A driver or a placebo? The role of financial support in farmer cooperative development in China

Qiao Liang
China Academy for Rural Development, School of Public Affairs, Zhejiang University, Hangzhou, China
Yining Xu
School of Economics, Fudan University, Shanghai, China and Shannxi International Trust Co., Ltd, Xi'an, China
Xinxin Wang
Zhejiang University of Finance and Economics, Hangzhou, China, and
Songqing Jin
Agricultural, Food and Resource Economics, Michigan State University, East Lansing, Michigan, USA

Abstract

Purpose – This paper explores the effect of financial support on farmer cooperative development in the Chinese context, aiming to evaluate the effectiveness of public inputs and draw implications for the sustainable development of cooperatives. The variance of the effect in different sectors, i.e. crop, forestry, husbandry, fishery and services, is investigated.

Design/methodology/approach – Provincial-level panel data from 2007 to 2017 are used for this study. A linear dynamic panel regression model is estimated using multiple estimation methods, i.e. the generalized method of moments (GMMs), fixed-effect model and ordinary least squares (OLS) are applied.

Findings – The empirical analyses indicate that the role of the government is important for the development of farmer cooperatives but limited in some specific aspects. First, the coverage of financial support is positively associated with the growth of cooperative population and membership size, but the strength of financial support, measured by the total amount of financial support divided by local agricultural gross domestic product (GDP), has no statistically significant effects on the development of cooperatives. Second, financial support does not exhibit significant influence on the revenue of cooperatives. Third, the magnitude of the effect of government support on cooperative development is heterogeneous across different sectors.

Originality/value – The research study adds to the institutional economics literature on the association between institutional environment and organization development by focusing on a particular and an important type of organization, i.e. farmer cooperatives. It is one of the attempts and a most extensive study to empirically investigate the role of financial support in the development of farmer cooperatives.

Keywords Farmer cooperative, The government, Financial support, China

Paper type Research paper

1. Introduction

There is a growing demand for the coordination among various players throughout the agro-food system, in which farmer cooperatives have a unique position (Kimball, 1988; Sykuta and Cook, 2001). Farmers establish cooperatives and act collectively to form countervailing power during transactions with other parties. Cooperatives pursue to maximize members' benefits in terms of both economic and noneconomic aspects (Feng and Hendrikse, 2012). The presence of cooperatives in markets can drive their counterparts to provide higher prices for

farmers and therefore increase the farm gate price of the whole sector, which is known as "competitive yardstick effect" (Liang and Hendrikse, 2016; Liang and Wang, 2020). Moreover, cooperatives can generate social welfare for local community such as construction of infrastructure and employment (Song *et al.*, 2014).

Although cooperatives have various advantages, they face some inherent limitations such as the capabilities of managers and access to finance (Maskur, 2016). Some scholars demonstrate that cooperatives are naturally less efficient compared with their counterparts such as investor-owned firms due to member patronage and collective decision governances (Vitaliano, 1983). The ownership feature and dual economic and social goals leave cooperatives inferior in economic efficiency. External support, e.g. government intervention, is therefore potentially justified (Liang and Hendrikse, 2013). The governments, around the world, are broadly involved in the development of cooperatives in one way or another (Deng *et al.*, 2010). It helps farmer cooperatives to survive the emergence stage and provide financial support to further development.

Opposite arguments regarding the role of government intervention prevail as well. Criticisms of government support for agriculture or farms hold that government intervention fosters centric governmentality, increases large farmers rather than small ones, causes obesity and so on (Graddy-Lovelace, 2017; Kovacs, 2015). Hussi *et al.* (1993) demonstrate that sustainable development of farmer cooperatives as well as other rural organizations had been constrained by close government control and involvement in some sub-Saharan African countries. Improper intervention from the government can result in low efficiency of public inputs or even generate negative outcomes. Capacity-building measures such as education and training for management and members are mainly advocated.

The wide existence of both positive and negative opinions in the role of government support in the literature implies that proper scheme and magnitude of government support vary geographically and may also depend on the lifecycle stage of cooperatives. This hypothesis motivates the current study, which is to investigate the role of government supports for farmer cooperative development based on the Chinese context, where farmer cooperatives were mainly founded in 21st century and are experiencing emergence and primary lifecycle stages (Huang and Liang, 2018). The findings would also provide implications for all the other developing countries, where farmer cooperatives are in the phase of fast development. The variance of the effects of financial support on cooperatives in different product sectors is also identified.

Farmer cooperatives were initiated in China in the late 1980s to serve farmers with technology instructions and/or market information. The development of cooperatives gained momentum after 2007 in response to the promulgation of the national cooperative law in China. The population of farmer cooperatives increased from 74,219 in the end of 2007 to 1,753,395 in 2017 [1]. Farmer cooperatives in China play important roles in linking smallholder farmers to modern agriculture. Particularly, they help farmers to obtain higher prices and value added of products (Liang and Wang, 2020), enhance innovation and technical efficiency (Ma *et al.*, 2018; Yang *et al.*, 2014) and improve quality, safety or risk control practices (Ji *et al.*, 2019; Zhong *et al.*, 2018).

China is one of the countries in which cooperatives are imposed as an intensive government intervention (Liang and Hendrikse, 2013). Some scholars criticize that the Chinese Government over-intervenes on the development of farmer cooperatives (Deng *et al.*, 2010; Huang *et al.*, 2015). Quite a lot of cooperatives in China were initiated top-down by the government, rather than bottom-up by farmers, in order to be compatible with the objective of farmers' market access and social strategy as well. In addition, some local governments provide generic subsidies for the foundation of cooperatives, which results in the rapid growth of cooperative population. However, the competitiveness of farmer cooperatives in markets remains low (Liang and Wang, 2020).

The Chinese Government provides various supports to promote the development of farmer cooperatives (Deng *et al.*, 2010; Liang and Huang, 2015). Examples are legislation in terms of laws and bylaws, tax deduction and exemption, financial subsidies, finance support, talent and technology trainings. Among these supports, the first two are generic policy, finance support is dependent much on policies of individual finance organizations, while expenditure on talent and technology trainings for cooperative members and managers is included in financial support. This paper therefore explicitly focuses on the effect of financial support on cooperative development. We also investigate the variance of the effect that financial support has on the development of cooperatives in different sectors.

We believe this research generates both theoretical and practical values. First, it adds to the institutional economics literature on the association between institutional environment and organization development by focusing on a particular and an important type of organization, i.e. farmer cooperatives. Classical institutional economics theory has formulated a theoretical framework to demonstrate how institutions influence the development, governance and performance of organizations (Williamson, 2000). However, the focus on farmer cooperative organizations is rare.

Second, it is one of the attempts and a most extensive study to empirically investigate the role of financial support in the development of farmer cooperatives. Despite of the richness of research on the role of financial support for farmers and agriculture, very little has been done on how and in which way that policy support works on the development of farmer cooperatives, except for Brusselaers *et al.* (2014) and Deng *et al.* (2010) mentioned above. We apply panel data comprising province-level information on cooperative development and financial supports in China from 2007 to 2017 and investigate the effects of different aspects of financial supports on the development of farmer cooperatives. Our results indicate that different aspects of supports can generate different outcomes for the development of farmer cooperatives. These results also provide important insights for developing countries which are experiencing the transition of agriculture and farmer cooperative development.

Third, this research offers more accurate policy implications by taking into consideration product diversities and looking at the variance of roles of financial support in various product sectors. Cooperatives in different product sectors differ in development levels and/or resource demand, which may result in their different dependence on government support. The empirical results reveal that the magnitude of the effects is heterogeneous across cooperatives in different sectors.

The paper starts in the next section with a theoretical framework and a literature review. An overview of the development of farmer cooperatives and the government's financial support for cooperatives is provided in Section 3. Section 4 is the methodology, introducing the data, the empirical model and various variables. Section 5 is dedicated to the empirical results and discussion. The final section concludes with policy implications.

2. The theoretical framework and relevant research
This section introduces the theoretical framework on which this study is based and reviews relevant research regarding the role of government support for the development of an agricultural organization.
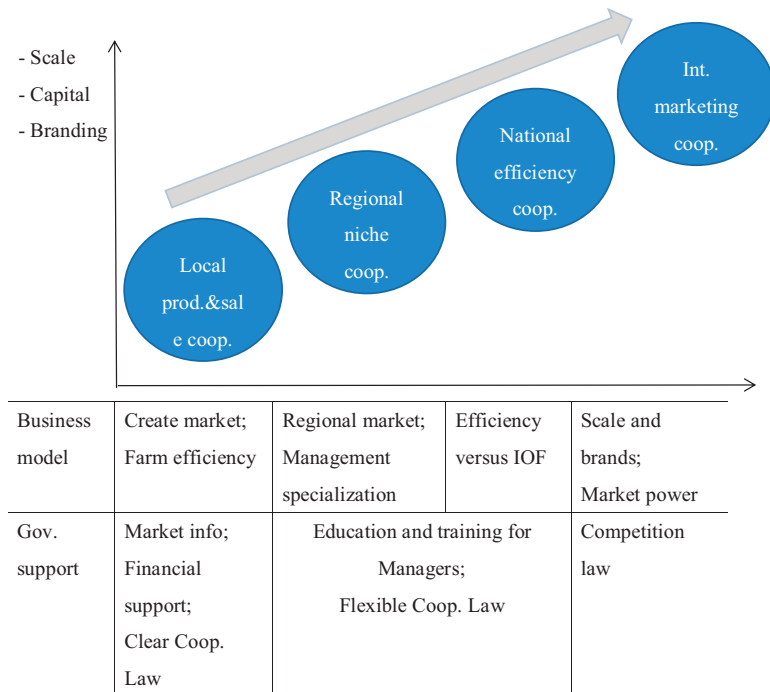
2.1 The theoretical framework
Institutional economics theory holds that the development of an organization is subject to formal and informal institutional environments (Williamson, 2000). Government support is an important component of formal institutions. Government support is to set the "rules of the game" in terms of various policies to facilitate the distribution of capital, technology and

information resources, which creates opportunities and/or pressure for organization development (Carlsson and Berkes, 2005; Young, 2006; Berkes, 2009; Bodin and Crona, 2009; Albena Pergelova and Fernando Angulo-Ruiz, 2014). Cooperatives are no exception, i.e. their development depends to a large extent on the appropriate institutional environment (Ostrom, 1990; Stefanson, 1999).

Cooperatives at different lifecycle stages of development require different institutional frameworks and support (Bijman et al., 2012). Generally speaking, at the early stage of cooperative development, a clearer and more specialized cooperative legal framework and greater government support are needed. With the maturity of cooperative development and the improvement of their own capabilities, government support can be gradually weakened and cooperatives also tend to be regarded as a general business or economic organization. For example, Denmark, The Netherlands, Sweden and other countries do not have a special cooperative law. Cooperatives, along with all other economic organizations, are subject to the corporate law.

Drawing on Bijman et al. (2012), this paper constructs a relationship diagram describing the association between the cooperative development stage and government support, which is shown in Figure 1. At the early stage of cooperative lifecycle, the main goal is to help farmers find the market and improve the efficiency of the farm or the production. The government should provide more policy measures to help cooperatives build abilities, such as providing market information and financial support, and there should be a clearer cooperative law.

Business model	Create market; Farm efficiency	Regional market; Management specialization	Efficiency versus IOF	Scale and brands; Market power
Gov. support	Market info; Financial support; Clear Coop. Law	Education and training for Managers; Flexible Coop. Law		Competition law

Figure 1.
Association between government support and cooperative development

Note(s): Based on Bijman et al. (2012) and authors' analysis

With the development of cooperatives and the improvement of their own capabilities, cooperatives have expanded to cross-regional and national scales, and they have paid more attention to the efficiency of the organization itself. At the same time, various natural insufficiencies caused by the characteristics of cooperative governance structures have emerged, such as horizon problems, management specialization issues, etc. Government support at these stages may shift from direct financial support and technical training to education and training for cooperative managers to help improve the management of cooperatives.

Further, with the development of cooperatives to the international market, scale and branding, there may also be a mixed form of cooperatives and investors' enterprises. One of the problems at this time is that the participation of members may be weakened. The government's unique intervention and support for cooperatives should also slowly withdraw and the law should be more and more relaxed (such as in Denmark and The Netherlands, etc.) to provide more freedom to treat cooperatives with other types of enterprises.

2.2 Relevant research
There is a sizable literature on the role of government intervention or support for agricultural production and marketing. Most research studies focus on the effect of government intervention in areas where market failure occurs, e.g. the adoption and innovation of technology (Wang, 2015; Zhang and Wu, 2018), practices related to resource and environmental sustainability (Ragkos *et al.*, 2017; Shiferaw and Holden, 2000), contracting relationship (Wu, 2006), farmers' or rural welfare (Heerink, 2006) and so on. Tools that the government uses are the friendly legal framework, price intervention, direct subsidy, favorable credit support, beneficial tax treatment, technical assistance and so on (Iliopoulos, 2013).

Limited academic literature, however, exists concerning the effectiveness of government support for agribusiness or farmer cooperatives, which are one of the dominant forms of agribusiness around the world. Brusselaers *et al.* (2014) examine the association of government policies and cooperative market shares based on data from the European Union countries. To the best of our knowledge, this is perhaps the only comprehensive research study about the role of government policies in cooperative development based on empirical but qualitative foundation. The study fails to establish a clear link between policy measures and market share of cooperatives. However, the study suffers from several limitations. One limitation is that government policies are measured by experts' scores on the effectiveness of policies in cooperative development. Such measure is subjective and ignores historic factors. Another limitation is that important factors such as the farming structure and characteristics of food chain were not controlled for in their econometric analysis, which could lead to omitted variable bias problem. Deng *et al.* (2010) look at the influence of policy measures in cooperative development in China, based on regionally surveyed data. In their study, they used whether or not a village had any available policy support as a proxy for government's supporting policies. They did not find any significant relationship between government supporting policies and cooperative development. This finding is not surprising in light of the fact that whether or not a village had any available policy support is highly endogenous. For example, it could be the case that a policy support was put forward in a village to promote the development of cooperatives because agroecological and socioeconomic conditions in the village are not suitable for the development of cooperatives in the first place. Failing to address this type of endogeneity problem would lead to a biased result.

The role of financial supports, ranging from price and input support to output support, in agricultural production and revenues has been widely studied (Anderson *et al.*, 2013; Demirdogen, 2016; Goodwin and Mishra, 2006). Most of these studies are conducted at the

individual farmer level. The effect of financial support on the development of farmer cooperatives, however, has hardly been empirically studied.

3. Background

Some empirical background of the development of farmer cooperatives and financial support in China is provided in this section.

3.1 Development of farmer cooperatives in China

Farmer cooperatives have been developing rapidly since the promulgation of national cooperative law in China. The population of farmer cooperatives and member farmers during 2007–2017 is displayed in Figure 2. Both the population of cooperatives and total membership size had been continuously increasing. The growth rate of cooperative population had been experiencing slightly but there was a stable decline since 2012, while the increase in membership size accelerated in 2012. We therefore can say, after a decade of fast growth of population, farmer cooperatives in China are nowadays developing toward quality enhancement and organization competitiveness (Huang and Liang, 2018).

Figure 3 reports total and average cooperative revenue from 2007 to 2017. The total revenue has been steadily increasing, while the average revenue per cooperative gradually decreased after experiencing the peak in 2009.

3.2 The government financial support for farmer cooperatives in China

The total financial support toward cooperatives had been initially growing since 2008, yet exhibited a trend toward decline since 2013, which is shown in Figure 4. Specifically, the

Figure 2.
Cooperative population and membership size (2007–2017)
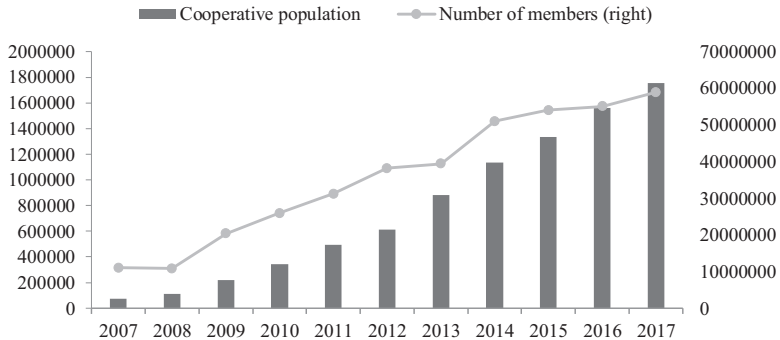
Figure 3.
Total revenue and average revenue of cooperatives (2007–2017)
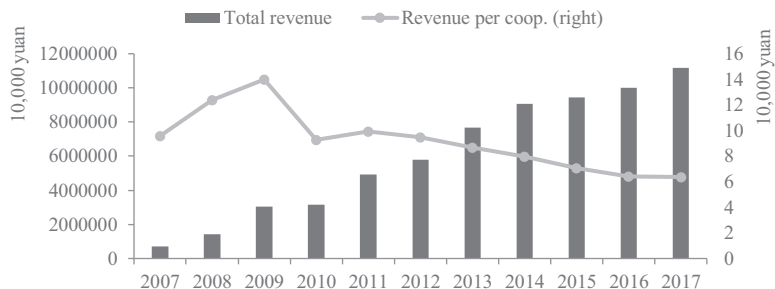
financial support for cooperatives increased from 230,276 thousand yuan in 2007 to 549,739 thousand yuan in 2013, with over 20% annual growth rate. However, the amount of funding was relatively lower in 2015 and 2016 and began to reach a new peak in 2017.

The average amount of financial support that a benefited cooperative received exhibits quite similar tendency to that of total amount of financial support. It firstly had been growing since 2008 and reached a peak, 171.39 thousand yuan per cooperative, in 2012, which is displayed in Figure 5. Later, it had been showing a downward tendency until 2015 and after that began to grow again. The coverage rate of financial support, i.e. the share of benefited cooperatives, was 18.18% in 2007, whereas after a slight ascent in 2008, it continually decreased to 2.04% in 2017.

There are some interesting implications from the trend of changes in financial support for farmer cooperatives, i.e. a decline in both the total and average amount of financial support for cooperatives since 2012. One of the reasons might be due to the fast development of family farms since 2012, which takes over part of the government's financial support (Huang and Liang, 2018). Another reason leading to the decline in financial support could be that the government purposely reduces the support in order to slow down the emergence of cooperatives and also puts more emphases on the improvement of the cooperatives' self-development by providing trainings for the managers and members rather than direct financial subsidies [2]. Center government emphasizes in the no.1 document in 2013 that more preferential policies should be given to college graduates to work in farmer cooperatives.

4. The research methodology
This section introduces the data, a model for the empirical tests and the measures and descriptive analyses of various variables.
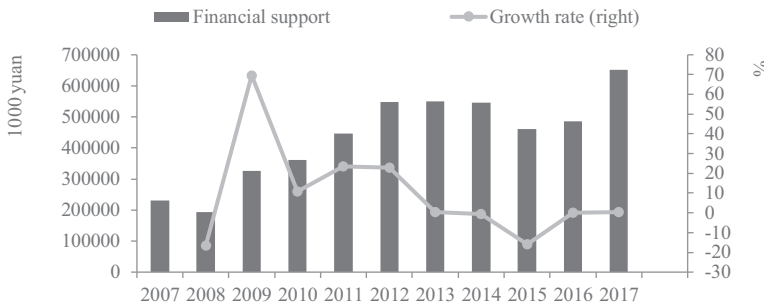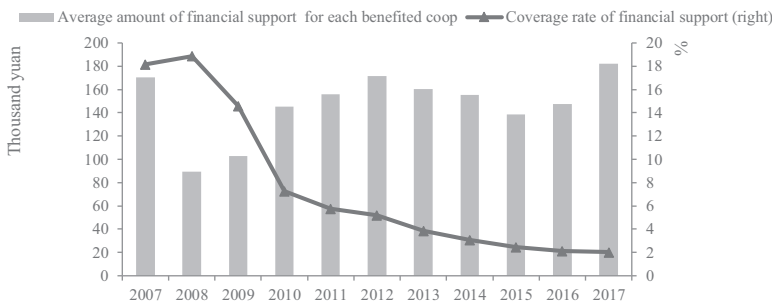

Figure 4.
Financial support for cooperatives

Figure 5.
Cooperatives benefitted from financial support

4.1 Data
A comprehensive database was established by incorporating data from multiple sources. Data for the development of cooperatives and the financial support are from the *China Rural Operation Management Statistical Yearbook (2007–2017)*, which were released by China's Ministry of Agriculture and Rural Affairs. These reports are available from the agro-economics statistics e-platform, which was established by the China's Ministry of Agriculture and Rural Affairs. Each report contains province-level data, i.e. the populations of cooperatives in general and in each of the main sectors, membership size, business scope, revenues, distributed profits (in part of years), amount of financial supports and number of cooperatives received supports, etc. in a specific year.

Data for control variables including economic development level, farmland size, agro-employees, sectoral gross domestic products (GDPs) and so on are obtained from the China Statistical Yearbook and the Rural Statistical Yearbook.

We chose 2007 as the starting year because cooperatives surged after the promulgation of the national farmer cooperative law in 2007 and there are hardly any data for farmer cooperatives before that. Tibet was excluded from the sample due to the vacancy of data. We also excluded Hong Kong, Macau and Taiwan as they adopt different statistical systems from mainland China. We finally have a database consisting of a sample of cooperatives in 30 provinces.

4.2 The empirical model
To estimate the impact of government financial support on the development of farmer cooperatives, we consider a linear dynamic panel regression model of the following form, where D_{it} is the development level of farmer cooperatives in province i in year t and $D_{i,t-1}$ is the lagged value of D_{it}, capturing the persistent effect of the past development level of cooperatives.

$$D_{it} = \beta_1 D_{i,t-1} + \text{GS}_{it}\beta_2 + X_{it}\beta_3 + \delta_i + \gamma_t + \varepsilon_{it} \tag{1}$$

In Equation (1), GS_{it} is a matrix of government support variables, X_{it} is a matrix of control variables, δ_i and γ_t are, respectively, province and year fixed effects and ε_{it} is the stochastic error term.

Estimating Equation (1) using ordinary least squares (OLS) will yield inconsistent estimates of β_2 because GS_{it} is endogenous. There are two sources for the endogeneity of GS_{it}. First, endogeneity may arise from reverse causality, i.e. the better development of farmer cooperatives in a province may motivate government to offer more financial supports to support the development of cooperatives. Second, local government's policy may be influenced by unobserved province-level factors, δ_i, such as culture and leader's preference, etc. The second type of endogeneity problem can be dealt with by taking the first difference of Equation (1) as follows:

$$\Delta D_{it} = \beta_1 \Delta D_{i,t-1} + \Delta \text{GS}_{it}\beta_2 + \Delta X_{it}\beta_3 + \Delta \gamma_t + \Delta \varepsilon_{it} \tag{2}$$

Where Δ is the sign for first differencing, e.g. $\Delta D_{it} = D_{it} - D_{it-1}$ and $\Delta D_{i,t-1} = D_{i,t-1} - D_{i,t-2}$.

Estimating Equation (2) by OLS will still yield inconsistent estimates because both $\Delta D_{i,t-1}$ and ΔGS_{it} are likely to be endogenous, that is, $E[\Delta D_{i,t-1}, \ \Delta \varepsilon_{it}] \neq 0$ and $E[\Delta \text{GS}_{i,t}, \ \Delta \varepsilon_{it}] \neq 0$. In order to estimate consistent estimates of Equation (2), we follow the idea by Arellano and Bond (1991) and use the first-order difference generalized method of moments (GMMs), where the past values of dependent variables are used to construct instruments for the lagged dependent variables. This method is suitable to cope with the dynamic panel data model and solve the weak instrument variable problem, which therefore increases estimating efficiency (Roodman, 2009) [3].

While the GMM estimates are the most preferred estimates, we also report the OLS results as well as the fixed effects model results for robustness checks.

4.3 Variable definition

4.3.1 Development of cooperatives. Brusselaers *et al.* (2014) and Hanisch *et al.* (2013) adopt the market share to indicate the competitiveness as well as the development of farmer cooperatives. Market concentration rate or the number of cooperatives per hundred producers are also used to measure the development of cooperatives (Milford, 2012). Organization size, such as total assets and employees, is frequently used as a proxy of the growth of organizations at the micro level (Greiner, 1989).

Considering the diversity of indicators which represent the development of cooperatives, we use three indicators, growth of cooperative population, average membership size and average revenue per cooperative, to specify the development of cooperatives in each province. Growth of cooperative population is calculated by the ratio of cooperative number in a certain year to that in the previous year. The average membership size embodies size of cooperative organization and is calculated by dividing the total number of cooperative members divided by the population of cooperatives in each province. The average revenue per cooperative indicates the performance of cooperatives, which is measured by the total revenue of all cooperatives divided by the population of cooperatives in each province. All dependent variables are relative indicators to eliminate the scale problem across different provinces. Definitions and measurements of each variable are displayed in Table 1.

4.3.2 Financial support. The financial support indicators capture both coverage and strength of financial support from the government. The former is measured by the proportion of the number of cooperatives receiving financial support in the population of cooperatives. The latter is calculated by the total amount of financial support divided by agricultural GDP.

4.3.3 Control variables. We also take into account other factors that may affect the development of farmer cooperatives. Variables such as the economic development level (Deng *et al.*, 2010), agriculture GDP, farming employee and farmland are controlled to capture the effect of economic and industrial environment on cooperatives. Besides, the lagged values of cooperative population growth and cooperative membership size are taken as control variables since the population of cooperative and the average cooperative membership in the current period are also influenced by their stocks in the last period.

Variable	Definition and measurement
Dependent variables (t)	
Growth of coop population	100% * population of cooperatives (*t*)/population of cooperatives (*t*-1)
Average membership size	Total membership size/population of cooperatives
Average revenue	Total revenue of cooperatives in a province/population of cooperatives
Independent variables (t-1)	
Financial support coverage	The proportion of cooperatives which received financial support (%)
Financial support strength	Total amount of financial support/agricultural GDP (%)
Control variables (t-1)	
Economic development	GDP per capita (1,000 RMB)
Farmland	Farmland per farmer (Mu)
Agro-population	The number of people engaged in agriculture (10,000)
Agro-population share	The proportion of people engaged in agriculture to total population (%)
Agro-GDP share	The proportion of agricultural GDP to total GDP (%)

Table 1.
Definition and measurement of variables

5. Results and discussion
Empirical results of the effect of financial support on the development of farmer cooperatives are reported and discussed in this section.

5.1 The effect of financial support on the development of farmer cooperatives
The results of the influence of financial support on the growth of cooperative population are estimated using system generalized method of moments (GMM hereafter). We also estimate the results using OLS and fixed-effect methods, in order to check the robustness of the results and obtain consistent results. All the results are displayed in Table 2. We conducted autocorrelation tests for the possible existence of the first- and the second-order autocorrelations (i.e. AR(1) and AR(2)) of residuals in the first-difference dynamic panel equation (Equation 2) and the Sargan test for overidentification of instrumental variables (IVs). The tests are conducted for all the three main models (Tables 2–4). The test results are highly consistent across the three models. The autocorrelation tests show that AR(1) is statistically significant but AR(2) is not significant. The fact that there is evidence for AR(1) but not for AR(2) suggests that the lagged levels of the dependent variable and the GS variable from lag2 onward can be used as instruments for their corresponding first-differenced variables in the dynamic panel GMM Equation (2). The results of Sargan tests further support the validity of IVs as we fail to reject the null hypothesis that the IVs used in the dynamic panel GMM estimation are appropriate.

The financial support coverage has a statistically significant and positive effect on the growth of cooperative population. Results of the GMM estimation in column (1) indicate that an increase of 1% of financial support coverage can contribute to an increase of growth rate of cooperative population by 2.49%. While both OLS and fixed effects results are consistent with the GMM results in terms of the level of significance and the direction of effect, the magnitude of the estimated coefficient differs considerably between GMM and fixed-effect models, reinforcing the importance of using the GMM method to address the endogeneity of $\Delta D_{i,t-1}$ and $\Delta \text{GS}_{i,t}$ $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ in Equation (2).

Variables	(1) GMM	(2) OLS	(3) Fixed-effect
Financial support coverage	2.399*** (0.443)	2.240*** (0.307)	1.035*** (0.395)
Financial support strength	−20.108 (47.54)	−37.51 (46.04)	−21.39 (40.35)
GDP per capita	−60.066*** (21.16)	−26.31*** (6.439)	8.166 (28.63)
Farmland per farmer household	0.261 (3.231)	1.652*** (0.524)	−6.925*** (2.225)
Agro-population	−44.938 (81.10)	1.870 (2.381)	−53.43 (52.03)
Agro-population share	1.188 (2.075)	0.167 (0.278)	−0.230 (1.286)
Agro-GDP share	222.214 (351.7)	−61.52 (58.88)	75.36 (207.2)
L.coopnum_incsrate	0.008 (0.0603)	0.174*** (0.0475)	−0.0877* (0.0517)
Constant	316.160 (477.7)	29.554 (23.18)	474.450* (303.7)
Observations	240	270	270
R-squared	–	0.423	0.664
[a]Arellano-Bond tests			
AR(1)	Prob(>z) = 0.0008		
AR(2)	Prob(>z) = 0.1178		
Sargan test	Prob > χ^2 = 0.7073		

Note(s): standard errors in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$
[a]AR(1) and AR(2) tests for the first- and second-order autocorrelations of the residuals in the first-differenced linear dynamic panel regression equation (Eq. 2). The Sargan test is to test whether the overidentifying moment conditions are valid, a critical condition for the validity of the instrument variables

Table 2.
The effect of financial support on the growth rate of cooperative population

Variables	(1) GMM	(2) OLS	(3) Fixed-effect
Financial support coverage	0.983*** (0.300)	1.096*** (0.284)	1.573*** (0.340)
Financial support strength	−14.03 (33.74)	2.386 (41.07)	−26.18 (35.92)
GDP per capita	−63.98*** (14.06)	3.745 (5.319)	−52.71** (21.03)
Farmland per farmer household	−1.187 (1.936)	−0.321 (0.437)	−2.863* (1.618)
Agro-population	−107.9** (54.88)	5.144** (2.063)	−90.67** (42.63)
Agro-population share	1.420 (1.404)	−0.00563 (0.233)	0.517 (1.024)
Agro-GDP share	140.2 (191.6)	−15.51 (50.98)	286.5* (151.4)
L.farmer_percoop	0.143*** (0.0424)	0.560*** (0.0313)	0.241*** (0.0401)
Constant	753.0** (317.9)	−24.80 (19.34)	625.3** (250.7)
Observations	270	300	300
R-squared		0.658	0.606
[a]Arellano-Bond tests AR(1)	Prob(>z) = 0.0677		
AR(2)	Prob(>z) = 0.1135		
Sargan test	Prob > χ^2 = 0.7600		

Note(s): standard errors in parentheses. ***p < 0.01, **p < 0.05, *p < 0.1
[a]AR(1) and AR(2) tests for the first- and second-order autocorrelations of the residuals in the first-differenced linear dynamic panel regression equation (Eq. 2). The Sargan test is to test whether the overidentifying moment conditions are valid, a critical condition for the validity of the instrument variables

Table 3.
The effect of financial
support on average
membership size per
cooperative

Variables	(1) GMM	(2) OLS	(3) Fixed-effect
Financial support coverage	−0.121 (0.103)	0.185*** (0.0670)	−0.0752 (0.101)
Financial support strength	−2.316 (12.07)	−7.566 (9.805)	−13.23 (10.63)
GDP per capita	−3.765 (4.214)	1.385 (1.242)	3.529 (6.210)
Farmland per farmer household	−0.527 (0.810)	−0.102 (0.104)	−0.0560 (0.471)
Agro-population	5.497 (19.09)	0.752 (0.495)	−14.67 (12.58)
Agro-population share	−0.0828 (0.479)	−0.124** (0.0566)	0.399 (0.303)
Agro-GDP share	42.73 (74.91)	5.167 (12.03)	58.42 (44.99)
L.revenue_percoop	0.295*** (0.0678)	0.450*** (0.0505)	0.260*** (0.0577)
Constant	−21.11 (111.4)	2.377 (4.581)	78.67 (73.72)
Observations	270	300	300
R-squared		0.361	0.168
[a]Arellano-Bond tests AR(1)	Prob(>z) = 0.1227		
AR(2)	Prob(>z) = 0.1363		
Sargan test	Prob > χ^2 = 0.9082		

Note(s): standard errors in parentheses; ***p < 0.01, **p < 0.05, *p < 0.1
[a]AR(1) and AR(2) tests for the first- and second-order autocorrelations of the residuals in the first-differenced linear dynamic panel regression equation (Eq. 2). The Sargan test is to test whether the overidentifying moment conditions are valid, a critical condition for the validity of the instrument variables

Table 4.
The effect of financial
support on average
revenue per
cooperative

However, financial support strength, measured by total amount of financial support for cooperatives divided by local agricultural GDP does not significantly influence the growth rate of cooperative population. This result reveals an interesting phenomenon that the presence of financial support attracts more and more agricultural entrepreneurs to rush into the cooperative "industry," although they have no idea about the amount of financial support they can obtain from the government. Among all the control variables, GDP per capita has a negative influence on growth rate of cooperative population.

Table 3 presents the estimated effects of financial support on membership size of cooperatives. Similar to the effects of financial support on growth of cooperative population, a higher level of financial support coverage led to a significant increase in cooperative membership size, while the strength of support has no significant effect on the membership size. The results of various estimation methods are quite consistent with minor differences. To be specific, the GMM estimate suggests that an increase of 1% of financial support coverage results in an increase of cooperative membership by around 1%. The fixed-effect method led to overestimation of the effects of financial support coverage on the growth of cooperative membership (column 3). As for the control variables, both GDP per capita and the size of agro-population negatively affect the average membership size.

The estimated GMM results in column (1) of Table 4 do not display any significant effect of financial support on average revenue of cooperatives. Though the results of the OLS method indicate a positive impact of financial support coverage on average revenue of cooperatives (column (2)), the statistical significance of impact disappears in either the fixed-effect (column 3) or GMM model (column 1).

Generally, financial support is significantly associated with the development of cooperatives, but the role of different dimensions of supports varies. To be specific, the increase of financial support coverage can promote the growth of cooperative population and membership size but has no significant impact on average revenue of cooperatives. The strength of financial support does not exhibit any significant influence on cooperative development.

There is a two-sided effect of financial support on the growth of cooperative population in the literature (Deng et al., 2010; Hussi et al., 1993). Our results are consistent with the observation by Deng et al. (2011) that subsidies for cooperatives contribute to a higher cooperative founding rate. What is notable is that the founding or increase of farmer cooperative population is desirable at the initial stage but not necessary throughout all the lifecycle stages of cooperative development (Bijman et al., 2012). This is also observed by our empirical results that the growth rate of cooperative population has been declining in the recent years.

Chinese farmer cooperatives are doubted about their capability in helping farmers because of their small membership size (Liang and Hendrikse, 2013). Theoretically, the competitive yardstick effect of cooperatives exists regardless of the membership size of cooperatives, i.e. the presence of cooperatives in markets enhances farm gate prices of the whole market (Nourse, 1992). The magnitude of market shares or market position of cooperatives matters, though (Hanisch et al., 2013). The larger the market shares of cooperatives, the larger the competitive yardstick effect might be. From this point of view, the increase in membership size, indicating the transferring from quantity expansion to quality improvement, is desirable for the sake of better function of cooperatives.

5.2 Heterogeneity of the effect across sectors

We further explore the heterogeneity of the effect of financial support on cooperative development across different sectors. We breakdown farmer cooperatives into five groups, according to the statistical yearbook of the Ministry of Agricultural and Rural Affairs. They are crop, forest, husbandry, fishery and service cooperatives [4]. The number of cooperatives of the five types, respectively, account for 48.45, 5.94, 23.05, 3.25 and 7.93% of the population in 2017.

Figure 6 displays the numbers of the five types of cooperatives from 2007 to 2017. The number of crop cooperatives has been growing at a higher speed than those in other sectors since 2012. The reason for the fast growing of crop cooperatives might be related with food security as the high growing speed of crop cooperative number is mainly caused by the growth of grain cooperatives [5]. The food import in 2012 exceeded 70 million tons and the self-sufficient rate was around 89.4% [6], which is smaller than the red warning line, i.e. 95%.
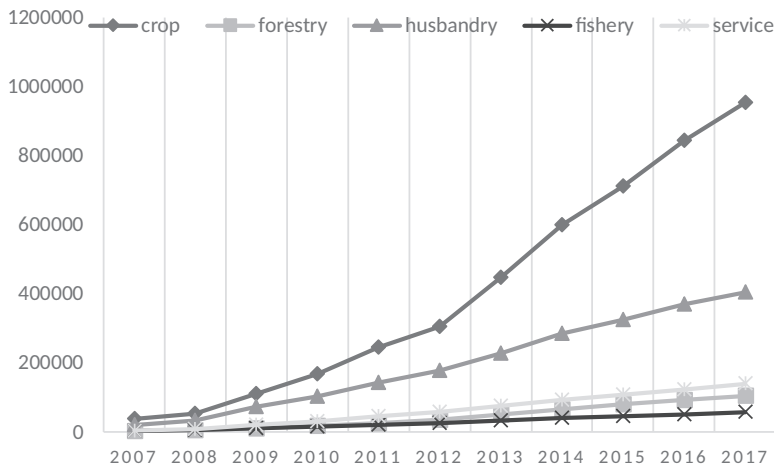
The theme of the World Food Day in 2012, "Agricultural cooperatives – key to feeding the world," also indicates a strong direction for the role of grain cooperatives in food security. The Chinese Government therefore increased supports toward grain production as well as producers to ensure food security (the no. 1 document, 2013).

The financial support for cooperatives in various sectors is measured by the same indicators as that for the aggregated model, i.e. the coverage and strength of financial support for all the cooperatives since we do not have the corresponding data in each sector. The development of cooperatives in all the sectors is indicated by the growth of cooperative numbers because of the lack of data for cooperative membership size and revenue in specific sector. The estimations on the effects of financial support on the population growth of cooperatives in various sectors are also conducted to check the robustness of the results of the aggregate model.

Besides the variables controlled in the aggregated model, it is necessary to take into account some sector-specific factors. For the models for crop, forest, husbandry and fishery cooperatives, we include the ratio of value of output in each sector to total value of agricultural output to indicate the weight of this sector in agriculture. The GMM method is applied to estimate the effect of financial support on the development of cooperatives in various sectors. Explanatory variables are also lagged by one year in order to take reverse causation into account.

The results are displayed in Table 5. The coverage of financial support exhibits significant and positive effects on the growth of cooperatives population in various sectors, while no significant influence of the strength of financial support on the growth of cooperative population in any sector is observed. The magnitude of the effects varies across various sectors. Specifically, the increase of 1% of financial support contributes to the population growth of crop, forest, husbandry, fishery and service cooperatives by 1.721, 12.67, 3.331, 2.291 and 2.242%, respectively.

From the estimated results of sector heterogeneity, two implications can be derived. First, the results confirm the robustness of empirical results for the aggregated model which are analyzed in Section 5.1. The empirical estimations based on both the whole sample and the subsamples of cooperatives in various sectors display highly consistent results regarding the effects of financial support on the development of farmer cooperatives.

Second, the effects of financial support on cooperative development are heterogeneous across various sectors. The effects of financial support on the population growth of

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Variables	(1) fcrop	(2) fforest	(3) fhusb	(4) ffish	(5) fserv
Financial support coverage	1.721*** (0.471)	12.67*** (0.945)	3.331*** (0.546)	2.291*** (0.585)	2.242** (0.920)
Financial support strength	−26.45 (49.55)	55.80 (106.2)	−34.51 (56.29)	−20.53 (64.26)	−13.29 (98.51)
GDP per capita	−74.58*** (18.70)	83.38** (40.42)	−62.60*** (21.81)	−72.27*** (23.83)	−142.6*** (42.94)
Farmland per farmer household	4.455 (3.249)	−12.11 (7.864)	−1.104 (3.686)	−2.646 (4.490)	9.729 (6.823)
Agro-population	−10.66 (86.33)	−90.96 (188.7)	−114.1 (93.82)	−99.85 (105.3)	−113.7 (161.7)
Agro-population share	1.784 (2.209)	−8.623* (4.893)	1.672 (2.405)	0.856 (2.671)	3.519 (4.082)
L.fcrop_change	−0.0148 (0.0597)				
Crop output value share	−80.06 (116.8)				
L.fforest_coopchange		−0.0163 (0.0320)			
Forest output value share		−2.391 (442.8)			
L.fhusb_coopchange			0.0655 (0.0541)		
Husbandry output value share			−50.10 (132.4)		
L.ffish_coopchange				−0.0809*** (0.0208)	
Fish output value share				−417.2 (462.8)	
L.fserv_coopchange					0.000649 (0.0617)
Agro-GDP share					−97.00 (715.7)
Constant	139.7 (506.1)	869.6 (1,104)	780.2 (554.3)	782.5 (622.6)	760.2 (954.5)
Observations	240	240	240	240	240
Number of id	30	30	30	30	30

Note(s): Standard errors in parentheses, ***p < 0.01, **p < 0.05, *p < 0.1

Table 5.
The effect of government financial supports on the development of farmer cooperatives in main sectors

cooperatives in the forest sector are the largest, followed by husbandry, fishery, service and crop cooperatives. Crop cooperatives have the highest growth rate and account for the largest proportion of cooperative population in China. Crop farming demands for more social services (e.g. seedling, technical training and machinery service) and collective action in markets. Crop cooperatives are also developed for the circulation of farm land in order to enhance the productivity of lands.

In contract, husbandry farmers in China rely less on cooperatives. A lot of husbandry cooperatives were established by or under the control of downstream processing companies (Liang and Wang, 2020). This type of cooperatives is more like a workshop of downstream companies and supplies products for companies. Therefore, farmers themselves have a limited incentive to establish cooperatives. For the forest sector, it is still common in rural China that forests are operated collectively by villages rather than by individual farmers. This weak property rights problem disincentivizes the foundation of forest cooperatives. Financial support therefore plays a larger role in sectors where cooperatives are more difficult to develop, i.e. forest and husbandry sectors, and a smaller role in the crop sector where farmers themselves have a stronger incentive to establish cooperatives.

5.3 Robustness and reliability checks for the results
As we mentioned in the previous subsections, we check the robustness of empirical results via a couple of methods. First, in addition to GMM results, we also estimate the results based on OLS and fixed-effect methods and obtain consistent results. Second, we break down the full sample into subsamples of cooperatives in different sectors and compare the results for the aggregate model and those for the sector models. The empirical estimations display highly consistent results regarding the effect of financial support on the development of farmer cooperatives.

Due to the aggregated and panel nature of the provincial data, measurement errors with both the dependent and independent variables are a potential concern and therefore are worth addressing. First, the measurement error problem for dependent variables would not bias our estimates if the measurement errors are not correlated with the main independent variables of interest. There is no particular reason for us to believe that the measurement errors of our dependent variables (i.e. population growth, average membership size and average revenue of cooperatives) are correlated with the level of government financial support. That is to say, even there are measure errors with the dependent variables, they would be part of the error terms that are not correlated with financial support and therefore do not cause the bias of the results for the effect of financial support on cooperative development.

The main concern lies in the measurement errors with independent variables, i.e. different measures of financial support. To check whether the measurement error problems with our independent variables cause biases of the estimated results, we conduct a formal test following Townsend (1994). If the estimated coefficients from fixed-effect (Equation 1) and first-differenced models (Equation 2) do not differ significantly, then this is an indication that measurement errors are not a concern. The equality of the two estimates is tested by constructing a *t*-statistic. The results indicate that there is no significant difference between the two estimates for all the three indicators of dependent variables (i.e. population growth, average membership size and average revenue of cooperatives). We report the results for the case when the independent variable is coverage of financial support and the dependent variable is population growth of cooperatives in Table 6 [7].

6. Concluding comments and policy implications
6.1 Concluding comments
This paper maps the development of farmer cooperatives as well as the government financial support for cooperatives, explores the impact of financial support on the development of

farmer cooperatives by considering regional and sector diversities and aims to provide some insights into policy measures for the government regarding the optimization of financial support and create a conductive institutional environment for cooperatives. A data set containing abundant information of farmer cooperatives in China during 2007 and 2017 is used.

The population of farmer cooperatives began to boom in 2007, when China promulgated the national farmer cooperative law. Many provincial governments followed by putting into practices local farmer cooperative laws and regulations. At the same time, the government provided various supports, e.g. funding, technology, tax reduction and so on, to promote the development of farmer cooperatives. The total financial support for farmer cooperatives had displayed a declining trend since 2012 but began to rise again in recent years. However, the coverage rate of cooperatives receiving financial support has been getting smaller since 2008.

The empirical analyses indicate that the financial support from the government plays an important role in the development of farmer cooperatives but limited in some specific aspects. First, the coverage of financial support is positively associated with the growing of cooperative population, but the strength of financial support, measured by the total amount of financial support divided by local agricultural GDP, has no statistically significant effects on the population growth of cooperatives. Second, the coverage of financial support contributes to the increase in membership size of farmer cooperatives. Third, neither the coverage nor the strength of financial support exhibits significant influence on the revenue of cooperatives. Fourth, the magnitude of the effects of government support for cooperatives development is heterogeneous across different sectors. These results reveal that financial support can promote the population growth and membership size increase of farmer cooperatives in China but is not able to significantly promote the revenue of organizations.

6.2 Policy implications

We next raise two recommendations for the development of farmer cooperatives in China, which also generate implications for other developing countries.

A broad coverage of funding for cooperatives is an effective measure for the development of cooperatives in China but diversity of support is necessary. The development of cooperatives in China is transforming from population growth toward enhancement of organization competitiveness in recent years. In fact, the government, especially some provincial governments of developed areas in China stopped promoting the foundation of organization and proposed the objective of enlarging the membership size and enhancing the competitiveness of cooperatives. Considering the fact that a limited part of farmer cooperatives in China is competitive, compared with other types of firms, a more advantageous and effective way would be to provide more supports for those

Variables	Coef	Obs	Mean	Std. err	Std. dev
b_con	1.0353	270	40.752	8.3666	137.4774
b_condi	0.0088	270	40.752	5.6945	93.5704
combined		540	40.752	5.0556	117.4822
diff			4.68e-07	10.1207	

Diff = mean (b_con)-mean (b_condi)	$t = 0.0000$	
H0: diff = 0	Degrees of freedom = 538	
Ha: diff < 0	Ha: differ = 0	Ha: diff > 0
Pr $(T < t) = 0.5000$	Pr $(|T| > |t|) = 1.0000$	Pr $(T > t) = 0.5000$

Table 6.
Two-sample *t*-test with equal variances

well-performing cooperatives. Hence, supports in terms of talent and technology trainings for cooperative members and managers and subsidies for high-quality products may have the potential to benefit cooperatives. These recommendations are beyond the scope of our current research, though.

Government support for cooperatives in different sectors can be different to reflect the objectives of cooperative development in various sectors due to the heterogeneity of the magnitude of the effects of financial support on cooperatives across various sectors. Nowadays, the Chinese Government allocates more financial support to the development of grain cooperatives due to its special role in food security and low profit margin of grain production. However, cooperatives in other sectors also play essential roles in farmers' income increase, product value added and food safety (Ji *et al.*, 2019; Narrod *et al.*, 2009; Zhou *et al.*, 2015). The government may provide different types of support accordingly to direct the development orientation of various sectors.

6.3 Limitations and future research

While this research comes up with some inspiring results and implications, there are a number of limits which provide potential possibilities for future research. First, it is interesting to look at the effect of a combination of various government supports on the development of cooperatives. We only look at the financial support for farmer cooperatives, which is the main support from the government, yet there are other aspects of supports such as technology training and finance support. We are not able to include these supports into the model due to the lack of data. More profound and comprehensive data might become available as the development of database construction. Then, more implications can be drawn from studies on various government supports for cooperatives.

Second, it is also desirable to estimate the effects of different types of financial supports on the development of farmer cooperatives. The data applied in the analysis for financial support are an aggregation of various types of supports, including not only financial support directly provided to cooperatives for the establishment and technique education but also that in the form of projects for infrastructure constructions, machineries, ago-product quality certification and so on. We are not able to breakdown these different types of financial supports due to data limit.

An additional way to extend the current study would be to investigate the roles of government supports in different contexts in terms of geographic areas and lifecycle stages.

Notes

1. Data source: <China Rural Operation Management Statistical Yearbook 2007> and <China Rural Operation Management Statistical Yearbook 2017>, Ministry of Agriculture and Rural Affairs.

2. The reason is proposed by an official from the Department of Agriculture and Rural Affairs in Zhejiang province during the interview.

3. A large N is required for obtaining consistency of estimates of GMM, and $N = 30$ appears to be a little small. Buddelmeyer *et al.* (2008) conduct Monte Carlo simulation to address the small N biases in panel data estimators. Their simulation results indicate that OLS outperforms the other estimators only in the case of $N = 20$ and $T = 5$ and lagged coefficient is large. In all other cases, fixed-effect, Anderson-Hsiao IV and GMM estimators perform much better than OLS. For example, when $N = 20$, $T = 20$, no matter what the coefficient of lagged dependent variable is, the bias estimates for the fixed effects are similar to those with $N = 500$, $T = 20$. And in our case, we have $N = 30$, which should perform much closer to $N = 500$.

4. Service cooperatives provide inputs, machinery, processing, etc. services for farmers and can be in any agricultural sector.

5. Based on the data from the China Rural Operation Management Statistical Yearbook (2007–2017)

6. Data source: 2013 China Agricultural Development Report.

7. The testing results of all the other cases, i.e. for any combination of independent variable and dependent variable, also indicate there is no significant difference between the two estimates from fixed-effect and first-differenced models.

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Corresponding author
Yining Xu can be contacted at: meggiexyn@163.com