomes, indicating that income gains from cooperative participation are substantially larger in villages with stronger collective economies.

Substantively, these findings point to a strong complementarity between cooperative participation and village-level industrial development. In villages with higher collective economic income, cooperatives are better able to coordinate production, consolidate supply, negotiate with downstream buyers, and transmit employment information, thereby amplifying both farm and off-farm income gains. These patterns imply that cooperatives are most effective when embedded in villages with stronger collective capacity and industrial foundations, where they function as coordination devices that magnify existing development potential.

6 Conclusions

This paper shows that agricultural cooperatives reshape rural households' income composition by jointly affecting farm and off-farm activities. Using administrative panel data from Shaanxi Province between 2013 and 2019 and exploiting staggered cooperative entry, we find that joining a cooperative raises per capita farm income by about 19 percent and off-farm income by about 22 percent, thereby increasing overall household income rather than merely reallocating income across sectors.

These gains operate through complementary mechanisms on the farm and off-farm sides. On the farm side, cooperatives raise profits and profit margins without increasing production expenditures, which is consistent with improved marketing efficiency and stronger bargaining power in output markets. The effects are larger for households in remote and poorly connected areas and become stronger as village-level participation intensity increases, highlighting the role of cooperatives in easing market-access constraints. On the off-farm side, cooperatives increase both off-farm work duration and wage rates. These gains are more pronounced where information and mobility frictions are more severe, and higher village-level participation is associated with greater clustering

of migration destinations.

The benefits are heterogeneous across households and villages. Gains are negligible for the most vulnerable households but substantial for economically active yet market-constrained households. In addition, the effects are amplified in villages with stronger collective economies. Overall, the findings suggest that well-designed cooperatives can simultaneously improve agricultural commercialization and access to better off-farm opportunities, easing the traditional trade-off between farm and non-farm activities.

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Tables

Table 1: Descriptive statistics

	Year 2013		Year 2019	
	Mean	Std. err.	Mean	Std. err.
Farming activities				
Farming income per capita	789.580	764.954	965.976	1,298.542
Farm expenditure per capita	656.648	795.771	667.882	1,194.669
Farming profit margin	0.128	0.118	0.371	0.147
Off-farm activities				
off-farm income per capita	2,003.372	1,486.442	5,775.950	5,549.664
Average off-farm working months	3.856	4.829	5.793	8.516
Off-farm wage rate (per working month)	692.281	752.158	1028.174	970.265
Village HHI of off-farm destination	0.151	0.071	0.243	0.157
Demographic characteristics				
Average age	39.620	19.471	44.639	20.535
Family size	3.649	1.401	3.446	1.594
Number of labor force	2.127	1.236	2.119	1.388
Number of unhealthy members	0.760	0.795	0.753	0.789
Number of illiterate members	0.234	0.532	0.250	0.519
Poverty status				
Wubao aids	0.006	0.074	0.064	0.244
Dibao aids	0.262	0.440	0.212	0.409
Poor without aids	0.733	0.442	0.002	0.040
Non-poor	0.000	0.000	0.722	0.448
Living conditions				
Distance to trunk roads (km)	0.616	1.631	0.450	3.683
Access to internet at home	0.256	0.335	0.854	0.353
Regular bus connecting to county	0.392	0.305	0.749	0.434
Village collective income (in thousand)	0.000	0.000	52.431	212.661

Note: This table reports summary statistics for key variables in 2013 and 2019. Means and standard errors are reported for each year. Income is measured by CNY. Farming profit margin is based on farm income and farm expenditure. Off-farm wage rate is based on off-farm income and off-farm working months. Village HHI of off-farm destination is the Herfindahl-Hirschman Index based on the share of each off-farm working destination province within each village. The detailed information on the destination is in Appendix Table A1. Village collective income is revenues generated by village-level collective economic activities and assets.

Table 2: Effects of cooperative participation on household income

Outcome variable:	Farm income per capita (log) (1)	Off-farm income per capita (log) (2)
$Coop_{ijt}$	0.192***	0.218***
	(0.075)	(0.038)
Household FE	Y	Y
Year FE	Y	Y
Village-specific trend	Y	Y
Observations	519,073	519,073
R-squared	0.586	0.735

Note: This table reports the effects of cooperative participation on household farm and off-farm income. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors in parentheses are clustered at the village level.

Table 3: Mechanisms: farm input

Outcome variable:	Farm expenditure per capita (log) (1)	Farming profit margin (2)
$Coop_{ijt}$	0.045	0.125***
	(0.073)	(0.031)
Household FE	Y	Y
Year FE	Y	Y
Village-specific trend	Y	Y
Observations	519,073	519,073
R-squared	0.537	0.582

Note: This table examines mechanisms through which cooperative participation affects agricultural input use. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors in parentheses are clustered at the village level.

Table 4: Mechanisms: market access and bargaining power

Outcome variable:	Farm income per capita (log)			
	(1)	(2)	(3)	(4)
$Coop_{ijt}$	0.213***	0.078	0.163*	0.001
	(0.075)	(0.089)	(0.097)	(0.001)
$Coop_{ijt} \times Distance_{it}$	0.053***			
	(0.012)			
$Coop_{ijt} \times Fiber_{it}$		-0.173***		
		(0.042)		
$Coop_{ijt} \times Bus_{it}$			-0.044***	
			(0.011)	
$Coop_{ijt} \times Share_{ijt}$				0.271***
				(0.067)
Household FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Village-specific trend	Y	Y	Y	Y
Observations	519,061	519,061	519,061	519,061
R-squared	0.622	0.622	0.621	0.615

Note: This table reports heterogeneous effects of cooperative participation by market access and bargaining power in the output market. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors in parentheses are clustered at the village level.

Table 5: Effects of cooperative participation on household off-farm labor supply and wage rate

Outcome variable:	Average off-farm working duration (1)	Off-farm wage rate (log) (2)
$Coop_{ijt}$	1.857***	0.173***
	(0.375)	(0.048)
Household FE	Y	Y
Year FE	Y	Y
Village-specific trend	Y	Y
Observations	519,073	519,073
R-squared	0.662	0.571

Note: This table examines the effects of cooperative participation on off-farm labor supply and wage outcomes. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors in parentheses are clustered at the village level.

Table 6: Mechanisms: external information exposure

Outcome variable:	Off-farm income per capita (log)			
	(1)	(2)	(3)	(4)
$Coop_{ijt}$	0.222***	0.039	0.247***	0.001
	(0.039)	(0.054)	(0.054)	(0.001)
$Coop_{ijt} \times Distance_{it}$	0.100***			
	(0.019)			
$Coop_{ijt} \times Fiber_{it}$		-0.272***		
		(0.056)		
$Coop_{ijt} \times Bus_{it}$			-0.041**	
			(0.018)	
$Coop_{ijt} \times Share_{ijt}$				0.251**
				(0.068)
Household FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Village-specific trend	Y	Y	Y	Y
Observations	519,061	519,061	519,061	519,061
R-squared	0.735	0.737	0.736	0.742

Note: This table reports heterogeneous effects of cooperative participation on off-farm income by market access and infrastructure conditions. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors in parentheses are clustered at the village level.

Table 7: Mechanisms: off-farm employment concentration

Outcome variable:	HHI	Largest share
	(1)	(2)
$Share_{jt}$	0.002***	0.001**
	(0.000)	(0.000)
Village FE	Y	Y
Year FE	Y	Y
Village-specific trend	Y	Y
Observations	10,156	10,156
R-squared	0.435	0.521

Note: This table reports the effects of participation intensity on off-farm work destination concentration measures. The outcome variables and observation are at village level. HHI and the largest share are calculated with destination defined at the province level. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors in parentheses are clustered at the village level.

Table 8: Heterogeneous effects by household type

	Wubao aids (1)	Dibao aids (2)	Poor without aids (3)	Non-poor (4)
Panel A outcome variable: farm income per capita (log)				
$Coop_{ijt}$	0.053	0.167**	0.292***	0.316**
	(0.121)	(0.071)	(0.083)	(0.125)
R-squared	0.657	0.624	0.641	0.890
Observations	19,816	125,242	293,089	39,552
Panel B outcome variable: off-farm income per capita (log)				
$Coop_{ijt}$	0.090	0.235***	0.270***	0.379***
	(0.060)	(0.070)	(0.041)	(0.035)
R-squared	0.667	0.711	0.739	0.871
Observations	19,816	125,242	293,089	39,552
Household FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Village-specific trend	Y	Y	Y	Y

Note: This table reports heterogeneous effects of cooperative participation by household type. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors in parentheses are clustered at the village level.

Table 9: Heterogeneous effects by labor endowment and human capital

Outcome variable:	Farm income per capita (log)			Off-farm income per capita (log)		
	(1)	(2)	(3)	(4)	(5)	(6)
$Coop_{ijt}$	-0.322***	0.175**	0.208***	-0.214***	0.281***	0.258***
	(0.075)	(0.088)	(0.076)	(0.058)	(0.041)	(0.041)
$Coop_{ijt} \times Labor_{it}$	0.250***			0.210***		
	(0.020)			(0.017)		
$Coop_{ijt} \times Unhealth_{it}$		0.021			-0.077***	
		(0.035)			(0.022)	
$Coop_{ijt} \times Unedu_{it}$			-0.055			-0.138***
			(0.046)			(0.033)
Household FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Village-specific trend	Y	Y	Y	Y	Y	Y
Observations	519,061	519,061	519,061	519,061	519,061	519,061
R-squared	0.586	0.586	0.586	0.736	0.735	0.735

Note: This table reports heterogeneous effects of cooperative participation by household labor endowment and human capital. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors in parentheses are clustered at the village level.

Table 10: Heterogeneous effects by collective income

Outcome variable:	Farm income per capita (log) (1)	Off-farm income per capita (log) (2)
$Coop_{ijt}$	0.189**	0.202***
	(0.074)	(0.037)
$Coop_{ijt} \times Collective\ income_{it}$	0.010***	0.004**
	(0.001)	(0.001)
Household FE	Y	Y
Year FE	Y	Y
Village-specific trend	Y	Y
Observations	519,061	519,061
R-squared	0.586	0.735

Note: This table reports how the effects of cooperative participation vary with the strength of the village collective economy. The collective income is on household level and per capita $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors in parentheses are clustered at the village level.

Figures

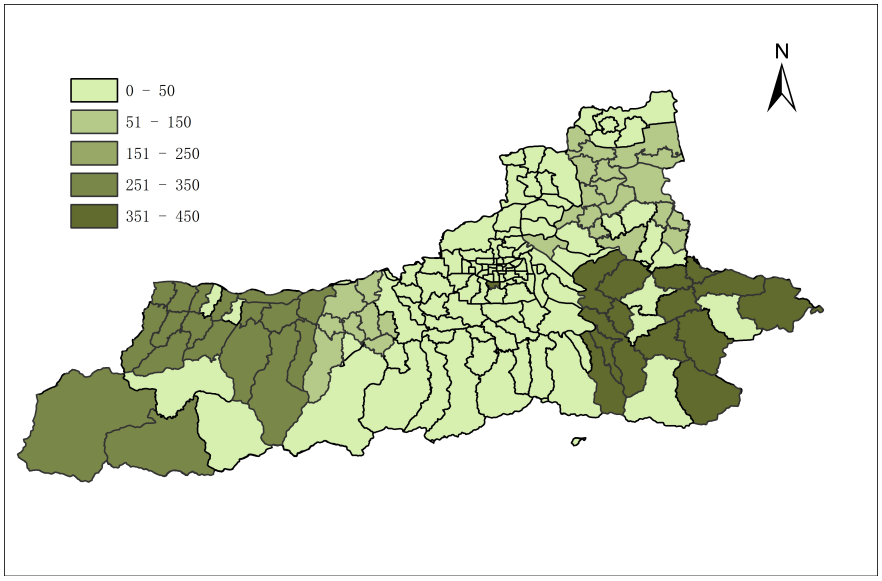


Figure 1: Distribution of agricultural participation in the sample city on the town level

Note: This figure shows the distribution of agricultural cooperatives in the sample city. Each block represents a county of the city.

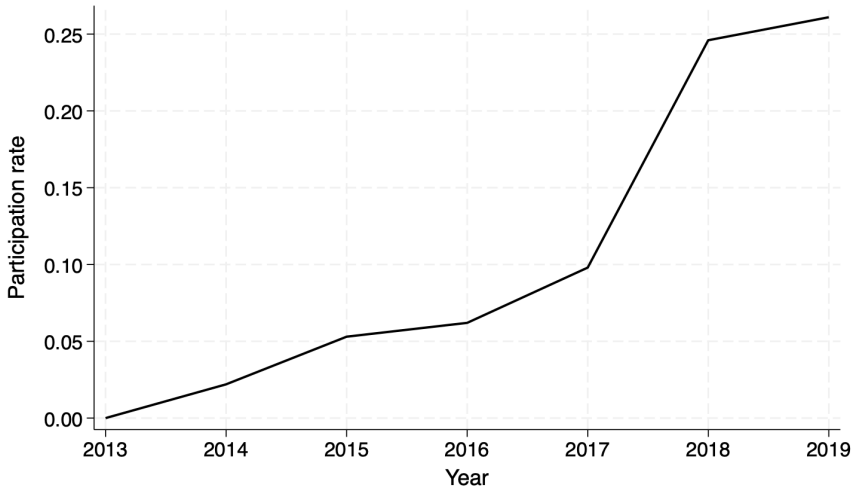


Figure 2: Cooperative participation rate

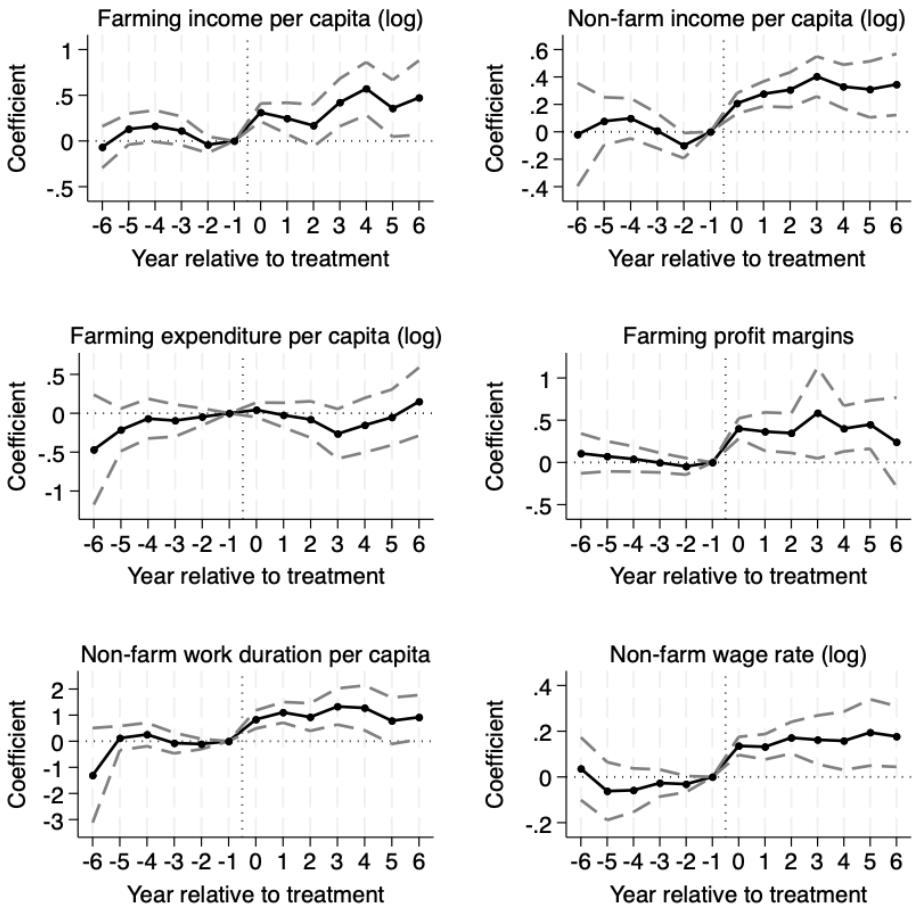


Figure 3: Coefficients of Event Study Approach

A Off-farm Working Destinations

Table A1: Top three destination provinces of off-farm working activities

Year	Top 1 (Share %)	Top 2 (Share %)	Top 3 (Share %)
2013	17.01	14.54	12.35
2014	18.55	14.25	13.58
2015	20.28	17.26	15.29
2016	22.28	19.36	16.18
2017	24.26	20.17	19.81
2018	29.28	19.48	18.17
2019	32.06	18.76	17.95

Note: This table reports distributions of primary destination provinces. Shares are expressed as percentages of total off-farm workers in each year.

B Selection

Table B1: Descriptive statistics by group

	Group 2014	Group 2015	Group 2016	Group 2017	Group 2018	Group 2019	Group NT
Farming activities							
Farming income per capita*	742.360	756.914	771.445	784.602	798.773	812.118	825.404
	(770.112)	(768.420)	(766.003)	(764.991)	(762.882)	(760.774)	(758.991)
Farm expenditure per capita	656.804	658.992	661.117	662.430	664.205	666.668	668.945
	(805.440)	(804.918)	(803.115)	(802.304)	(801.660)	(800.210)	(798.880)
Farming profit margin	0.128	0.129	0.130	0.131	0.132	0.133	0.134
	(0.118)	(0.118)	(0.118)	(0.117)	(0.117)	(0.117)	(0.117)
Off-farm activities							
Off-farm income per capita*	2,003.372	2,056.884	2,108.441	2,159.905	2,211.440	2,264.930	2,318.220
	(1,486.442)	(1,480.210)	(1,475.116)	(1,470.880)	(1,466.220)	(1,461.905)	(1,458.110)
Average off-farm working months	3.856	3.879	3.902	3.925	3.948	3.971	3.994
	(4.829)	(4.820)	(4.812)	(4.804)	(4.796)	(4.788)	(4.781)
Off-farm wage rate (per working month)	692.281	698.118	703.518	708.404	712.992	717.665	722.118
	(752.158)	(748.880)	(745.311)	(742.220)	(739.330)	(736.910)	(734.220)
Demographic characteristics							
Average age	39.620	39.641	39.663	39.598	39.632	39.607	39.615
	(19.471)	(19.468)	(19.462)	(19.476)	(19.469)	(19.474)	(19.470)
Family size*	3.649	3.612	3.578	3.546	3.515	3.485	3.456
	(1.401)	(1.404)	(1.407)	(1.410)	(1.413)	(1.416)	(1.419)
Number of labor force	2.127	2.128	2.126	2.129	2.125	2.127	2.126
	(1.236)	(1.236)	(1.236)	(1.236)	(1.235)	(1.236)	(1.236)
Number of unhealthy members	0.760	0.761	0.759	0.760	0.761	0.760	0.760
	(0.795)	(0.795)	(0.795)	(0.795)	(0.795)	(0.795)	(0.795)
Number of illiterate members	0.234	0.231	0.229	0.227	0.225	0.223	0.221
	(0.532)	(0.531)	(0.530)	(0.529)	(0.528)	(0.527)	(0.526)
Living conditions							
Distance to trunk roads (km)**	0.616	0.592	0.568	0.547	0.528	0.510	0.494
	(1.631)	(1.620)	(1.610)	(1.601)	(1.592)	(1.584)	(1.576)
Access to internet at home***	0.256	0.298	0.342	0.385	0.426	0.468	0.509
	(0.335)	(0.338)	(0.341)	(0.344)	(0.347)	(0.350)	(0.353)
Regular bus connecting to county	0.392	0.401	0.409	0.417	0.425	0.432	0.439
	(0.305)	(0.308)	(0.311)	(0.314)	(0.317)	(0.320)	(0.323)
Village collective income (in thousand)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Note: This table reports descriptive statistics in 2013. Standard errors are in parentheses. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$ for ANOVA test between groups. Group 2014 to 2019 are households who become a cooperative member in 2014 to 2019, respectively. Group NT is the never-treated households who do not join the cooperatives between 2013 to 2019.

Table B2: Determinants of cooperative memberships

Dependent variable: whether a member of cooperatives	(1)	(2)	(3)
Distance to trunk roads	0.001*		0.000
	(0.000)		(0.000)
Access to internet at home		0.003	0.001
		(0.003)	(0.001)
Observations	81,283	81,283	81,283
R-squared	0.268	0.107	0.317

Note: This table reports the determinants of cooperative participation. The outcome variable is whether the household is a cooperative member between 2013 to 2019. The two independent variables are the levels in 2013. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors in parentheses are clustered at the village level.

C Robust Event Study Estimates

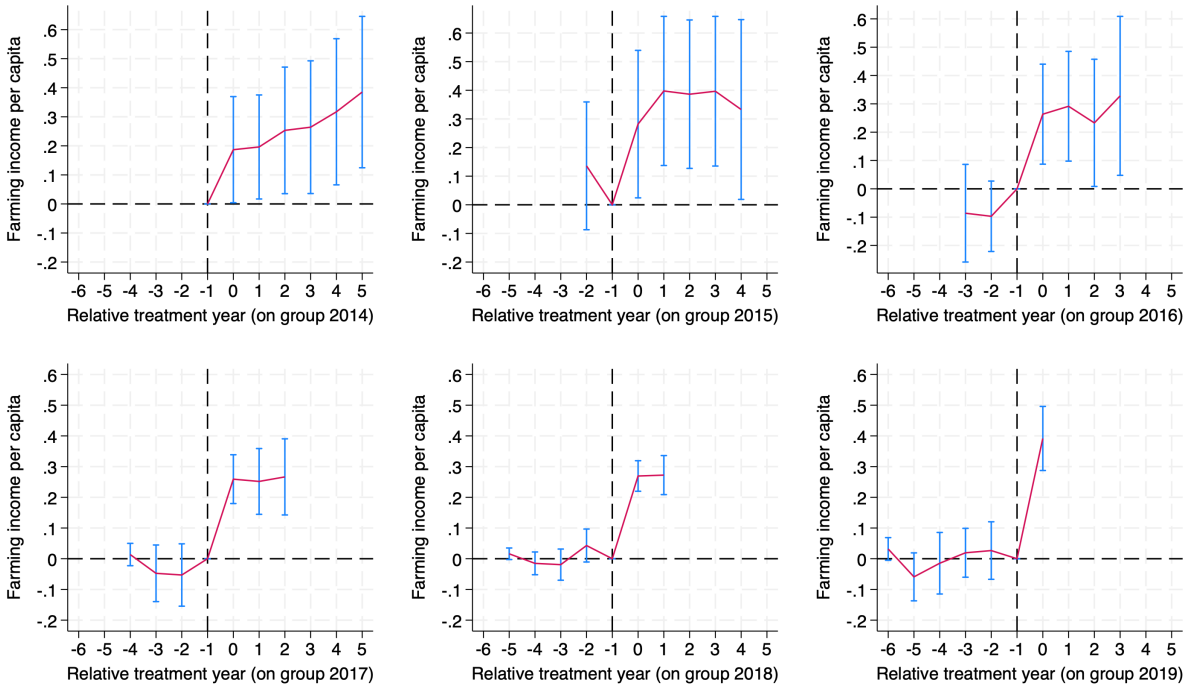


Figure C1: Treatment effects on farm income by groups with different treatment years

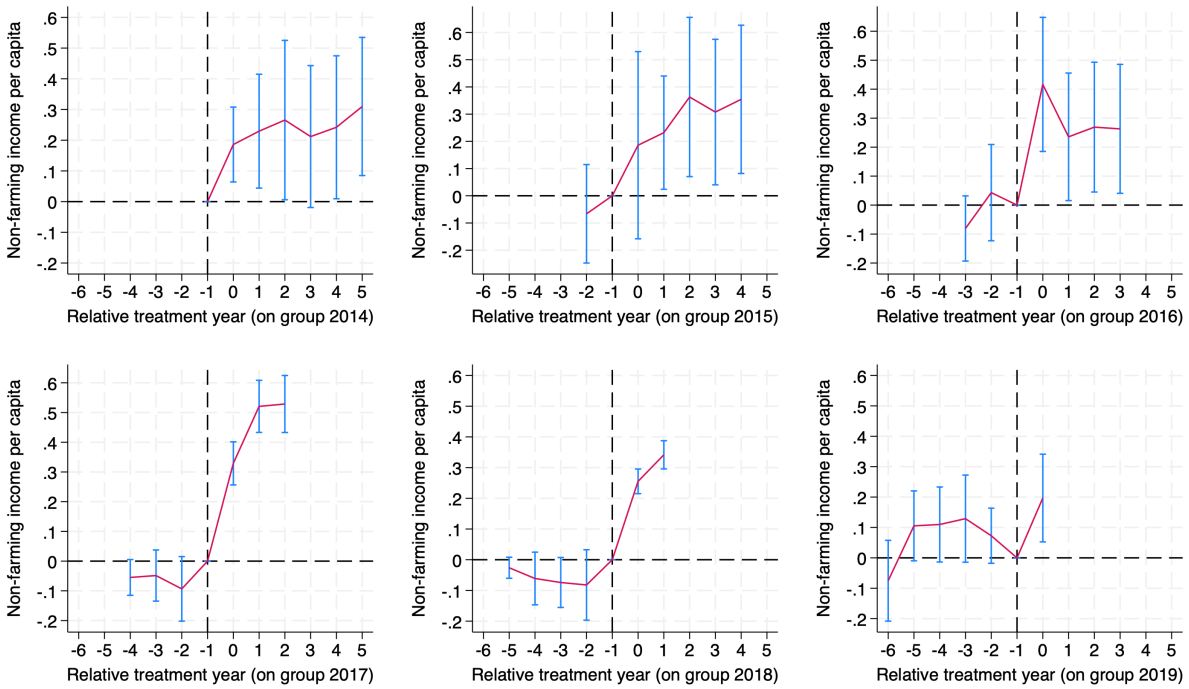


Figure C2: Treatment effects on off-farm income by groups with different treatment years

D Confounding Policies

Table D1: Household overlap between cooperatives and other policies

Year	Resettlement	Industry	Financial	Overlap
2013	0.0000	0.0000	0.0000	0.0000
2014	0.0000	0.0000	0.0000	0.0000
2015	0.0000	0.0000	0.0000	0.0000
2016	0.0000	0.0000	0.0000	0.0000
2017	0.0000	0.0193	0.0000	0.0021
2018	0.0365	0.0269	0.0425	0.0052
2019	0.0365	0.0328	0.0507	0.0091

Note: This table reports the yearly share of households participating in agricultural cooperatives that also participate in other policy programs, including resettlement, industrial development, and financial initiatives. The overlap column indicates households jointly covered by cooperatives and at least one of these policies.

Table D2: Controlling for confounding policy interventions

	Farm income (1)	Off-farm income (2)
$Coop_{ijt}$	0.182***	0.205***
	(0.081)	(0.032)
Indicators of other policies	Y	Y
Household FE	Y	Y
Year FE	Y	Y
Village-specific trend	Y	Y
Observations	519,073	519,073
R-squared	0.620	0.792

Note: This table controls for confounding policy interventions by including indicators for other major policy programs implemented during the sample period. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors in parentheses are clustered at the village level.

Table D3: Excluding households exposed to confounding policies

	Farm income (1)	Off-farm income (2)
$Coop_{ijt}$	0.193***	0.210***
	(0.079)	(0.030)
Indicators of other policies	N	N
Household FE	Y	Y
Year FE	Y	Y
Village-specific trend	Y	Y
Observations	492,526	492,526
R-squared	0.613	0.782

Note: This table excludes households exposed to other confounding policy interventions during the sample period. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors in parentheses are clustered at the village level.

E Spillovers

Table E1: Spillovers

	Off-farm income (1)
$Coop_{ijt}$	0.001
	(0.001)
$Coop_{ijt} \times Share_{it}$	0.261**
	(0.057)
$(1 - Coop_{ijt}) \times Share_{it}$	0.002
	(0.003)
Household FE	Y
Year FE	Y
Village-specific trend	Y
Observations	519,061
R-squared	0.821

Note: This table reports the check of spillover effects using off-farm income. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors in parentheses are clustered at the village level.

Table E2: Destination clustering in sub-sample

	HHI		Largest share	
	Members	Non-members	Members	Non-members
	(1)	(2)	(3)	(4)
Share within village	0.003***	0.000	0.002**	0.000
	(0.001)	(0.000)	(0.000)	(0.000)
Village FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Village-specific trend	Y	Y	Y	Y
Observations	10,156	10,156	10,156	10,156
R-squared	0.482	0.471	0.510	0.507

Note: This table reports the check of spillover effects using sub-sample working concentration. $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Standard errors in parentheses are clustered at the village level.