Farmers' Cooperatives' Poverty-Reducing Roles in Agricultural Supply Chain Finance

Shen Yun (申云)[1*], Li Qinghai (李庆海)[2] and Yang Jing (杨晶)[3]

[1] School of Economics, Sichuan Agricultural University, Chengdu, China
[2] School of Economics, Nanjing University of Finance and Economics, Nanjing, China
[3] Social Security Research Center, Wuhan University, Wuhan, China

Abstract: *Agricultural supply chain finance (SCF) plays a vital role in reducing poverty and linking smallholders with broader markets. By creating a multi-dimensional poverty index (MPI) for farmer households with A-F binary boundary method, this paper employs the propensity score matching and difference-in-difference (PSM-DID) method to estimate how farmers' cooperatives run by various entities affect farmer households' multi-dimensional poverty status. Our findings suggest that: (i) Each percentage of increase in the probability of farmers' access to SCF credit from their cooperatives makes it 8% and 10% more likely for farmers' MPI and multi-dimensional poverty order to decrease with a significant poverty-reducing effect. (2) SCF credit from farmers' cooperatives run by large farmers, agribusinesses and the village cadres are significantly poverty-reducing for full-time poor farmers. (iii) The higher non-farm incomes as a share of farmers' total income, the less poverty-reducing SCF credit from farmers' cooperatives run by large farmers and villagers becomes, and the more poverty-reducing SCF credit for agribusiness everyone cooperatives becomes. These findings highlight the importance of policy guidance for farmers' cooperatives to offer appropriate credit products and solutions according to local conditions, which is vital to maximizing the effects of targeted financial poverty reduction.*

Keywords: *farmers' cooperatives, supply chain finance, poverty-reducing effect, multi-dimensional poverty, PSM-DID*

JEL Classification Codes: Q14, G20

DOI: 1 0.19602/j .chinaeconomist.2020.05.06

1. Introduction and Literature Review

In more than four decades of reform and opening up since 1978, China has lifted 700 million rural poor out of poverty. According to the National Bureau of Statistics (NBS), China's rural poor populations and poverty incidence dropped to 16.60 million and 1.7% at the end of

* Corresponding author: Shen Yun, email: shenyun2014@cqu.edu.cn

This paper is supported by the Key Project of the Key Research Base of Humanities and Social Sciences of the Ministry of Education "Study on China's Anti-Poverty Strategy" (Grant No.: 16JJD840007), the Country Key Research Base Project of the Department of Education, Sichuan Province "Study on the Policy Optimization for Modern Agriculture Industrial System in Sichuan Province under the Countryside Revitalization Strategy" (Grant No.: ZDF1801), and the Soft Science Project of the Department of Science and Technology, Sichuan Province "Study on the Financing and Credit Extension Mechanisms of New Agricultural Operators under the Countryside Revitalization Strategy" (Grant No.: 19RKX0123). We appreciate the valuable comments from anonymous reviewers and colleagues from the editorial department, but take sole responsibility for this paper.

(C)1994-2023 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net

2018,[1] respectively. Despite the tremendous achievements in rural poverty reduction, the vast majority of poor populations in China live in contiguous extremely poor regions and deeply poor regions. The role of financial services is essential to tackling the grave challenges of deep poverty. In 2019, the No.1 Central Document of the CPC Central Committee called for encouraging banking financial institutions to extend mid- and long-term credit for countryside revitalization and poverty reduction, improving policies on family farms and farmers' cooperatives, and creating shared interests between farmers and cooperatives.

Jointly released by five agencies including China's central bank, the *Guiding Opinions on Putting the Financial Industry at the Service of Countryside Revitalization* calls for developing agricultural supply chain finance, integrating smallholders into the modern agricultural system with shared interests, and increasing access to finance for smallholders and new agricultural operators. These measures are expected to promote the role of financial services in reducing poverty and supporting countryside revitalization. Supply chain finance (SCF) for farmers' cooperatives will help reduce poverty among smallholders by integrating them into the supply chain and offering them access to finance. Therefore, it is of great theoretical and practical significance to investigate agricultural SCF's poverty-reducing effects from the perspective of farmers' cooperatives, particularly in the context of China's "countryside revitalization strategy."

Compared with agricultural SCF credit, traditional bank credit is focused on rural micro-finance to reduce poverty and increase incomes by extending credit availability to farmers and supporting agricultural development. Such poverty abatement effects can be achieved by (i) overcoming the credit constraint for low-income people (Caminada and Goudswaard, 2009), smoothing household consumption (Guo, *et al*., 2012), and reducing the cost of transaction (He *et al*., 2018); and (ii) reducing poverty incidence and intensity (Imai, *et al*., 2012) by indirectly increasing the risk resilience of participants through inclusive economic growth, and promoting the role of rural financial leverage in inducing farmers' income growth (Sanchis and Navarro, 2011). For poor farmers without collaterals or valid guarantee, the cost of credit supply is high due to information asymmetry. Formal financial institutions are not motivated to extend financial services to poor rural regions, posing an intractable problem of financial exclusion. The lack of credit demand among poor farmers further gives rise to a "vicious cycle of financial poverty," dimming their poverty reduction outlook.

With innovative internet-based applications, agricultural SCF credit for farmers' cooperatives is conducive to financial factor flow between countryside and cities under the effect of financial leverage. Differences in the resource endowment among operators of farmers' cooperatives have led to heterogeneous poverty-reducing effects of agricultural SCF credit (Guo, Liao, 2010). However, farmers' cooperatives may increase shared interests among members and improve their positions on the value chain via horizontal and vertical integration (Meng, 2016), and receive credit from formal financial institutions for agricultural development that helps reduce poverty among farmers (Mao, *et al*., 2014). Examples include "savings clubs" in Bangladesh and rotating savings and credit associations (ROSCA) in Africa (Xiong, *et al*., 2007).

SCF credit for farmers' cooperatives may better organize farmers in accessing cooperative finance (Liu, *et al*., 2013), and promote agricultural supply chain value addition and concerted poverty reduction (Ye, *et al*., 2012; Shao, 2013). Yet the traditional models of financial poverty reduction and product innovations are focused on direct credit from commercial banks to farmers. Credit line is often imprecise, and financial institutions avoid lending to the poor farmers who need credit to escape poverty. By effectively linking smallholders with broader markets, agricultural SCF plays a pivotal role in reducing poverty via farmers' cooperatives.

[1] Monitoring and survey data of rural poverty in China, 2018: http://www.stats.gov.cn/tjsj/zxfb/201902/t20190215_1649231.html

(C)1994-2023 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net

The existing body of literature is dominated by qualitative analysis and case studies, and a few studies offer effective evaluation of national and local policies. The poverty-reducing effects of SCF for farmers' cooperatives are yet to be evaluated. In addition, the poverty-reducing effects of traditional bank credit are estimated mainly based on income poverty, which cannot properly reflect farmers' multi-dimensional poverty. By evaluating the poverty-reducing effects of SCF for multi-dimensionally poor farmers at cooperatives run by different operators, this paper intends to offer scientific basis for financial pro-poor policies and countryside revitalization program.

This paper may offer the following innovations: (i) creating a multi-dimensional poverty index to measure farmers' multi-dimensional poverty to compensate for the inadequacy of income poverty estimation and prevent farmers from slipping back into poverty; (ii) adopting PSM-DID method to evaluate and compare the poverty-reducing effects for heterogeneous farmers before and after obtaining SCF credit through farmers' cooperatives run by different operators to provide scientific basis for evaluating how financial services reduce poverty and support countryside revitalization; and (iii) offering empirical evidence for testing SCF's poverty-reducing mechanism to explore innovative pathways for SCF to contribute to poverty reduction through farmers' cooperatives.

2. Research Hypotheses

Supply chain finance (SCF) is a financial business model for cross-organizational planning, operation and control of financial resources, and creates value for the internal and external supply chain participants (Hofmann, 2005). In agricultural SCF, a farmers' cooperative acts as a credit intermediary that facilitates financial credit support to upstream and downstream farmers based on their agricultural production or service orders, thus overcoming the credit finance constraint facing them. The cooperative also facilitates farmers' access to credit from formal financial institutions by overcoming information asymmetry, giving play to the advantages of cash flow, information flow, material flow and other forms of internal credit supervision (Antonella *et al*., 2018). Cooperatives allow farmers to access information, production material, technology and product sales, thus linking them with agricultural supply chain; cooperatives reduce overall poverty incidence among farmers, increase the efficiency of financial support to agriculture, and break through the vicious cycle of "financial poverty" (Shen and Peng, 2016). In adopting closed-loop financing for agricultural production, supply and distribution, cooperatives encourage their members to check upon each other's credibility, allowing those with good credit standing to gain to access finance more efficiently (Hong, 2011). Cooperatives also make credit from formal institutions more available to their members, whose credit standing is tied to the collective. Yet cooperatives are run by heterogeneous operators such as larger farmers, marketers, enterprises and village cadres, resulting in difference in the poverty-reducing effects of SCF credit.

SCF credit for farmers' cooperatives run by large farmers: With broad social connections and agribusiness experience, large farmers often take the lead in applying new agricultural technology and set an example for others to follow. They help other farmers use credit funds effectively, and contribute to more precise credit targeting (Liu, *et al*., 2013). Yet most large farmers are inexperienced in managing supply chain funds with a limited access to credit (Meng, 2016). Credit supply is also tilted towards farmers who rely on farming as their main livelihood,[2] especially those receiving production orders from large farmers. For part-time farmers whose main or partial incomes are from non-farm sources, their access to credit is restricted by the lack of production orders and transaction records from farmers'

[2] Based on the estimation of income poverty dimension, farmers are further divided into full-time farmers who solely rely on farming income (with non-farming income accounting for less than 10% of total household income), part-time farmers who mainly rely on farming income (with non-farming income accounting for 10%-50% of total household income), and part-time farmers who partially rely on farming income (with non-farming income accounting for 50%-90% of total household income).

(C)1994-2023 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net

cooperatives, which commercial banks require in making lending decisions. As a result, SCF is less poverty-reducing for part-time farmers than for full-time farmers. Hence, we put forward the following hypothesis:

H1: SCF credit for cooperatives run by large farmers is significantly poverty-reducing for full-time farmers, and increasingly less poverty-reducing for part-time farmers as the share of farm income in their total income drops.

SCF credit for marketer-run cooperatives: Some farmers who specialize in marketing have a knack for selling farm produce. Cooperatives run by such farmer-turned marketers work with farmers primarily for supplying the means of production and distributing their final farm produce, and such cooperation is more loosely organized and based on fewer shared interests (Mao, *et al*., 2014). In the distribution stage when farmers' cash demand is small, access to SCF credit has a limited impact on the operating income of full-time farmers and part-time farmers who mainly rely on farm income. Yet for part-time farmers whose non-farm incomes account for more than 50% of their total income, access to SCF credit will boost their non-farm incomes with greater poverty-reducing effects. Hence, we put forward Hypothesis 2:

H2: SCF credit for marketer-run cooperatives is less poverty-reducing for full-time farmers and part-time farmers whose chief source of income is farming, but is more poverty-reducing for part-time farmers who mainly rely on non-farm income.

SCF credit for agribusiness-run cooperatives: With more explicit ownership systems, agribusiness-run cooperatives boast absolute superiority when it comes to human and material resources and market control. Their advantages in procurement, production and sales offer assurance for commercial banks to extend credit support. More reputable and larger agribusinesses are better positioned to extend more credit to poor farmers (Guo and Liao, 2010). While linking smallholders with broader markets, financial capital plays a vital role in catalyzing integrated industrial development and creating part-time and full-time non-farm jobs to rural surplus labor. Apart from helping full-time farmers earn more incomes and escape poverty, integrated agricultural development contributes to the poverty-reducing effects of credit for full-time and part-time farmers, who benefit from more non-farm jobs and entrepreneurial opportunities. Such poverty-reducing effects are likely to increase as a growing share of farmers' income comes from sources other than farming. Hence, we put forward Hypothesis 3:

H3: SCF credit for agribusiness-run cooperatives is more poverty-reducing for farmers with more non-farm incomes, and generally facilitates their access to credit.

SCF credit for farmers' cooperatives run by village cadres: While village cadres are vested with powers to mobilize farmers, their involvement may also lead to biased allocation of SCF credit in favor of some farmers at the expense of others, leading to the "elite capture" phenomenon. Political endorsement from village cadres tends to convince commercial banks to extend credit support (Li, 2018). Saddled with poverty relief responsibilities, the first village Party secretaries are motivated to assist poor farmers by calling upon cooperatives to provide them with credit funds (He *et al*., 2018). In managing SCF credit, cooperatives run by village cadres tend to prioritize full-time farmers, who are poorer than part-time farmers with non-farm incomes. The fact that cooperatives place agricultural production orders to full-time farmers also gives them an edge over part-time farmers in terms of receiving credit. The poverty-reducing effects of SCF credit are further enhanced by the preference of village cadres to prioritize poor farmers as part of their political mandate to assist the poor in general. Hence, we put forward Hypothesis 4:

H4: Cooperatives run by village cadres show a credit preference - and are thus more poverty-reducing - for poor full-time farmers, and the poverty-reducing effects diminish for part-time farmers as their non-farm incomes increase.

(C)1994-2023 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net

3. Data Source, Model Design and Variable Specification

3.1 Data Source

This paper employs rural financial poverty reduction data of 2015 and 2016 from the Big Data Platform of Yunnan Province for Targeted Poverty Reduction.[3] This platform tracks the poverty reduction status for poor farmers, and contains information about target poor groups, poverty relief measures, achievements, performance evaluation, and data analysis. Among them, the segment of poverty reduction measures includes reliable data about financial services extended to poor farmers. Research should focus on several state-designated poor counties with a broad coverage of SCF credit for farmers' cooperatives. Data from the platform suggest that a total of 142 farmers' cooperatives offered SCF credit services to 5,003 poor farmer households out of 6,791 registered poor households. To meet the quasi-experiment conditions, we have identified 2,884 farmer households who received credit only in 2016, excluding those who received credit in both years of 2015 and 2016. To further analyze the poverty-reducing effects of SCF credit for farmers' cooperatives, the project group interviewed managers in charge of the cooperatives to learn about their credit issuance procedures and risk control policies.

3.2 Model Design

The net poverty-reducing effects of SCF credit for farmers' cooperatives cannot be estimated directly since change in farmers' multi-dimensional poverty status before and after receiving SCF credit is unavailable. For this reason, simply comparing the poverty-reducing effects of SCF credit for farmers who received SCF credit and those who did not is likely to cause systematic deviations. The use of DID method is predicated upon the common trend of change between farmers who received SCF credit and those who did not. Hence, this paper adopts the PSM-DID method developed by Heckman *et al*. (1997) to eliminate sample selection bias, and after matching farmers having received SCF credit with a reasonable control group, and employs DID method to evaluate the net effect of SCF credit on the multi-dimensional poverty status of farmers who received SCF credit compared with poor farmers who did not.

3.2.1 Propensity score matching (PSM) method

The purpose of matching is to address the sample selection bias and mixed deviation in traditional research methodology by creating a counterfactual framework. Specifically, probit method is employed to estimate the probability of each poor farmer household to receive SCF credit from a cooperative (propensity score), and then the experiment group is matched with a control group based on the common support domain of propensity score to calculate the average treatment effect on the treated (ATT) for the experiment group. The propensity score is the conditional probability for farmer i to obtain SCF credit from a cooperative under a given group of covariates X_i. Under the assumption of independent conditional expectations, farmers with similar key attributes who had received SCF credit are matched with those who had not by estimating the propensity score of each farmer household $P(X_i)$. The propensity score can be expressed as:

$$P(X_i) = \Pr\{\exp_i = 1 / X_i\} \tag{1}$$

After propensity score ($P(X_i)$) matching, the ATT of farmer i who received SCF credit from the cooperative can be expressed as:

[3] Big Data Platform for Targeted Poverty Reduction in Yunnan Province: http://222.221.10.139:8081/ynfp/. Counties surveyed by the project group include Lanping, Lushui, Mengla, Luxi, Funing, Shidian, Lancang and Fengqing counties in Yunnan Province.

(C)1994-2023 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net

$$ATT = \tau = E(Y_1 | p = 1) - E(Y_0 | p = 1) \quad (2)$$

In equation (2), Y_1 is the multi-dimensional poverty index (MPI) of farmer households in the experiment group after receiving SCF credit from their cooperatives, and Y_0 is the multi-dimensional poverty index (MPI) of farmer households in the control group who did not receive SCF credit. Since the latter cannot be directly observed, a counterfactual framework should be created, and $E(Y_0 | p = 1)$ in the ATT after counterfactual estimation is the counterfactual effect.

3.2.2 Difference-in-difference (DID) method

After matching, this paper proceeds to conduct a difference-in-difference analysis of results after PSM. Referencing Smith and Tood (2005), this paper includes the two dummy variables of policy and time and their interaction term into the regression equation to effectively control for the impact of unobservable individual heterogeneity on the explained variables and conduct unbiased estimation of policy effects, avoiding the impact of unobservable factors stemming from the progression of time. The result will reveal the poverty reduction effect of SCF credit through farmers' cooperatives and the multi-dimensional poverty status of farmers after receiving SCF credit. After obtaining the PSM results, we include into the DID model the multi-dimensional poverty status of farmer households in the experiment group and control group before and after obtaining SCF credit from their cooperatives to assess the net policy effects for both groups.

It is assumed that farmer households having received SCF credit from their cooperatives are in the experiment group, while those who had not are in the control group. Y_0^T and Y_1^T respectively denote the multi-dimensional poverty status of farmer households in the experiment group before and after receiving SCF credit from their cooperatives. Y_0^C and Y_1^C respectively denote the multi-dimensional poverty status of farmer households in the control group before and after receiving no SCF credit. With equation $(Y_1^T - Y_0^T) - (Y_1^C - Y_0^C)$, we calculate change in the multi-dimensional poverty status of the experiment group before and after receiving SCF credit. Econometric model equation for DID is as follows:

$$DID = E[(Y_1^T - Y_0^T) | T = 1] - E[(Y_1^C - Y_0^C) | T = 0] \quad (3)$$

In equation (3), $T = 0$ and $T = 1$ respectively denote non-receipt and receipt of SCF credit from farmers' cooperatives in 2015 and 2016, respectively, and the DID model expression is:

$$y_{ijt} = \beta_0 + \alpha_0 B_t + \alpha_1 B\mu_{ij} + \alpha_2 B\mu_{ij} \times B_t + \delta X_{ijt} + \varepsilon_{it} \quad (4)$$

In equation (4), β_0 is constant term; i is poor farmer household; j is farmers' cooperatives run by various entities, and those run by large farmers, marketers, agribusinesses and village cadres are assigned the values of 1, 2, 3 and 4, respectively; t is time, and y_{ijt} is change in the multi-dimensional poverty index of farmer household i after receiving SCF credit from a cooperative run by type j entity during period t; $B\mu_{ij}$ is a binary dummy variable for measuring whether farmer household i has received SCF credit from a cooperative run by type j entity. If so, $B\mu_{ij}$=1. For instance, if a farmer household has received SCF credit from a cooperative run by a large farmer, $B\mu_{i1}$=1, and so on and so forth. If no credit is received, $B\mu_{ij}$=0. B_t is dummy variable for policy implementation, i.e. whether the farmer household has received SCF credit from a cooperative during this period. If so, B_t=1; otherwise, B_t=0; $Bu_{ij} \times B_t$ is the interaction term between grouping dummy variable and policy implementation dummy variable, and coefficient α_2 is the net effect of policy implementation. X_{ijt} is a group of observable control variables that affect farmer households' multi-dimensional poverty status, and ε_{ijt} is stochastic disturbance term.

(C)1994-2023 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net

3.3 Estimating Farmer Households' Multi-Dimensional Poverty Index

A-F method is straightforward and offers a significant advantage for policy analysis (Alkire & Foster, 2011). First, we should determine whether a farmer household is deprived with respect to the critical value of deprivation (Zhang, 2017). Assuming that n farmer households participate in SCF credit schemes offered by their cooperatives, the multi-dimensional poverty status of farmer household i is measured by d indicators. The value of farmer household i on each dimension l is denoted by g_{il}, and $g_{il} \in R, i = 1, \cdots n; l = 1, \cdots d$. Poverty identification relies on two critical values, i.e. z and k. If g_{il} is below critical value z_l, which indicates that farmer household i is deprived of specific indicators, $g_{il}=1$; otherwise, no deprivation is suffered, and $g_{il}=0$. The weight of indicator l is specified as w_l, and $\sum_{l=1}^{d} w_l = 1$. The weighted score of farmer household i on all dimensions d is the weighted total score of deprivation for farmer household i, which is expressed as: $c_i = \sum_{l=1}^{d} w_l g_{il}; (c_i \in [0,1])$. The second critical value k is for comparing the level of deprivation c_i to determine a farmer household's multi-dimensional poverty status: if $c_i \geq k$, the implication is that the level of deprivation suffered by the farmer household is intolerable and deemed as multi-dimensional poverty. Referencing A-F "double-line" analysis method (Alkire and Foster, 2011), the multi-dimensional poverty status of farmer households can be reflected from six dimensions, including income, education, health, sanitation, living standards, and food spending. With the same weight assigned to each dimension of poverty status, the multi-dimensional poverty index (MPI) of a farmer household can be expressed as:

$$MPI = \frac{1}{n} \sum_{l=1}^{d} c_l(k) \tag{5}$$

Table 1: Multi-Dimensional Poverty Indicators and Weights

Dimension	Indicator	Critical criteria for poverty deprivation	Weight	Poverty incidence
Income	Per capita net income	With the national poverty line of 2,300 yuan, per capita net income <2,300 yuan=1; per capita net income≧2,300 yuan=0.	1/6	16.31%
Education	Length of education	Farmers aged above 18 but not yet completed nine-year compulsory education are assigned value 1; otherwise, it is 0;	1/6	37.22%
Health	Health status	Farmers suffering from illnesses or with very poor health are assigned value 1; otherwise, it is 0;	1/6	20.21%
Sanitation	Sanitary facilities	Lack of access to indoor flushing toilets at home is assigned value 1; otherwise, it is 0;	1/6	62.18%
Living conditions	Kitchen fuel	Kitchen fuel being firewood or other forms of energy is assigned value 1; the use of natural gas or liquefied gas is assigned value 0;	1/6	53.19%
Food spending	Engel's coefficient	Food spending in excess of 60% of total household spending is defined as deprivation of food spending, and value 1 is assigned; otherwise, value 0 is assigned.	1/6	45.39%

Note: See Zhang Zhao *et al*. (2017) for the specification of MPI.

(C)1994-2023 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net

Table 2: Farmer Households' Multi-Dimensional Poverty Status

Poverty dimension	Poverty incidence	Poverty dimension	Poverty incidence
Not poor at all	8.72%	Four-dimensional poverty	8.17%
One-dimensional poverty	27.33%	Five-dimensional poverty	0.85%
Two-dimensional poverty	32.47%	Six-dimensional poverty	0.10%
Three-dimensional poverty	22.36%	Aggregate share	100%

Note: There are six poverty dimensions, including income, education, health, sanitation, living conditions, and food spending. A farmer household is deemed as living in one-dimensional poverty if it is only below the critical value of income, or living in two-dimensional poverty if it is below the critical values of both income and education, and so on and so forth. If a farmer household is below the critical values of all six dimensions, it is deemed as living in six-dimensional poverty.

In equation (5), n is the number of farmer households, and d is the total number of farmer households' multi-dimensional poverty orders; $c_l(k)$ is the value of poor farmer households after weighted on dimension l; the multi-dimensional poverty index of farmer households (MPI) is primarily subject to the level of deprivation of farmer households' individual capacities under given the national standards.

Judging by the multi-dimensional poverty indicators and poverty incidence in Table 1, 16.31% of farmer households were below the national poverty line in terms of per capita net income, i.e. the threshold for absolute poverty; 37.22% of farmer households had children aged above 18 years without completing nine-year compulsory education; 20.21% of farmer households lived with diseases; 62.18% of farmer households had no indoor flushing facilities; 53.19% of farmer households still burned firewood for cooking; 45.39% of farmer households spent more than 40% of their incomes on food. Judging by the statistical results of Table 2, most farmer households lived below three-dimensional poverty, accounting for 82.16% on a cumulative basis. Few farmer households lived in high-dimensional poverty. Those who lived in five- and six-dimension poverty, in particular, account for less than 1% on a cumulative basis; 8.72% of farmer households were completely free from poverty.

3.4 Variable Explanation

In this section, we identify the non-farm incomes of poor farmer households as a share of their total income to examine the poverty-reducing effects of SCF credit offered by farmers' cooperatives run by various entities (Table 3). The explained variables are the multi-dimensional poverty index and the number of multi-dimensional poverty orders. Control variables include characteristics of farmers, households, social capital, villages and financial institutions. In general, credit constraint increases with farmer's age. The education of a household head is positively linked with income, and credit availability is conducive to income growth. If a household head is a village cadre, the household may have more access to credit support. With more social capital, village cadres also benefit from higher credit availability. The more assets a household has that can be mortgaged and used as collateral, the more access to lending from formal financial institutions the household will have. Households with relatives and friends working at banks are more creditworthy to financial institutions. Indicators like business revenue reflect the strength of farmers' cooperatives. Better understanding about banks' credit policies makes it more likely for a household to obtain credit support.

(C)1994-2023 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net

Table 3: Descriptive Statistical Explanations of Variables

Variable name	Variable explanation	Mean value	Standard deviation	Min.	Max.
Multi-dimensional poverty index (MPI)	Reflects poor farmer households' overall poverty status	0.0693	0.0011	0.0039	0.5124
Multi-dimensional poverty order	One-dimensional poverty=1; Two-dimensional poverty=2; Three-dimensional poverty=3; Four-dimensional poverty=4; Five-dimensional poverty=5; Six-dimensional poverty=6	1.9688	0.9364	1	6
Credit availability	SCF credit received by farmers / expected cash demand	0.712	0.149	0	1
Receipt of SCF credit from farmers' cooperative	Yes=1; No=0	0.372	0.212	0	1
Age	Year	52.15	10.33	37	66
Level of education	Primary school and below=1; junior middle school=2; high school=3; junior college and above=4	2.477	0.315	1	4
Village cadre status	Yes=1; No=0	0.103	0.002	0	1
Total household assets	Including fixed assets, liquid assets and various types of assets that can be cashed in (yuan)	52,940	1,390	4,200	214,500
Has friends or relatives who work at banks	Yes=1; No=0	0.349	0.029	0	1
Annual average business revenue of farmers' cooperative (10,000 yuan)	(0, 300k]=1; (300k, 2 million]=2; (2 million-5 million]=3; above 5 million yuan=4	2.146	0.214	1	4
Knows about bank's credit policy	Yes=1; No=0	0.738	0.188	0	1

4. Analysis of Econometric Results

First, our correlation analysis of control variables shows that the correlation coefficients between variables are all smaller than 0.4, i.e. collinearity does not exist between variables and thus meets PSM precondition. Then, we employ probit model to estimate the probability for farmer households to obtain SCF credit from the cooperatives as propensity scores for them to access credit, and test whether there is any synchronous change in farmer households' multi-dimensional poverty index with PSM method. Judging by the kernel density function before matching experiment group with control group as shown in Figure 1, the gravity of MPI matching probability (horizontal axis) for farmer households who had received SCF credit from cooperatives is significantly higher compared with those who had not received SCF credit. There is a noticeable difference in the matching probability values between them. After matching (Figure 2), the difference in their matching probabilities has narrowed, and two very close curves appear in the probability distribution of kernel density functions. The implication is that the matching with control group farmer households can effectively reduce deviation in the experiment group farmer households' access to SCF credit, and satisfies the common support hypothesis (Rosenbaum & Rubin, 1985). This result offers strong support to the subsequent comparison of SCF credit's poverty-reducing effects with DID method.

(C)1994-2023 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net

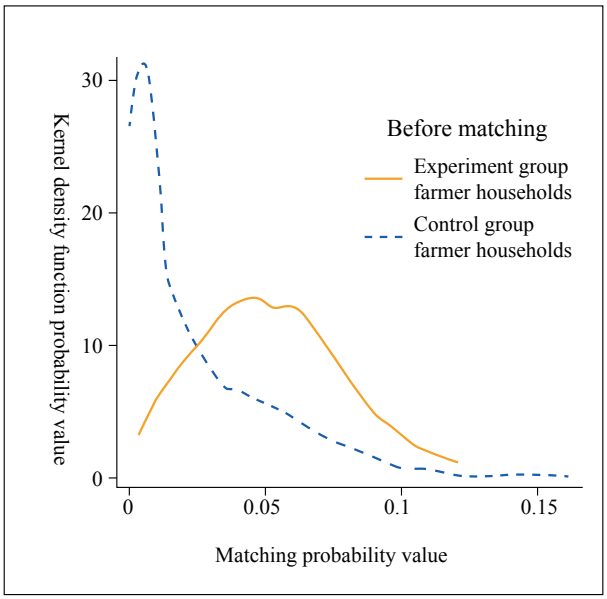

Figure 1: Kernel Density Function before Matching

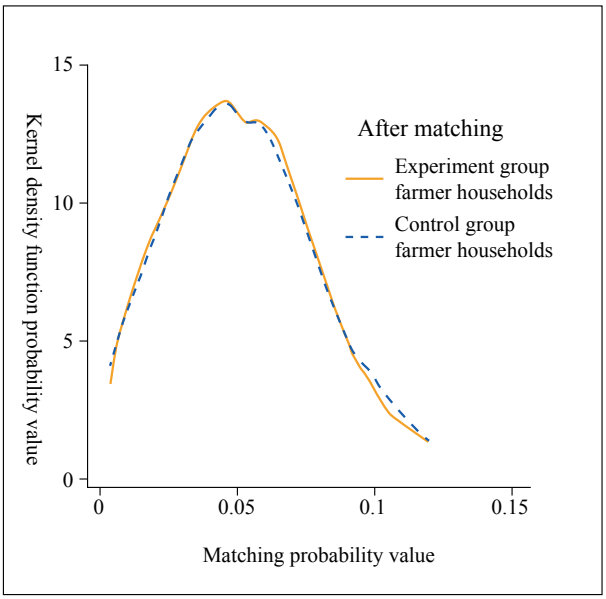

Figure 2: Kernel Density Function after Matching

4.1 Balance Analysis

As can be seen from the balance test results of Table 4, large deviations exist in farmer households' multi-dimensional poverty index before and after matching, which implies significant differences between experiment group and control group. After matching, there is a sharp decline in the deviation ratio of MPI with no significant difference between experiment group and control group. By reducing deviation stemming from observable heterogeneity, PSM method is consistent with the results of balance test and robust matching, and supports the further evaluation of the poverty-reducing effects of SCF credit for farmers' cooperatives run by various entities.

4.2 Poverty-Reducing Effect of Farmer Households' Access to SCF Credit from Their Cooperatives

In PSM estimation, all the standard errors of estimation results are obtained with bootstrap method (Table 5). Compared with farmer households who had not received SCF credit from their cooperatives, there are significant reductions in the multi-dimensional poverty order and MPI for farmer households who had received SCF credit. This finding suggests that access to SCF credit from cooperatives is poverty-reducing for farmer households. For the nearest neighbor matching, radius matching and kernel matching methods, farmer households' multi-dimensional poverty order is significantly negative at 1% with ATT of -0.0993, -0.0984 and -0.0987, respectively. In other words, for each percentage of increase in the probability of a farmer household's access to SCF credit from the cooperative, its multi-dimensional poverty order is about 10% more likely to decrease (ATT). With the nearest neighbor matching, radius matching and kernel matching methods, farmer households' MPI is also significantly negative at 1% with ATT of -0.0827, -0.0816 and -0.0803. That is to say, each percentage of increase in the probability of a farmer household's access to SCF credit from the cooperative makes it around 8% more likely for its MPI to decrease (ATT). The matching effect of the two is generally consistent and thus fairly robust.

(C)1994-2023 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net

Table 4: MPI Balance Test Results for Experiment and Control Group Farmer Households

Explanatory variable	Matching type	Treatment group	Control group	Bias ratio (%)	Bias reduction ratio (%)	t-Value of inter-group difference
Age	Before matching	1.9823	1.9618	1.04	100	1.32
	After matching	1.9823	1.9823	0		0.00
Level of education	Before matching	0.3782	0.3791	-0.24	100	-0.25
	After matching	0.3782	0.3782	0.00		0.00
Village cadre status	Before matching	0.2617	0.2844	-7.98	-92.2	-0.17
	After matching	0.2617	0.2619	-0.08		-0.02
Total household assets	Before matching	3.1792	3.2141	-1.09	100	-1.84**
	After matching	3.1792	3.1792	0		0.00
Has friends or relatives who work at banks	Before matching	0.1617	0.1643	-1.58	-86.3	-1.73**
	After matching	0.1617	0.1619	-0.12		-0.81
Annual average business revenue of farmers' cooperative (10,000 yuan)	Before matching	3.6298	3.9781	-8.76	100	-3.29***
	After matching	3.6298	3.6298	0		0.00
Knows about bank's credit policy	Before matching	0.1027	0.1107	-7.23	-98.5	-0.39
	After matching	0.1027	0.1028	-0.10		-0.04

Note: *, ** and *** respectively denote significance at 10%, 5% and 1%.

Table 5: Poverty-Reducing Effect of Farmer Households' Access to SCF Credit from Cooperatives

Explained variable	Matching method	Experiment group/Control group	ATT
Multi-dimensional poverty order	Nearest neighbor matching	2,488/2,511	-0.0993*** (0.0280)
	Radius matching	2,483/2,509	-0.0984*** (0.0218)
	Kernel matching	2,488/2,511	-0.0987*** (0.0220)
Multi-dimensional Poverty Index (MPI)	Nearest neighbor matching	2,488/2,511	-0.0827*** (0.0183)
	Radius matching	2,483/2,509	-0.0816*** (0.0193)
	Kernel matching	2,488/2,511	-0.0803*** (0.0193)

Note: Numbers in parentheses are standard errors after bootstrapping for 200 times. The nearest neighbor matching distance is specified as 0.01; the radius matching is specified with a radius of 0.005; kernel matching is specified with a bandwidth of 0.01; *, ** and *** denote significance at 10%, 5% and 1%, respectively.

(C)1994-2023 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net

Table 6: Rosenbaum Boundary Estimation Results for the MPI Effect of SCF Credit from Farmers' Cooperatives

Γ	Sig^+	Sig^-	t-hat^-	t-hat^+	CI^-	CI^+
1	0.000	0.000	-0.0213	-0.0212	-0.3001	-0.7301
1.1	0.000	0.000	-0.0802	-0.4181	-0.2201	-0.7491
1.2	0.000	0.000	-0.0401	-0.4171	-0.1743	-0.7040
1.3	0.000	0.000	-0.7001	-0.3043	-0.1201	-0.8031
1.4	0.000	0.000	-0.7302	-0.2991	-0.0001	-0.8322
1.5	0.000	0.000	-0.7490	-0.2442	-0.9901	-0.8010
1.6	0.000	0.000	-0.7491	-0.2082	-0.9702	-0.8840
1.7	0.000	0.000	-0.7701	-0.1090	-0.9182	-0.9201
1.8	0.000	0.000	-0.7912	-0.1411	-0.8801	-0.9370
1.9	0.000	0.000	-0.8243	-0.0872	-0.8410	-0.9042
2	0.000	0.000	-0.8302	-0.0031	-0.7990	-0.8921

Note: Sig^+ and Sig^- respectively denote the upper and lower limits of significance level; t-hat^+ and t-hat^- respectively denote the upper and lower limits of HL point; CI^+ and CI^- respectively denote the upper and lower limits at 5% significance level.

4.3 Robustness Test

Table 6 provides the results of Rosenbaum boundary estimation under the kernel matching method for a robustness test. Difference in farmer households' access to SCF credit (Γ) gradually increases from one to two times. Farmer households' access to SCF credit reduces their MPI at 1% significance level, and the lower limits of Hodges-Lehmann (HL) point estimation and confidence interval at 5% significance level are both smaller than zero. The implication is that access to SCF credit significantly reduces farmer households' MPI, and that PSM estimation results remain robust (Table 6).

In addition, we convert farmer households' MPI into a traditional income index for robustness test, and conduct a quantile regression based on farmers' income levels to test the impact of access to SCF credit on farmers' income at various percentiles. As shown in Table 7, access to SCF credit has a positive effect on the per capita disposable incomes of both full-time and part-time farmers who partially or mainly rely on non-farm incomes at 5% significance level. That is to say, access to SCF credit can indeed increase farmers' income and reduce poverty among them, proving DID estimation result to be robust.

4.4 Poverty-Reducing Effect of SCF Credit Offered by Cooperatives Run by Various Entities

While simultaneously controlling for the effects of region and time, we conduct an empirical evaluation of the poverty-reducing effects of SCF credit for cooperatives run by various entities. We find that farmers' access to SCF credit has a significant negative impact on their MPI. That is to say, access to SCF credit will reduce farmers' multi-dimensional poverty. Yet the poverty-reducing effects vary among cooperatives run by different entities.

For full-time farmers (Table 8), their MPI can be reduced through access to SCF credit from cooperatives run by large farmers, agribusinesses and village cadres, but SCF credit from marketer-run

(C)1994-2023 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net

Table 7: Robustness Test Results

		Per capita disposable income of farmer households in the first 25% income bracket	Per capita disposable income of farmer households in the first 50% income bracket	Per capita disposable income of farmer households in the first 75% income bracket
Full-time farmers' access to SCF credit	ATT	0.0519** (0.0213)	0.0475** (0.0245)	0.0437** (0.0238)
	ATE	0.0524** (0.0263)	0.0483** (0.0249)	0.0461** (0.0255)
	ATU	0.0492** (0.0244)	0.0471** (0.0243)	0.0414** (0.0214)
Part-time farmers' (who mainly rely on farm income) access to SCF credit	ATT	0.0422** (0.0198)	0.0441** (0.0241)	0.0455** (0.0207)
	ATE	0.0397** (0.0179)	0.0416** (0.0188)	0.0403** (0.0191)
	ATU	0.0413** (0.0194)	0.0393** (0.0185)	0.0404** (0.0191)
Part-time farmers' (who rely on farming for less than half of their income) access to SCF credit	ATT	0.0407** (0.0186)	0.0389** (0.0225)	0.0411** (0.0185)
	ATE	0.0385** (0.0173)	0.0402** (0.0188)	0.0392** (0.0184)
	ATU	0.0389** (0.0188)	0.0387** (0.0183)	0.0382** (0.0181)

Note: Numbers in parentheses are standard deviations obtained after bootstrapping for 200 times, and regional linear regression is specified with a bandwidth of 0.01. *, ** and *** respectively denote significance at 10%, 5% and 1% levels. In the interest of length, the robustness test results of control variables are not reported here. ATT is the average treatment effect on the treated (experiment group), ATU is the average treatment effect on the untreated (control group), and ATE is the average treatment effect for all samples (including experiment group and control group).

cooperatives is not significantly poverty-reducing. Cooperatives run by large farmers, agribusinesses and cadres are well-positioned to use agricultural production orders for risk control, and tend to supply credit to farmers who mainly rely on farm income. Commercial banks, on the other hand, are unable to use agricultural production orders and other supply chain information to manage credit risks, and thus refrain from lending to marketer-run cooperatives. Moreover, marketers also find it easier to access credit themselves. As a result, SCF credit for marketer-run cooperatives is not significantly poverty-reducing. Obviously, the poverty-reducing effect of SCF credit varies among cooperatives run by different entities: The effect is the highest for cooperatives run by village cadres, followed by those run by agribusinesses, and lastly those run by large farmers. The advantage of village cadres is that they are able to link SCF credit with government poverty reduction projects and involve local farmers in such projects. Through agricultural supply chain financing with agricultural production orders, farmers' cooperatives run by agribusinesses increase credit availability for full-time farmers and work with a broader scope of poor farmers, contributing more to poverty reduction compared with cooperatives run by large farmers.

SCF credit for cooperatives run by agribusinesses and village cadres has negative effects on the MPI of part-time farmers who mainly or partially rely on farm income at both 1% significance level (Table 8). The advantage of agribusiness-run cooperatives lies in their market competitiveness and credit

(C)1994-2023 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net

Table 8: Poverty-Reducing Effect of Farmer Households' Access to SCF Credit from Cooperatives (DID Analysis Results)

Index	MPI for full-time farmers				MPI for part-time farmers who mainly rely on farm income				MPI for part-time farmers who mainly rely on non-farm income			
$B\mu_{ij}$	-0.063*** (-5.224)	-0.061*** (-5.192)	-0.064*** (-5.734)	-0.063* (-5.473)	-0.051*** (-3.738)	-0.052*** (-4.264)	-0.055*** (-5.427)	-0.048*** (-5.626)	-0.043*** (-4.774)	-0.041*** (-4.546)	-0.042*** (-4.873)	-0.043*** (-4.629)
B_t	-0.016*** (-3.326)	-0.015*** (-3.254)	-0.013*** (-3.462)	-0.014*** (-3.732)	-0.014*** (-4.243)	-0.014*** (-4.152)	-0.013*** (-4.782)	-0.013*** (-4.646)	-0.007*** (-5.356)	-0.007*** (-5.364)	-0.008*** (-5.459)	-0.008*** (-5.826)
$B\mu_{i1}\times B_t$	-0.064*** (-4.551)				-0.053*** (-4.362)				-0.048 (-1.026)			
$B\mu_{i2}\times B_t$		-0.026 (-0.615)				-0.047 (-0.615)				-0.025 (-0.827)		
$B\mu_{i3}\times B_t$			-0.066*** (-5.339)				-0.072*** (-4.262)				-0.079*** (-5.625)	
$B\mu_{i4}\times B_t$				-0.084*** (-4.739)				-0.042** (-2.426)				-0.041** (-2.241)
β_0	1.315** (2.213)	1.311*** (6.462)	1.315*** (4.162)	1.316*** (4.513)	1.224** (3.024)	1.221*** (3.331)	1.217*** (3.514)	1.208*** (3.626)	1.0232** (2.146)	1.011*** (4.327)	1.008*** (4.142)	1.007*** (4.254)
Pseuodo R^2	0.234	0.229	0.235	0.233	0.242	0.242	0.243	0.241	0.232	0.229	0.231	0.229
Observation value	234	182	221	213	243	168	204	187	231	164	224	217

Notes: Numbers in parentheses are t statistic; *, ** and *** respectively denote significance at 10%, 5% and 1% levels. In the interest of length, control variables are not reported in this paper, but are available upon request.

risk control for agricultural supply chain to form shared interests with farmers. Their creditworthiness ensures access to finance for agricultural production, operation and sales. Moreover, managers in charge of agribusiness-run cooperatives are motivated to enhance the business performance, poverty reduction achievements, and social reputation of their organizations (Gornall and Strebulaev, 2018). Tax breaks and policy incentives offered by local governments in some poor regions also help agribusinesses to contribute more to reducing poverty. Under the pressure of poverty reduction targets, some village cadres are motivated to assist the poor farmers and prioritize them when it comes to allocating SCF credit. For this reason, SCF credit for cooperatives run by village cadres is also significantly poverty-reducing.

By comparing the absolute values of poverty-reducing effect coefficients, we find that SCF credit for cooperatives run by large farmers and village cadres is more poverty-reducing for full-time farmers and part-time farmers whose chief income source is farming, and such poverty-reducing effect diminishes as the share of their non-farm income increases. SCF credit for cooperatives run by large farmers and village cadres gives more priority to poor farmers who rely on farming as their livelihood, and is thus more poverty-reducing for full-time farmers with paltry non-farm income. Such priority is consistent with the principle of putting financial industry at the service of targeted poverty reduction. It is consistent with the primary goal of SCF for farmers' cooperatives to support agriculture. SCF credit for marketer-run cooperatives is not significantly poverty-reducing for poor farmers because such cooperatives mainly target at households in relative poverty with higher proportions of non-farm incomes. SCF credit for agribusiness-run cooperatives is significantly poverty-reducing for full-time and part-time farmers

(C)1994-2023 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net

with the absolute value of poverty reduction coefficient increasing with the share of farmers' non-farm incomes. Namely, the poverty-reducing effect is more significant for poor farmers with higher non-farm incomes. The reason is that poor farmers with higher non-farm incomes are able to earn more incomes by working for businesses or offering social services. With their different endowments, SCF credit for farmers' cooperatives run by various entities has heterogeneous poverty-reducing effects. Policymakers should be reminded that such heterogeneity calls for targeted policymaking to maximize the effects of SCF credit through farmers' cooperatives. The financial industry plays a critical role in targeted poverty reduction, but more work remains to be done in the long run.

5. Conclusions and Policy Implications

Based on the financial poverty reduction data from the Big Data Platform of Yunnan Province for Targeted Poverty Reduction, this paper creates farmer households' multi-dimensional poverty index (MPI). With A-F binary boundary method to reflect poor farmer households' multi-dimensional poverty status. With PSM-DID model, this paper examines how SCF credit for farmers' cooperatives run by various entities contributes to poverty reduction among heterogeneous poor farmer households. Our findings suggest that:

(i) There are reductions in both the multi-dimensional poverty order and MPI for farmer households who had received SCF credit compared with their peers who had not. Each percentage point of increase in farmer households' probability to access SCF credit from their cooperatives will make it 10% and 8% more likely for their multi-dimensional poverty order and MPI to decrease, respectively. Direct poverty-reducing effect of SCF credit is significant.

(ii) There is certain heterogeneity in the poverty-reducing effects of SCF credit for cooperatives run by various entities. SCF credit for those run by large farmers, agribusinesses and village cadres is the most poverty-reducing for full-time farmers in poverty. In comparison, SCF credit for marketer-run cooperatives does not have any significant poverty-reducing effect.

(iii) With increasing non-farm incomes as a share of total income, the poverty-reducing effects of SCF credit for cooperatives run by large farmers and village cadres start to diminish. In other words, the higher the share of non-farm incomes, the less poverty-reducing SCF credit becomes. In comparison, SCF credit for agribusiness-run cooperatives is significantly poverty-reducing for all poor farmer households irrespective of the percentage of their non-farm incomes, and the higher percentage of their non-farm incomes, the more significant the poverty-reducing effect becomes.

Based on the conclusions of this paper, we put forward the following policy recommendations:

(i) During the implementation of targeted poverty reduction and countryside revitalization strategies, financial institutions should be encouraged to explore innovative forms of credit supply to the new agricultural operators, and offer innovative financial credit products for the supply chain of farmers' cooperatives in agricultural production, supply of agricultural means of production, agricultural machinery services, among others. The goal is to lower credit threshold, enhance risk monitoring, reduce poverty through agricultural supply chain credit, and promote the role of financial services in targeted poverty reduction in a more sustainable manner.

(ii) Farmers' cooperatives should ease SCF credit to promote industrial chain integration. In particular, they should foster shared interests with farmer households and integrate smallholders into modern agriculture. Agribusiness-run farmers' cooperatives should play an active role in supporting agricultural processing, rural trade logistics and countryside tourism by extending SCF credit to poor farmer households and thus increasing the share of their non-farm incomes. Meanwhile, farmers' cooperatives run by large farmers and capable village cadres should extend SCF credit for poor farmer households to develop capacities for escaping poverty.

(iii) Internet and big data technologies should be employed to develop a credit reference system

(C)1994-2023 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net

encompassing farmer households and farmers' cooperatives and increase credit availability for poor farmer households and the inclusiveness of SCF credit from farmers' cooperatives.

References:

[1] Alkire, S., and J. Foster. 2011. "Counting and Multi-dimensional Poverty Measurement." *Journal of Public Economics*, 95(7-8): 476-487.

[2] Antonella, M., ed. 2018. "Supply Chain Finance: from Traditional to Supply Chain Credit Rating." *Journal of Purchasing & Supply Management*, 6(4): 124-136.

[3] Caminada, K., and K. Goudswaard. 2009. "Social Expenditure and Poverty Reduction in the EU15 and Other OECD Countries." MPRA. ub.uni-muenchen.de/20138/1/MPRA_paper: 1-33.

[4] Gornall, W., and I A, Strebulaev. 2018. "Financing as a Supply Chain: The Capital Structure of Banks and Borrowers." *Journal of Financial Economics*, 129 (3): 510-530.

[5] Guo, Xiaoming and Zujun Liao. 2010. "Clan Network, Rural Finance and Smooth Consumption: Experience from 77 Villages in 11 Provinces of China." *China Rural Survey,* no.5: 48-55+84.

[6] Guo, Yunnan, and Yao Yang. 2012. "The Mechanism for Determining the Company-led Cooperatives and Institutional Characteristics: Evidence from Jinli Pig Cooperatives Function in Qionglai City, Sichuan Province." *China Rural Survey,* no.1: 32-45.

[7] He, Lilong, Ke Huang, and Yijun Zheng. 2018. "Effectiveness of Credit Support on Poverty Alleviation: An Empirical Study in the Perspective of Demand and Supply." *Economic Review,* no.1: 62-77.

[8] Heckman J J., ed. 1997. "Matching as an Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Programme." *Review of Economic Studies*, 64(4) : 605-654.

[9] Hofmann, E. 2005. "Supply Chain Finance: Some Conceptual Insight." *Logistik Management: Innovative Logistikkonzepte*, (S): 203-214.

[10] Hong, Zheng. 2011. "Is the Reform of New Rural Financial Institutions Feasible? ——Analysis from the Perspective of Monitoring Efficiency." *Economic Research Journal,* no.2: 44-58.

[11] Imai, K., ed. 2012. "Microfinance and Poverty—A Macro Perspective." *World Development*, 40(8): 1675-1689.

[12] Li, L.Y. 2018. "Financial Inclusion and Poverty: The Role of Relative Income." *China Economic Review*, 52 (6): 165-191.

[13] Li, Mingqiao. 2016. "The Effect of Income Component on Poverty Level of Pool Farmers-based on the Investigation of Poor Farmers in Guizhou Mountainous Areas." *Journal of Nanjing Agricultural University(Social Sciences Edition),* no.6: 131-140+156.

[14] Liu, Bing, Yun Ye, Weimin Yang, and Dinghuan Hu. 2013. "An Empirical Analysis of the Effect of Constructing Preponderant Agri-products Supply Chain on Farmers' Poverty Reduction in Poor Areas——Evidence Based on Dingxi Survey Database of Farmers." *Journal of Agrotechnical Economics,* no.6: 88-95.

[15] Mao, Fei, Xu Wang, and Xiangzhi Kong. 2014. "Supply of Financial Services of Farmers' Professional Cooperatives and Its Influencing Factors." *China Soft Science,* no.7: 26-33.

[16] Meng, Fei. 2016. "Rural Large-scale Leading Cooperatives: Formation, Influence and Regulation." *Issues in Agricultural Economy,* no.9: 71-79+111.

[17] Rosenbaum, P. and D B.Rubin.1985. "Constructing a Control Group Using Multivariate Matched Sampling Methods that Incorporate the Propensity Score. "*American Statistician*, 39(1): 33-38.

[18] Sanchis, J.R. and A. M. Navarro. 2011. "Strategic Diagnosis of Spanish Farming Cooperative Credit Sections: A Swot Analysis." *Annals of Public & Cooperative Economics,* 82(2): 167-186.

[19] Shao, Xian. 2013. "Innovation of Financial Mode in Agricultural Supply Chain: Evidence from Mawangdui Vegetable Wholesale Market." *Issues in Agricultural Economy,* no.8: 62-68+111.

[20] Shen, Yun, and Xiaobing Peng. 2016. "Chain Financing Mode and the Effect of Accurate Poverty Alleviation——Based on Quasi-experimental Research." *Journal of Finance and Economics,* 42(9): 4-15.

[21] Smith, J.A. and P. E. Todd. 2005. "Does Matching Overcome Lalonde's Critique of Nonexperimental Estimators?" *Journal of Econometrics,* 125(1-2): 305-353.

[22] Xiong, Xueping, Hongxin Ruan, and Fahai Yi. 2007. "Research on Farmers' Financial Behavior, Financing Demand and Demand Orientation of Financing System——Based on the Survey of Farmers in Tianmen, Hubei Province." *Journal of Financial Research,* no.8: 167-181.

[23] Ye, Fei, Qiang Lin, and Ruijun Mo. 2012. "Contract Farming Supply Chain Coordination Mechanism Based on B-S model." *Journal of Management Sciences in China,* no.1: 66-76.

[24] Zhang Zhao, Chengyu Yang, and Qiang Yuan. 2017. "Identification and Mobility of Income-Oriented Multi-dimensional Poverty." *Economic Theory and Business Management,* no.2: 98-112.

(C)1994-2023 China Academic Journal Electronic Publishing House. All rights reserved. http://www.cnki.net