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# The impact of shell cooperatives on farmers' income: analysis based on Chinese grain farming cooperatives

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Farmers' professional cooperatives play a crucial role in bridging small-scale farmers to broader markets and offering an important mechanism for increasing the livelihood and source of income of the farmers. However, issues related to irregular development have gradually emerged during their evolution that are constraining the full realization of their intended functions. Using data from the National Fixed Point Survey (2014–2017) and the China Academy for Rural Development–Qiyang China Agri-Research Database, this study matches micro-level data on grain farming cooperatives with village locations based on geographic coordinates. The analysis focuses on assessing the impact of irregular development—represented by shell cooperatives—on farmers' income levels. Empirical findings reveal that: (1) the proportion of grain farming shell cooperatives exerts a significant negative effect on total household income, a result confirmed through a series of robustness tests; (2) shell cooperatives primarily influence household operating income by affecting both the amount of land leased and the level of household subsidy income, which in turn reduces total income; and (3) the adverse impact of shell cooperatives is more pronounced among low-income households and those mainly dependent on operating income. These results provide important empirical support for government initiatives aimed at eliminating shell cooperatives and offer valuable insights for promoting the healthy and regulated development of agricultural cooperatives in China.

## KEYWORDS

farming cooperatives, grain farming, shell cooperatives, farmer income, land transfer

## 1 Introduction

The establishment of smallholder organization is an important means for smallholders to connect with modern agriculture. The greater the potential profits from organization, the higher the likelihood that farmers will form production organizations (Wu et al., 2023). Farmer professional cooperatives formed through this organizational means can effectively provide smallholders with production, management, and financial services, enabling them to overcome the limitations of their operational scale, access mechanized services, understand market dynamics, and obtain financing from traditional banks (Cheyo et al., 2024; Jiang et al., 2024). The key to seamlessly integrating small-scale farmers into modern agriculture lies in farmer organization and service scaling. Enhancing the level of farmer organization and leveraging cooperatives to provide social services can effectively reduce cost of production and increase the profitability of farmers (Malvido Perez Carletti et al., 2019; Neupane et al., 2023; Yang et al., 2018). As of the end of 2022, there were 2.34 million cooperatives legally registered in China, involving nearly half of the country's farmers. Among these, 720,000 farmers'

cooperatives were established in poverty-stricken areas, helping and driving 6.3 million households out of poverty.

Since the implementation of the Law of the People's Republic of China on Farmers' Professional Cooperatives (hereinafter referred to as the Cooperative Law) in 2007, China's cooperatives have developed rapidly. However, several irregularities have also been exposed. Some scholars have examined issues that emerged in the early stages of cooperative legislation. Their studies found that although the number of cooperatives increased significantly after the implementation of the law, various challenges including farmers' insufficient understanding of cooperatives, unclear objectives for establishing cooperatives, inadequate democratic control by members, and the failure to implement profit distribution based on patronage are confronted by policy makers. These issues have led to cooperative development that emphasizes quantity over quality (Liu et al., 2019; Zhang and Huang, 2014).

Since the implementation of the Cooperative Law, many well-developed cooperatives have been led by large-scale farmers or enterprises, where the leaders hold the majority of shares, while most participating farmers have none or only a small number of shares (Garnevska et al., 2011; Liu et al., 2024). On one hand, ordinary farmers lack the assets to invest in shares; on the other hand, the newly implemented legislation places excessive emphasis on the number of cooperatives, leading to several drawbacks. Deng et al. (2010) found that there are very few genuine cooperatives in China, as the main criterion for regulating cooperatives is the distribution of profits as patronage dividends. Based on transaction cost theory, appropriate conditions for cooperative development have been analyzed, revealing that the high transaction and organizational costs of cooperatives in China stem from incomplete quality supervision of agricultural products, the limited operational scale and strong heterogeneity of farmers, and the lack of effective external resource support. These are also the fundamental reasons why strong cooperatives have limited operations or activities in China.

The heterogeneity among cooperative members in terms of capital investment has led to differences in surplus distribution (Ji et al., 2023; Qiao et al., 2025). Members who invest more capital prefer surplus distribution based on shareholding, thereby compensating for capital investment differences not reflected in distribution based on transaction volume. Furthermore, members with higher capital investment are often the initiators of cooperatives, meaning that in cooperatives with significant member heterogeneity, surpluses are more likely to be distributed according to shareholding rather than transaction volume (Zou and Wang, 2022).

This paper focuses on analyzing the impact of irregularities in cooperative development. Among the various manifestations of irregular development, shell cooperatives represent one of the most serious problems and cause significant damage to the reputation of cooperatives (Chen C. et al., 2023). The impact of shell cooperatives on farmers' incomes is the primary focus of this study. Liu et al. (2017) examined the impact of farmers joining cooperatives on non-agricultural employment and concluded that cooperative membership promotes land transfers, thereby facilitating farmers' engagement in non-agricultural employment. Conversely, when cooperatives become hollowed out, the impact on farmers' land transfer behavior becomes a key concern. If shell cooperatives influence farmers' land transfer decisions, this will directly affect their operating income and, consequently, their total household income.

The structure of this paper is as follows: the second section defines shell cooperatives and analyzes their characteristics; the third section reviews the literature and proposes research hypotheses; the fourth section presents the research design; the fifth section discusses the empirical results; and the sixth section provides the conclusions and policy implications.

## 2 Definition and characteristics of shell cooperatives

### 2.1 Definition of shell cooperatives

The government has not provided a specific definition of a shell cooperative but has generally outlined the characteristics of cooperatives that may qualify as such. In 2019, the Central Rural Work Leading Group and ten other departments jointly issued the Work Plan for the Special Cleanup of Shell Cooperatives among Farmers' Professional Cooperatives. The issues addressed in the cleanup and rectification of cooperatives primarily included the following six categories: lack of actual participation by farmer members; absence of substantive production or business operations; cessation of operations due to poor management; suspected misuse of cooperative names to fraudulently obtain national fiscal subsidies and project support funds; reports of illegal activities by the public; and engagement in illegal financial activities, such as disguised high-interest deposit solicitation, high-interest lending, or operating under the guise of a bank.

According to Article 71 of the Law of the People's Republic of China on Farmers' Professional Cooperatives (Revised in 2017), "If a farmers' professional cooperative has not engaged in business operations for two consecutive years, its business license shall be revoked." In summary, the most important characteristics of shell cooperatives are the absence of actual farmer participation and the absence of actual business operations.

Existing literature has also explored the definition of shell cooperatives. Jia and Huang (2011) argued that cooperatives that do not provide services to their members are shell cooperatives. Chen F. et al. (2023) contended that the core characteristic of a shell cooperative is the absence of actual operations, thus defining cooperatives with no or minimal business activities. However, in empirical analyses, determining whether a cooperative is a shell cooperative is usually based on the overall assessment of the cooperative by investigators. Zhong et al. (2023) defined three types of fake cooperatives: (1) cooperatives that never file annual reports and are therefore considered to have no business activities; (2) cooperatives without farmer participation; and (3) cooperatives without capital contributions. Hua (2025) identified shell cooperatives using two methods: backtracking and current occurrence. The backtracking method classifies cooperatives that were deregistered or listed as operating abnormally during 2019 cleanup campaign as shell cooperatives. The current occurrence method classifies cooperatives listed as operating abnormally or subject to administrative penalties in the current period as shell cooperatives. Under this method, less than 10% of cooperatives are identified as shell cooperatives.

This paper argues that the two most important characteristics of shell cooperatives are the absence of actual farmer participation and the absence of actual business operations. In practice, the absence of actual farmer participation is difficult to identify. This is because

cooperative registration requires a minimum of five members, and it is impossible to determine solely from the data whether farmers have actually participated in the cooperative's production and business activities. Therefore, identification methods for shell cooperatives focus more on the second characteristic—namely, the absence of actual business operations.

The definition adopted in this paper is similar to that of [Chen F. et al. \(2023\)](#) but differs in that [Chen F. et al. \(2023\)](#) relied on subjective evaluation criteria to determine whether a cooperative was a shell cooperative. This paper argues that extracting operational income data from cooperatives' annual reports to determine whether they have engaged in actual business operations is a more objective approach. In accordance with Article 71 of the Law of the People's Republic of China on Farmers' Professional Cooperatives (Revised in 2017), which stipulates that “a farmers' professional cooperative that has not engaged in business operations for two consecutive years shall have its business license revoked,” this paper contends that using two consecutive years of no business operations as the criterion for identifying shell cooperatives is reasonable. Additionally, whether a cooperative has operational income in the current year serves as the basis for determining whether it is engaged in business operations.

The mechanisms through which different types of cooperatives affect farmers' incomes via hollowing out vary significantly. Therefore, this study focuses exclusively on grain-growing cooperatives—the largest category among cooperative classifications—while excluding other agricultural, livestock, and service cooperatives. This approach avoids confusion arising from differences in operational mechanisms across cooperative types.

Regarding the definition of shell cooperatives, this paper also addresses the issue of defining cooperatives in their start-up phase. During the initial stages of operation, the absence of operating income can be normal and does not necessarily indicate that a start-up cooperative is a shell cooperative. Therefore, this paper defines cooperatives established for less than 3 years as start-up cooperatives, which cannot be classified as shell cooperatives even if they report zero operating income for two consecutive years. The selection of

3 years as the cutoff point is based on the definition of zombie enterprises ([Blazková and Dvouletý, 2022](#)).

After defining cooperatives in their start-up phase, the definition of shell cooperatives becomes clearer. The specific definition can be understood in conjunction with [Figure 1](#) which illustrates four cooperative statuses. The first represents start-up cooperatives, defined as those operating for 3 years or less. During this phase, cooperatives are not classified as shell cooperatives even if they report zero income for more than two consecutive years. The remaining three statuses constitute the shell cooperative conditions defined herein. All three shell cooperative states have existed for more than 3 years. The first state is defined as a cooperative with zero income for two consecutive years and an existence period exceeding 3 years. The second state refers to a cooperative with zero income for a continuous period exceeding 2 years and an existence period exceeding 3 years. The third state is a cooperative that has existed for more than 3 years with zero income throughout its entire existence. This methodology serves as the standard for identifying shell cooperatives in subsequent analyses.

The cooperative data used in this paper are sourced from the China Academy for Rural Development–Qiyang China Agri-Research Database (CCAD). This database covers all cooperatives registered with the industrial and commercial authorities in China and provides annual report data for cooperatives. This study primarily analyzes grain-growing cooperatives as a case study. The focus on grain-growing cooperatives is based on two main considerations: Firstly, grain-growing cooperatives account for the highest proportion (20.17%) of shell cooperatives and are therefore most worthy of analysis; Secondly, this paper aims to examine the impact of shell cooperatives on farmers' incomes from the perspective of land transfer, and grain-growing cooperatives are the most closely related to land transfer activities.

Operational income indicators from published annual reports are used to determine whether a cooperative is a shell cooperative. Among cooperatives that have published annual reports, those with zero operational income for two or more consecutive years are classified as

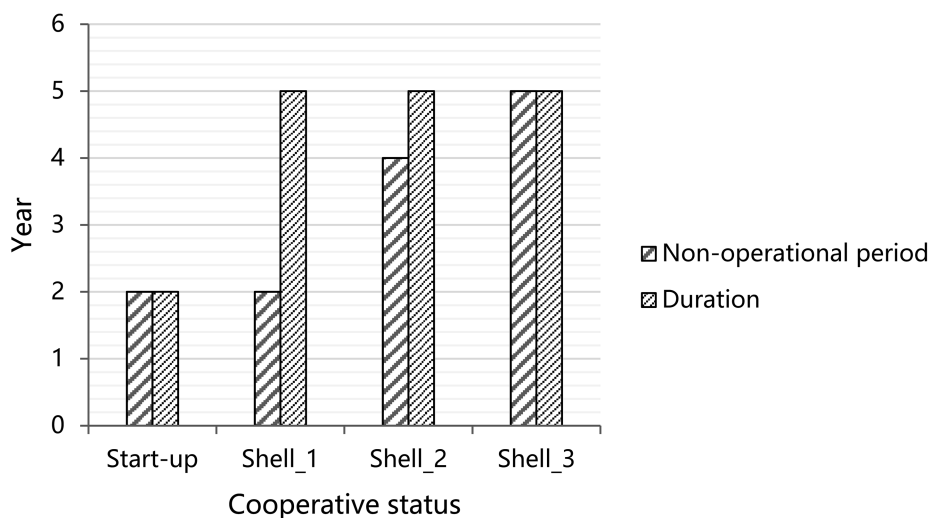


FIGURE 1  
Identification criteria for shell cooperatives.

shell cooperatives. Cooperative annual report data were first published in 2013; therefore, it became possible to identify shell cooperatives starting from 2014.

As shown in the Table 1, except for 2014 (since annual report data were only available beginning in 2013, it was only possible to determine whether a cooperative's operational income was zero for two consecutive years starting from 2014. Moreover, in the annual reports submitted in the previous 2 years, there were few cooperatives with zero operational income, resulting in a relatively low proportion of shell cooperatives in 2014), the proportion of shell cooperatives among grain-growing cooperatives calculated in this paper ranges from approximately 30 to 60%.

## 2.2 Characteristic fact

After defining shell cooperatives, a preliminary analysis can be conducted to examine the relationship between shell cooperatives and income of farmers. Cooperatives (including shell cooperatives) are matched with villages to calculate the total number of cooperatives and the number of shell cooperatives at the village level. The proportion of shell cooperatives at the village level is then computed (see below for the specific matching process).

This study matches cooperative data from the CCAD with household income data from the National Fixed Point Survey to identify the correlation between the proportion of shell cooperatives and household income. To more intuitively demonstrate the impact of the proportion of shell cooperatives on household income, this paper first calculates the average proportion of shell cooperatives across all villages (average = 0.24). Villages are then divided into two groups: those with a proportion of shell cooperatives greater than the average and those with a proportion less than the average. The average household income of the two groups of villages is then compared.

Figure 2 presents a line chart illustrating household income categorized by the proportion of shell cooperatives. As shown in the figure, between 2015 and 2017, the average household income in villages where the proportion of shell cooperatives was greater than the average amounted to 56,958.26 yuan, while the average household income in villages where the proportion was less than the average was 60,166.79 yuan. Households in villages with a higher proportion of shell cooperatives therefore exhibited lower average incomes. This

result provides preliminary evidence of a negative correlation between the proportion of shell cooperatives and household income.

## 3 Literature review and hypothesis

### 3.1 Impact of joining a cooperative on farmers's income

In the existing literature on cooperatives and farmers, most studies have focused on the impacts of cooperative participation, with a significant number concluding that joining cooperatives has a positive effect on farmers' income and technology adoption (Liu et al., 2022; Wang et al., 2023; Yang et al., 2021; Liu et al., 2025).

Gezahegn et al. (2019) examined the relationship between cooperative scale and farmers' cost-effectiveness, finding that larger cooperatives can provide members with lower service costs, thereby enabling farmers to achieve greater economies of scale. Bernard et al. (2008) investigated the impact of cooperative participation on farmers' commercial behavior and found that cooperative participation could obtain higher selling prices, although there was no significant effect on the proportion of agricultural products sold. The authors suggest that price incentives have been ineffective because greater price fluctuations led poorer farmers to increase self-consumption.

Cheyo et al. (2024) used a sample of 206 farmers in northern Uganda to explore the main drivers of participation in peanut-growing cooperatives and their commercialization activities. The study revealed that cooperatives play a key role in leasing equipment to farmers, adding value, and providing training. Moreover, cooperatives' control over product quality was found to motivate farmer participation. However, the study also showed that equity strategies—particularly membership fees and input supply—negatively affected the commercialization process of cooperative participation.

Ahado et al. (2021) analyzed the effect of joining cooperatives on potato yields and technical efficiency, finding that joining cooperatives significantly enhances both. Similarly, Abebaw and Haile (2013) investigated the influence of cooperatives on agricultural technology adoption and found that cooperative members were more likely to access agricultural technical services and engage in non-agricultural work, with cooperative membership having a significant positive effect on fertilizer use. These findings underscore the important role of cooperatives in accelerating the adoption of agricultural technologies.

Bachke (2019) employed a difference-in-differences model to study the impact of joining farmer organizations on welfare outcomes in Mozambique. The study found that joining farmer organizations increases farmers' market surplus, enhances the value of agricultural products, and boosts total income. Kumar et al. (2018), using a sample of 148 randomly selected dairy farmers in India, found that joining a cooperative was significantly and positively associated with milk production, net profit, and adherence to food safety measures, with the effects being more pronounced among small-scale farmers. Likewise, Ma and Abdulai (2016), using data from Chinese apple-growing households, found through an endogenous switching model that joining a cooperative positively influenced apple production, net profit, and overall farmer income, again with stronger effects for small-scale farmers.

However, some studies suggest that joining cooperatives has limited effects on improving farmers' standard of living. Jena et al.

TABLE 1 Proportion of shell cooperatives in grain-growing cooperatives.

| Year | Number of cooperatives | Number of shell cooperatives | Proportion of shell cooperatives |
|------|------------------------|------------------------------|----------------------------------|
| 2015 | 245,176                | 105,428                      | 43.00%                           |
| 2016 | 293,986                | 143,019                      | 48.65%                           |
| 2017 | 337,481                | 111,687                      | 33.09%                           |
| 2018 | 369,037                | 116,038                      | 31.44%                           |
| 2019 | 382,175                | 140,790                      | 36.84%                           |
| 2020 | 398,178                | 205,905                      | 51.71%                           |
| 2021 | 402,862                | 259,508                      | 64.42%                           |
| 2022 | 409,673                | 149,631                      | 36.52%                           |

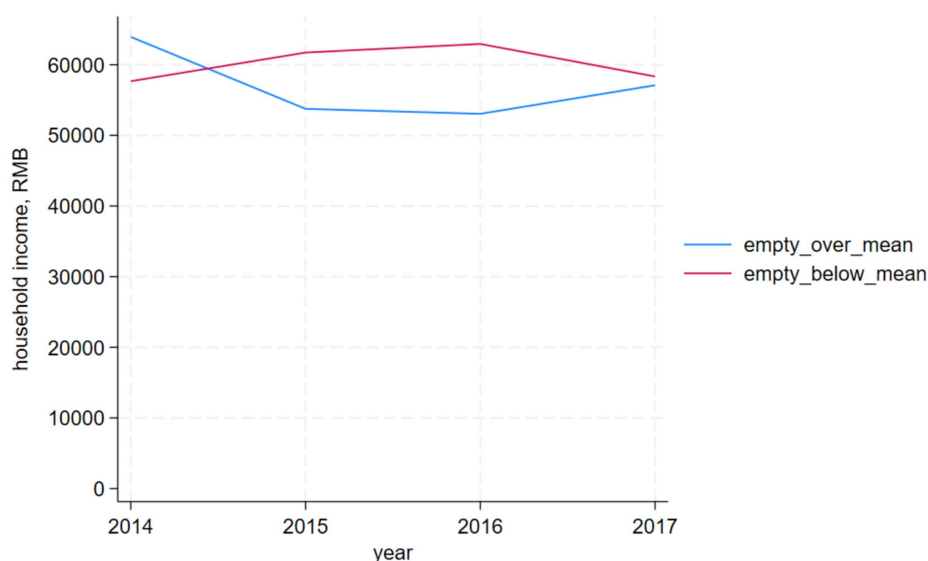


FIGURE 2

Line chart showing farm household income classified by the proportion of Shell cooperatives.

(2012) examined the impact of agricultural product certification on smallholder farmers' living standards—including income, consumption, and poverty levels—and found that certification for coffee cooperatives had little noticeable effect. The study highlighted differences in production and organizational capacity among cooperatives as key factors influencing farmers' ability to benefit from certification. Similarly, Di Marcantonio et al. (2022) analyzed the effects of dairy farms in four European countries joining producer organizations (similar to cooperatives) on trade conditions and bargaining power. The study found that joining producer organizations reduced the frequency of unfair trade practices and also reduced the farms' bargaining power.

### 3.2 Reasons for the formation of shell cooperatives

Shell cooperatives represent a classic manifestation of the principal-agent problem (Hua, 2025). The development of cooperatives is one of the central government's key objectives for rural revitalization; however, the authority to establish cooperatives rests primarily with local governments and the public. Local governments, motivated by career advancement, and the public, driven by the desire to obtain cooperative-related subsidies, have strong incentives to establish shell cooperatives. In this setting, the central government acts as the principal, seeking to revitalize the rural economy by promoting the development of farmers' cooperatives, while local officials and citizens serve as agents who possess considerable autonomy over the procedure and timing of cooperative formation.

Due to performance assessments that link cooperative establishment to local government performance evaluations, officials often prioritize registering new cooperatives rather than managing existing ones effectively. Consequently, short-term economic incentives lead local governments to favor the establishment of

nominal cooperatives that exist in name only, primarily to secure subsidies rather than engaging in business operational activities.

The rapid growth of farmers' cooperatives in China has been closely tied to government support. Chen F. et al. (2023) argued that because the social functions of cooperatives cannot be fully realized through market mechanisms alone, government support for their development of farmers' cooperatives is justified. While cooperatives typically exhibit lower economic efficiency than private agricultural enterprises, they compensate through their social and community functions. To ensure sustainable development, the Chinese government incorporated cooperative performance indicators into the evaluation metrics of local institutions.

Seemingly, the decade following the enactment of the Law of the People's Republic of China on Farmers' Professional Cooperatives in 2007 witnessed rapid growth in both the number and membership of rural cooperatives. However, excessive government intervention simultaneously produced non-standard and distorted market outcomes. Chen F. et al. (2023) estimated the proportion of shell cooperatives before and after 2014 based on nationally representative survey data from 504 cooperatives in Jiangsu, Jilin, and Sichuan provinces. Using a subsample of 241 marketing cooperatives, their empirical analysis revealed that direct administrative intervention led to the emergence of different shell cooperatives—approximately 37% of the total. Furthermore, the analysis confirmed that task-oriented policy support was positively correlated only with nominal coverage and had no significant impact on the functional performance of cooperatives. These findings suggest that direct administrative intervention, while initially promoting expansion, cannot be conducive to the long-term healthy development of cooperatives.

The mismanagement and weak controls of government subsidies further encourage subsidy-seeking behavior among cooperatives, distorting incentive mechanisms and resulting in a "bad money drives out good" phenomenon (Li et al., 2024). Such subsidy-seeking motives of farmers' cooperatives arise mainly from two effects: the inducement effect and the misdirection effect.

The inducement effect exhibits as “excessive pursuit”—that is, as more cooperatives receive subsidies, the perceived threshold for obtaining support lowers, encouraging additional cooperatives to focus on qualifying for subsidies rather than improving operational efficiency or market competitiveness (Yu et al., 2025; Li et al., 2025). On the other hand, the misdirection effect, a subset of the inducement effect, occurs when an increasing number of shell cooperatives receive government subsidies which leads farmers to mistakenly believe that operational performance is not a prerequisite for financial support. This misconception reinforces subsidy-seeking behavior and further accelerates the formation of shell cooperatives.

Subsidy-seeking behavior can therefore shift government subsidies from serving as incentives for development to fueling the proliferation of shell cooperatives. On one hand, such behavior diminishes cooperatives’ competitiveness, making it difficult for them to survive in market competition. Although government subsidies do not directly influence the total factor productivity of market organizations (Crisuolo et al., 2019), they shape competitiveness by altering cost–benefit structures. However, excessive subsidy-seeking disrupts these structures (Kalouptsi, 2018), increasing the costs of maintaining political connections with local governments and weakening long-term growth potential and market competitiveness (Chen and Yu, 2019).

On the other hand, subsidy-seeking reduces internal controls and management, preventing subsidies from being effectively invested in cooperative operations. The costs associated with acquiring subsidies make cooperatives more likely to divert funds for non-productive purposes, raising the risk of misappropriation or personal misuse (Zhang and Xu, 2019). Empirical evidence of government subsidies leading to the formation of shell cooperatives through small-scale surveys supports this concern. Chen F. et al. (2023), analyzing cooperative data from three Chinese provinces, found that administrative intervention significantly contributed to the rise of shell cooperatives. Task-oriented policy support increased the nominal number of cooperatives but had no significant effect on their operational performance. Due to differences in perception among market entities, government subsidies can inadvertently induce or mislead cooperatives, reinforcing the misconception that “establishing a cooperative qualifies for government subsidies” and thereby exacerbating the formation of shell cooperatives.

### 3.3 Hypothesis

The central focus of this study is to examine the impact of shell cooperatives on farmers’ income. The most relevant work to this study is Hua (2025), who analyzed the effect of the proportion of shell cooperatives at the county level on rural poverty reduction. The results indicated that as the proportion of shell cooperatives increases, the per capita income of low-income farmers decreases, income disparities within rural areas widen, and the likelihood of escaping poverty declines. Mechanism analysis further indicated that the presence of shell cooperatives diverts subsidies and loans that should benefit farmers, reduces the supply of rural public goods, and diminishes social trust among rural residents.

While Hua’s (2025) findings are significant, his study has two key limitations. First, the measurement of shell cooperatives at the county level does not accurately capture the relationship between farmers and

cooperatives at the micro (village or household) level. Second, the analysis of mechanisms overlooks the role of land transfer, an important channel through which shell cooperatives can influence farmers’ income. To address these gaps, our study identifies shell cooperatives at the village level, calculates the proportion of shell cooperatives within each village, and examines how they affect farmers’ income through the mechanisms of land transfer and participation in cooperative activities.

Existing research on the relationship between shell cooperatives and farmers’ welfare primarily employs the principal–agent theory framework. Within this framework, the central government acts as the principal, responsible for rural revitalization and agricultural modernization, while local governments function as agents, implementing these objectives by promoting the establishment of farmers’ cooperatives. Driven by performance-based incentives, local governments tend to prioritize the formation of new cooperatives to meet quantitative targets rather than ensuring the effective management of existing ones. As a result, many nominal cooperatives—commonly referred to as shell cooperatives—emerge. Moreover, information asymmetry between the principal and agent prevents the central government from accurately monitoring cooperative quality at the local level, indirectly contributing to their proliferation.

Although the traditional principal–agent framework helps explain the widespread emergence of shell cooperatives, it does not adequately account for their effects on household-level outcomes. Specifically, it fails to explain how shell cooperatives influence farmers’ behavior, land use, and income. To address this limitation, this study refines the principal–agent model by introducing a two-tier agency structure, in which local governments act as intermediate agents and farmers as sub-agents. In this mechanism, local governments receive directives from the central government and transmit these to farmers, who are tasked with establishing and operating cooperatives. Once cooperative formation is delegated to the farmer level, local governments become less concerned with their operational performance, focusing instead on the number of cooperatives established. Consequently, many cooperatives evolve into shell cooperatives over time due to poor management and controls.

This extended two-tier framework enables a more granular analysis of how shell cooperatives affect farmers’ economic behavior and their income. The relationship between farmers and cooperatives can be categorized as direct or indirect. Here, Direct involvement refers to farmers who participate in cooperatives, benefiting from services such as access to production inputs, agricultural machinery, crop protection, and collective marketing. On the other hand, Indirect involvement occurs when farmers do not participate directly but engage with cooperatives through land leasing arrangements, transferring land to cooperative members for cultivation.

When a village cooperative becomes a shell cooperative, directly involved farmers lose access to production services, face higher input costs, and encounter reduced market access. Consequently, rational cooperative members tend to scale back production rather than expansion, reducing the scale of land inflows. Indirectly involved farmers, who lease their land to cooperatives, are similarly affected: as demand for leased land declines, land transfers and rental income decrease.

Therefore, the influence of shell cooperatives on land transactions operates through both direct and indirect effects. However, the direct

involvement effects—particularly those linked to reduced cooperative services—are likely to materialize more quickly. Empirical evidence is expected to show that the proportion of shell cooperatives primarily affects land inflows (cooperatives' land acquisition) rather than land outflows (farmers' land leasing). As cooperative efficiency declines, directly involved farmers can become less willing to engage in agricultural activities and instead seek non-agricultural employment. Nevertheless, due to labor market frictions and structural constraints, the likelihood of transitioning to non-agricultural employment does not increase significantly in the short term.

Based on the above analysis, the following research hypotheses are proposed:

*Hypothesis 1:* the higher the proportion of shell cooperatives at the village level, the greater the decline in household income.

*Hypothesis 2:* shell cooperatives reduce household operating income by lowering the proportion of land transfers.

## 4 Research design

### 4.1 Model design

In the factual section, we preliminarily concluded that there is a negative correlation between the proportion of shell cooperatives and farmers' income. In the empirical analysis section, we will further explore the causal relationship between them. Referring to [Hua \(2025\)](#), we constructed the following econometric model:

$$Y_{it} = \alpha_0 + \alpha_1 \cdot shell_{vt} + Z \cdot \beta + \mu_t + \omega_i + \varepsilon_{it} \quad (1)$$

Among these,  $Y_{it}$  is the total household income of farmer  $i$  in year  $t$ ,  $shell_{vt}$  represents the proportion of shell cooperatives in village  $v$  where farmer  $i$  resides in year  $t$ , and  $Z$  includes a series of control variables at the farmer and province levels.  $\mu_t$  is the year fixed effect,  $\omega_i$  is the household fixed effect,  $\varepsilon_{it}$  is the random disturbance term.

### 4.2 Variable selection

#### 4.2.1 Dependent variable

The dependent variable in this study is total annual household income ( $h\_income$ ), which comprises four components: operating income, wage income, property income, and transfer income. In a typical farming household, *operating income* primarily refers to agricultural income, while *wage income* denotes non-agricultural income. *Property income* includes rental income from land and housing, and *transfer income* represents various government subsidies and allowances. In the empirical analysis, the natural logarithm of household income is used to normalize the data distribution.

#### 4.2.2 Independent variable

The key independent variable in this paper is the proportion of shell cooperatives at the village level ( $v\_shell$ ). The calculation method follows the procedure outlined in the definition section. Specifically, among cooperatives that publicly disclosed annual reports, those reporting zero operating income for two consecutive years are identified

as *shell cooperatives*. These cooperatives are then matched with villages to compute the proportion of shell cooperatives within each village.

#### 4.2.3 Control variables

Following [Hua \(2025\)](#), two categories of control variables are included: household-level variables and province-level variables.

- *Household-level variables* capture demographic and socioeconomic characteristics.
  - *Health status* ( $h\_health$ ): measured by the average self-rated health level of household members.
  - *Education level* ( $h\_edu$ ): represented by the average years of schooling among household members.
  - *Gender structure* ( $h\_gender$ ): expressed as the proportion of female members in the household.
  - *Age structure*: captured through two indicators—the number of household members under 15 years old ( $h\_young$ ) and those over 60 years old ( $h\_old$ ).
- *Province-level variables* control for regional socioeconomic conditions.
  - *Road density* ( $p\_road$ ): kilometers of road per square kilometer of land area.
  - *Rail density* ( $p\_rail$ ): kilometers of railway per square kilometer.
  - *Population density* ( $p\_pop$ ): number of people per square kilometer.
  - *Export share* ( $p\_export$ ): ratio of export value to provincial GDP.
  - *Primary industry wage level* ( $p\_salary$ ): average wage in the primary industry.
  - *Fiscal expenditure on agriculture* ( $p\_fiscal$ ): proportion of agriculture-related government spending relative to GDP.
  - *Primary industry value added* ( $p\_prim$ ): proportion of primary industry value added to provincial GDP.

### 4.3 Data sources and matching

#### 4.3.1 Cooperative data

The primary independent variable in this study is whether a cooperative is a shell cooperative, which is determined based on cooperative income data. The cooperative data are obtained from the China Academy for Rural Development–Qiyang China Agri-research Database (CCAD). This database contains detailed information on various types of new agricultural business entities in China, including agricultural enterprises, family farms, and cooperatives, along with their business registration records. The dataset includes financial and fundamental attributes such as registered capital, establishment and dissolution dates, number of members, geographic coordinates (latitude and longitude), assets, and income.

Using this information, cooperatives are matched with villages based on their geographic coordinates. Moreover, shell cooperatives are identified based on their annual income data, following the criterion of having zero operating income for two consecutive years.

#### 4.3.2 Household data

The household-level data used in this study are derived from the National Fixed Point Survey (NFPS), compiled by the Ministry of Agriculture and Rural Affairs. The NFPS is a bookkeeping-style panel dataset jointly managed by the Central Policy Research Office

TABLE 2 Descriptive statistics of variables.

| Variable | Definition                                                                                           | Mean     | SD       |
|----------|------------------------------------------------------------------------------------------------------|----------|----------|
| h_income | Total household income, yuan                                                                         | 50419.07 | 51572.52 |
| v_empty  | Proportion of grain-growing shell cooperatives in villages                                           | 0.19     | 0.31     |
| h_health | Average self-rated health status of family members                                                   | 3.32     | 0.78     |
| h_edu    | Average years of education among family members, year                                                | 7.05     | 2.27     |
| h_gender | Proportion of female members in the family                                                           | 0.47     | 0.17     |
| h_young  | Number of family members under the age of 15, persons                                                | 0.57     | 0.79     |
| h_old    | Number of family members above the age of 60, persons                                                | 0.67     | 0.84     |
| p_road   | Province-level road density, kilometers/square kilometer                                             | 0.88     | 0.40     |
| p_rail   | Province-level rail density, kilometers/square kilometer                                             | 0.02     | 0.01     |
| p_pop    | Province-level number of hukou residents per square kilometer in the county, people/square kilometer | 363.07   | 413.24   |
| p_export | Province-level export share                                                                          | 0.14     | 0.17     |
| p_salary | Province-level primary industry wage level, yuan                                                     | 21826.45 | 6965.274 |
| p_fiscal | Province-level share of fiscal expenditure on agriculture                                            | 0.03     | 0.02     |
| p_prim   | Province-level share of primary industry value added                                                 | 0.11     | 0.04     |

and the Ministry of Agriculture and Rural Affairs, and implemented by the National Fixed Point Office. The survey began in 1986 and annually selects counties at varying income levels from each province. Within each county, representative sample villages are chosen, and households within these villages are tracked continuously over time.

Excluding 1992 and 1994, the NFPS includes 30 panel data periods up to 2017, covering 31 provinces (excluding Hong Kong, Macao, and Taiwan), 355 county-level units, and an average of over 20,000 households per year. This dataset provides detailed information on household income, demographics, production activities, and other socioeconomic characteristics.

### 4.3.3 Province-level data

The province-level control variables are sourced from the China Statistical Yearbook, a comprehensive dataset offering detailed statistics on the socio-economic development of China's provinces from 2000 to 2022. The yearbook covers multiple sectors—including the economy, culture, education, and healthcare—and contains over 500 statistical indicators and millions of data points, providing a reliable basis for provincial-level analysis.

### 4.3.4 Data matching process

The data matching process primarily involves linking cooperative microdata from the CCAD with village-level data from the NFPS. The matching is carried out in several stages:

1. *Initial matching*: cooperative microdata from CCAD are first matched with NFPS village data using fuzzy matching techniques.
2. *Geographic matching*: using the latitude and longitude coordinates of cooperatives, NFPS village locations are identified. All cooperative samples within a 3-kilometer radius of each survey village are obtained to establish household-cooperative microdata.
3. *County code alignment*: County codes are assigned to both cooperatives and villages. The datasets are merged using the

*joinby* command in Stata, retaining only pairs of cooperatives and villages located within the same county.

4. *Distance calculation*: the straight-line (Euclidean) distance between each cooperative and village is calculated using their geographic coordinates. For each cooperative, only the shortest distance is retained, ensuring that each cooperative is matched with a single village.
5. *Final filtering*: samples with distances greater than 3 kilometers are excluded. This distance threshold is justified by calculating the average village area in China—dividing the total national village area by the number of villages yields an area approximately equivalent to a circle with a 3-km radius.

The final matched dataset provides a comprehensive linkage between household microdata and cooperative microdata, allowing for robust analysis of the relationship between shell cooperatives and household income (see Table 2).

## 5 Empirical findings

### 5.1 Baseline findings

Table 3 presents the estimation results of Equation 1.

Models (1) to (3) correspond to estimations without control variables, with household-level control variables only, and with both household-level and province-level control variables, respectively. The estimation results indicate that a higher proportion of shell cooperatives at the village level significantly reduces household income. Specifically, for every 1% increase in the proportion of shell cooperatives at the village level, household income in that village decreases by 6.4% (approximately 1,966.34 yuan). This finding aligns closely with Hua (2025), who reported that for every one standard deviation increase in the proportion of shell cooperatives at the county level, household income decreases by 3.4%. The consistency between these results further validates the negative

TABLE 3 Empirical results on the impact of shell cooperatives on farmers' income.

| Variables          | (1)        | (2)       | (3)         |
|--------------------|------------|-----------|-------------|
|                    | Income     | Income    | Income      |
| Shell cooperatives | −0.0442    | −0.0633** | −0.0641**   |
|                    | (0.0322)   | (0.0319)  | (0.0322)    |
| health_h           |            | 0.1526*** | 0.1523***   |
|                    |            | (0.0238)  | (0.0238)    |
| edu_h              |            | 0.0563*** | 0.0568***   |
|                    |            | (0.0082)  | (0.0082)    |
| female_r           |            | 0.0496    | 0.0450      |
|                    |            | (0.1027)  | (0.1023)    |
| young_h            |            | 0.1425*** | 0.1408***   |
|                    |            | (0.0168)  | (0.0169)    |
| old_h              |            | −0.0306   | −0.0311     |
|                    |            | (0.0204)  | (0.0205)    |
| road_p             |            |           | 1.0738***   |
|                    |            |           | (0.2424)    |
| rail_p             |            |           | −12.5926*** |
|                    |            |           | (4.3782)    |
| pop_p              |            |           | 0.9060      |
|                    |            |           | (0.9183)    |
| export_p           |            |           | 0.0051      |
|                    |            |           | (0.0052)    |
| salary_p           |            |           | −0.1550     |
|                    |            |           | (0.1162)    |
| fiscal_p           |            |           | −0.0335*    |
|                    |            |           | (0.0199)    |
| prim_p             |            |           | −0.0232*    |
|                    |            |           | (0.0140)    |
| _cons              | 10.5206*** | 9.5486*** | 5.4079      |
|                    | (0.0078)   | (0.1178)  | (5.0540)    |
| Household fixed    | Yes        | Yes       | Yes         |
| Year fixed         | Yes        | Yes       | Yes         |
| N                  | 16,077     | 16,077    | 16,077      |
| r2                 | 0.8778     | 0.8837    | 0.8843      |

① \*, \*\* and \*\*\* indicate significance at 10, 5, and 1% levels, respectively; ② the values in parentheses are heteroscedasticity-robust standard errors.

relationship between the prevalence of shell cooperatives and farmers' income. Regarding the control variables, the estimation results indicate that the average health status and average years of education of household members exert a significant positive influence on household income. Likewise, provincial road density also shows a significant positive association with household income. Specifically, for every 1-unit increase in the average self-assessed health score of household members, total household income rises by 15.2%, while an additional year of average education among household members corresponds to a 5.7% increase in total household income.

## 5.2 Robustness

This paper conducts a series of robustness tests using Model (3) in Table 3 as the benchmark specification. First, village-level fixed effects are added. In the benchmark model, only household-level fixed effects were controlled for, and village-level control variables were not included. To address potential endogeneity arising from omitted village-level characteristics, this test incorporates village-level fixed effects. The results remain consistent with the benchmark model, confirming the robustness of the findings.

Second, we incorporated county-level fixed effects. In the benchmark estimations, only household-level fixed effects were controlled, and no county-level control variables were included. To prevent potential endogeneity issues caused by omitted variables at the county level, we further controlled county-level fixed effects and the results show robustness.

Third, the number of family farms in each village is controlled for. The subsequent mechanism analysis primarily examines the impact of the emergence of shell cooperatives on farmers' land transfer behavior. If the emergence of shell cooperatives discourages farmers from leasing land to cooperatives, they can instead transfer land to large family farms. This can lead to the objection that the emergence of shell cooperatives increase farmers' income. To reduce this potential bias, the number of family farms at the village level is included as a control variable. The results show that after controlling this factor, the negative effect of the proportion of shell cooperatives on farmers' income becomes even stronger.

Fourth, we control for the effect of capital inflows to rural areas, a key policy initiative during the study period. The policy of encouraging capital to flow into rural areas can simultaneously influence both the formation of shell cooperatives and household income, necessitating its inclusion as a control. Considering that the primary vehicle for capital inflows is the establishment of agriculture-related enterprises in villages, this paper uses the number of agriculture-related enterprises in each village as a proxy variable for capital inflows. Model (4) shows that, even after controlling for this variable, the regression results remain robust (see Table 4).

## 5.3 IV Regression

The proportion of shell cooperatives at the village level in this study has strong endogeneity issue, necessitating the use of an appropriate instrumental variable (IV) to address this. Two possible IVs are identified.

The first IV is the average proportion of shell cooperatives across other villages within the same province. Among the 355 villages included in the National Fixed Point Survey, 252 villages were successfully matched with grain-growing cooperatives distributed across 30 provinces. Villages within the same province tend to exhibit correlated proportions of shell cooperatives. However, given the significant geographical distance between surveyed villages in the same province, the average proportion of shell cooperatives in other villages is unlikely to exert a direct influence on household income in the target village, which is satisfying the exogeneity condition.

The second IV is the lagged proportion of shell cooperatives within the same village. This lagged measure is strongly correlated with the current proportion of shell cooperatives but does not directly affect current household income. In this study, both the one-period

TABLE 4 Robustness test regression results.

| Variables          | (1)           | (2)          | (3)         | (4)                 |
|--------------------|---------------|--------------|-------------|---------------------|
|                    | Village fixed | County fixed | Family farm | Capital going rural |
| Shell cooperatives | −0.0641**     | −0.0641**    | −0.0766*    | −0.0635*            |
|                    | (0.0322)      | (0.0322)     | (0.0396)    | (0.0329)            |
| Control            | Yes           | Yes          | Yes         | Yes                 |
| Household fixed    | Yes           | Yes          | Yes         | Yes                 |
| Year fixed         | Yes           | Yes          | Yes         | Yes                 |
| Village fixed      | Yes           | No           | No          | No                  |
| County fixed       | No            | Yes          | No          | No                  |
| N                  | 16,077        | 16,077       | 11,759      | 15,149              |
| r2                 | 0.8843        | 0.8843       | 0.8818      | 0.8864              |

① \*, \*\* and \*\*\* indicate significance at 10, 5, and 1% levels, respectively; ② the values in parentheses are heteroscedasticity-robust standard errors.

and two-period lagged proportions of shell cooperatives at the village level are included in IV regression.

The regression results are summarized as follows.

In Model (1), the mean proportion of shell cooperatives across other villages in the same province is used as IV. The estimation results are statistically insignificant. A likely explanation is that surveyed villages in the National Fixed Point Survey are geographically dispersed even within provinces, resulting in weak correlations among the proportions of shell cooperatives across villages and, consequently, insignificant IV regression estimations.

In Model (2), the IVs are the one-period and two-period lagged values of the proportion of shell cooperatives within each village. The IV estimation results remain significantly negative, indicating that although endogeneity exists for the key independent variable, its impact on the estimated results is relatively minor.

We report the Cragg–Donald Wald F-statistic for both models. Typically, a value above 10 suggests the absence of a weak instrument problem. In Table 1, both Model (1) and Model (2) yield F-statistics exceeding 10, indicating that neither model suffers from weak instrumentation. For overidentification testing—applicable when the number of instruments exceeds the number of endogenous variables—we perform the Hansen *J*-test for Model (2). The Hansen *J* statistic of 0.452 ( $p = 0.502$ ) fails to reject the null hypothesis that all instruments are exogenous, confirming the validity of the selected instruments and the robustness of the estimation results (see Table 5).

## 5.4 Mechanism

To explore the mechanism through which the proportion of shell cooperatives affects household income, this paper decomposes total household income into four components: wage income, operating income, property income, and transfer income. The objective is to identify which specific income category is most affected by the proportion of shell cooperatives. The empirical results are presented in Table 6.

TABLE 5 Instrumental variables regression results.

| Variables                       | (1)      | (2)        |
|---------------------------------|----------|------------|
|                                 | Income   | Income     |
| Shell cooperatives              | −0.0031  | −0.2499*** |
|                                 | (0.0959) | (0.0906)   |
| Control                         | Yes      | Yes        |
| Household fixed                 | Yes      | Yes        |
| Year fixed                      | Yes      | Yes        |
| First-stage <i>F</i> -statistic | 1592.93  | 251.50     |
| N                               | 16,077   | 3,296      |
| r2                              | 0.0525   | 0.0136     |

① \*, \*\* and \*\*\* indicate significance at 10, 5, and 1% levels, respectively; ② the values in parentheses are heteroscedasticity-robust standard errors.

TABLE 6 Analysis of income distribution mechanisms.

| Variables          | (1)      | (2)        | (3)      | (4)      |
|--------------------|----------|------------|----------|----------|
|                    | Wage     | Operating  | Property | Transfer |
| Shell cooperatives | −0.0264  | −0.0943*** | −0.0748  | 0.1345** |
|                    | (0.1134) | (0.0291)   | (0.0943) | (0.0597) |
| Control            | Yes      | Yes        | Yes      | Yes      |
| Household fixed    | Yes      | Yes        | Yes      | Yes      |
| Year fixed         | Yes      | Yes        | Yes      | Yes      |
| N                  | 12,293   | 12,293     | 12,293   | 12,293   |
| r2                 | 0.8529   | 0.8772     | 0.8360   | 0.8693   |

① \*, \*\* and \*\*\* indicate significance at 10, 5, and 1% levels, respectively; ② the values in parentheses are heteroscedasticity-robust standard errors.

The findings reveal that the proportion of shell cooperatives significantly reduces household operating income while increasing household transfer income, with no significant effect on wage income or property income. Specifically, a 1% increases in the proportion of shell cooperatives leads to a 9.4% declines in operating income (equivalent to 2,552.32 yuan) and a 13.5% increases in transfer income (equivalent to 115.67 yuan).

These results indicate that shell cooperatives primarily influence farmers through changes in their operating and transfer income, with the decline in operating income substantially outweighing the modest rise in transfer income—ultimately leading to an overall reduction in total household income. The reasons for the decline in operating income will be further discussed in the subsequent sections of this paper. Regarding the observed increase in transfer income, this study argues that a higher proportion of shell cooperatives increases the probability of households falling into low-income status (Hua, 2025), thereby raising their chances of receiving government subsidies designated for low-income households.

Why has the operating income of farmers decreased? This paper analyzes this issue from the perspective of land transfer. After the emergence of shell cooperatives, farmers lost their source of high-quality, low-cost production factors and their channels for accessing sales markets. As a result, farmers became less willing to expand their operations and even reduced their scale of operations. Consequently, the overall area of land transferred decreased, and farmers became less

TABLE 7 Analysis of land transfer mechanisms.

| Variables          | (1)                  | (2)                    |
|--------------------|----------------------|------------------------|
|                    | Land transferred out | Land transferred in    |
| Shell cooperatives | −0.0186<br>(0.0174)  | −0.0540***<br>(0.0134) |
| Control            | Yes                  | Yes                    |
| Household fixed    | Yes                  | Yes                    |
| Year fixed         | Yes                  | Yes                    |
| N                  | 17,223               | 17,223                 |

① \*, \*\* and \*\*\* indicate significance at 10, 5, and 1% levels, respectively; ② the values in parentheses are heteroscedasticity-robust standard errors; ③ the area of land transferred out and transferred in is left-truncated, so it is estimated using the Tobit model.

willing to engage in agricultural production activities. The empirical results in Table 7 indicate that a 1% increases in the proportion of shell cooperatives leads to a 5.4% decreases in the average area of land transferred into by farmers, while the impact on the area of land transferred out by farmers is insignificant.

After joining cooperatives, farmers can typically obtain productive loans through cooperative channels to expand their operations and increase income. However, as the proportion of shell cooperatives increases, farmers' access to such loans tends to decline, which is expected to negatively impact bank financing and consequently reduce the total farmers' income.

Regarding the subsidy mechanism, shell cooperatives often exhibit a tendency to capture government subsidies, diverting funds originally intended for farmers. As a result, in villages with a higher proportion of shell cooperatives, farmers receive limited government subsidies, further diminishing their income.

Empirical results indicate that while the proportion of shell cooperatives does not have a significant impact on farmers' access to credit, but it has a significant negative impact on subsidy income. Specifically, a higher presence of shell cooperatives substantially reduces the grain subsidies and agricultural machinery subsidies received by farmers. This finding suggests that shell cooperatives get subsidies intended for farmers, thereby contributing to the observed decline in farmers' income (see Table 8).

## 5.5 Heterogeneity

The above analysis demonstrates that the proportion of shell cooperatives at the village level affects total household income primarily by influencing farmers' operating income. This study finds that farmers with lower total income typically have a higher proportion of operating income. Consequently, shell cooperatives can have a stronger impact on low-income farmers and the ones having higher proportion in operating income.

To examine this heterogeneity, this study constructs two dummy variables: dum1, which is if a household's total income is below the sample mean, and dum2, which is if the proportion of household operating income is above the sample mean. These dummy variables are then interacted with the proportion of shell cooperatives to analyze heterogeneous effects of proportion of shell cooperatives on households.

TABLE 8 Mechanism verification of regression results.

| Variables          | (1)                | (2)                    | (3)                    | (4)                    |
|--------------------|--------------------|------------------------|------------------------|------------------------|
|                    | Loan               | Total subsidy          | Food subsidy           | Machine subsidy        |
| Shell cooperatives | 3.1972<br>(2.9893) | −0.5978***<br>(0.1222) | −0.5923***<br>(0.0462) | −0.2675***<br>(0.0628) |
| Control            | Yes                | Yes                    | Yes                    | Yes                    |
| Household fixed    | Yes                | Yes                    | Yes                    | Yes                    |
| Year fixed         | Yes                | Yes                    | Yes                    | Yes                    |
| N                  | 17,423             | 16,077                 | 16,077                 | 16,077                 |
| r2                 | —                  | 0.8648                 | 0.8182                 | 0.4260                 |

① \*, \*\* and \*\*\* indicate significance at 10, 5, and 1% levels, respectively; ② the values in parentheses are heteroscedasticity-robust standard errors; ③ due to the prevalence of zero values in the farmer credit variable in Model (1), a Tobit model was employed for estimation.

TABLE 9 Heterogeneity analysis.

| Variables               | (1)                    | (2)                   |
|-------------------------|------------------------|-----------------------|
|                         | Income                 | Income                |
| Shell cooperatives      | 0.0225<br>(0.0165)     | −0.0119<br>(0.0189)   |
| Shell cooperatives*dum1 | −0.0971***<br>(0.0204) |                       |
| dum1                    | −0.7522***<br>(0.0187) |                       |
| Shell cooperatives*dum2 |                        | −0.0672**<br>(0.0266) |
| dum2                    |                        | 0.0202<br>(0.0276)    |
| Control                 | Yes                    | Yes                   |
| Household fixed         | Yes                    | Yes                   |
| Year fixed              | Yes                    | Yes                   |
| N                       | 16,072                 | 16,072                |
| r2                      | 0.9172                 | 0.8829                |

① \*, \*\* and \*\*\* indicate significance at 10, 5, and 1% levels, respectively; ② the values in parentheses are heteroscedasticity-robust standard errors.

The empirical results, presented in Table 9, show that the interaction terms between the proportions of shell cooperatives and both dum1 and dum2 are significantly negative. This indicates that households with total income below the average and households with a higher proportion of operating income are more likely to be negatively affected by the presence of shell cooperatives.

## 6 Conclusion

Amid the continuous expansion in the number of cooperatives, ensuring the quality of cooperative development has become increasingly important. This paper focuses on the issue of irregularities in the development of grain-planting cooperatives, with an in-depth study of

the uprising issue of shell cooperatives. Cooperatives were originally intended to serve as crucial bridges connecting smallholder farmers with larger markets. However, the emergence of shell cooperatives disrupts this linkage mechanism and a significant impact on farmers' incomes.

This study empirically examines the impact of grain-growing shell cooperatives on farmers' incomes. The results show that a higher proportion of shell cooperatives at the village level is associated with lower farmers' incomes, with a series of robustness tests confirming this research inferring. The mechanism analysis further reveals that shell cooperatives primarily affect farmers' income by reducing the amount of land they lease, thereby diminishing their operating income. Specifically, as the proportion of shell cooperatives increases, the amount of leased farmland and the resulting operational income both decline. The heterogeneity analysis also indicates that farmers with below-average total household income and those with a higher proportion of operating income are more vulnerable to the negative effects of shell cooperatives.

Based on these findings, this study concludes that shell cooperatives have a significant negative impact on farmers' incomes within grain-growing cooperatives—mainly through reductions in both operating income and subsidy income. To address this issue, the government should intensify the investigation of shell cooperatives that fraudulently obtain subsidies, ensuring that agricultural subsidies are accurately distributed to the farmers. This would enhance farmers' motivation for grain cultivation and improve their agricultural income.

At the same time, future cooperative development policies should emphasize quality over quantity by standardizing registration procedures, daily operations, and financial accounting practices to minimize the emergence of shell cooperatives. Given that these entities disproportionately affect low-income farmers and those reliant on operational income, regulatory policies should be aligned with income-enhancement initiatives. With strict controls and supervision, proactive guidance should be provided to guide cooperatives to drive income growth among low-income farming households.

Furthermore, the exit mechanism for inactive cooperatives should be refined to ensure that poorly managed or long-dormant cooperatives withdraw from the market in an orderly manner to foster a favorable environment for cooperative development. Farmers' cooperatives should be encouraged to establish robust operational mechanisms that truly embody the principles of “farmer-run, farmer-managed, and farmer-benefited” organizations. Efforts should also be made to attract more farmers to join cooperatives, positioning them as key step for implementing national agricultural programs and innovating fiscal support mechanisms. Finally, cooperatives should strengthen institutional capacity, consolidate organizational foundations, and enhance service quality—providing low-cost, efficient services that link all stages of agricultural production and operation, thereby offering strong organizational support for the modernization of agriculture.

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## Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

## Author contributions

YY: Conceptualization, Writing – original draft, Writing – review & editing. ZL: Data curation, Methodology, Writing – review & editing.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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