AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Non-economic societal impact or economic revenue? Performance and efficiency analysis of farmer cooperatives in China

L. Yu[1]; W. Huang[2]

1: Fujian Agriculture and Forestry University, Department of Economics, China, 2: Swedish University of Agricultural Sciences (Sveriges lantbruksuniversitet), Department of Economics, Sweden

Corresponding author email: yuliyan733@163.com

Abstract:

Although the role of farmer cooperatives as a social unit can have impact on their performance, empirical analysis on how societal output and social value relevant variables affect the cooperatives performance is sparse. The objective of this paper is to provide an economic framework and operational model for performance measurement of farmer cooperative associated with societal impact. A multi-output translog production function considering social output represented by the number of beneficiary farmers using data from surveys 164 cooperatives in Fujian province, China, is estimated. The average technical efficiency of cooperatives is estimated to be 0.747, implying that cooperatives can be increased by 25.30% without any additional resources given the current production input level. It is interesting to find that cooperatives' efficiency scores and their rankings are significantly different with and without taking societal output into account, which indicates that social output created by the number of beneficial farmers' cannot be ignored when evaluating cooperative's performance. The societal value relevant variables for technical inefficiency factors represented by extent of providing members' service, namely training members and selling products are also found negatively affecting technical efficiency of cooperatives. The findings indicate the evaluation of cooperatives performance should consider their non-economic social contribution.

Acknowledegment: The authors gratefully acknowledge financial support from Fujian Agriculture and Forestry University FAFU university: 2016 project (social science category) for supporting outstanding young scientific researchers: (NO: xjq201632).We also acknowledge the kind help from Professor Jerker Nilsson.

JEL Codes: A13, P13

#1304

Non-economic societal impact or economic revenue? Performance and efficiency analysis of farmer cooperatives in China

Abstract:

Although the role of farmer cooperatives as a social unit can have impact on their performance, empirical analysis on how societal output and social value relevant variables affect the cooperatives performance is sparse. The objective of this paper is to provide an economic framework and operational model for performance measurement of farmer cooperative associated with societal impact. A multi-output translog production function considering social output represented by the number of beneficiary farmers using data from surveys 164 cooperatives in Fujian province, China, is estimated. The average technical efficiency of cooperatives is estimated to be 0.747, implying that cooperatives can be increased by 25.30% without any additional resources given the current production input level. It is interesting to find that cooperatives' efficiency scores and their rankings are significantly different with and without taking societal output into account, which indicates that social output created by the number of beneficial farmers' cannot be ignored when evaluating cooperative's performance. The societal value relevant variables for technical inefficiency factors represented by extent of providing members' service, namely training members and selling products are also found negatively affecting technical efficiency of cooperatives. The findings indicate the evaluation of cooperatives performance should consider their non-economic social contribution.

Key words: technical efficiency; stochastic frontier analysis; farmer cooperative; societal impact; social value.

[JEL code: A13; P13; Q13]

1. Introduction

Farmer cooperatives are one of the most vital farmers' associations in China with the aim of providing benefits to farmers through services that enhance the adoption of new agricultural technologies, sustainable farm practices, and output marketing (Ma et al., 2017). The number of farmer cooperatives was 26,400 when the Chinese Cooperative Law ("Law" thereafter)[1] was promulgated on July 1st, 2007. By the end of 2016, there were 1,794,000 farmer cooperatives with around 44.4% of the farmers who have joined cooperatives and the average annual growth of farmer cooperatives reached 60% since 2007. Farmer cooperatives are serving as a channel to assist farmers or rural poor to enlarge or improve operations, to adopt a new technology, to provide stable sales channels and financing assistance etc., thus promoting village construction, increasing farmers' income and enhancing their welfare.

To keep cooperatives' highly efficient is necessary because inefficient cooperatives will exit from the industry in a competitive market (Hailu et al., 2005; Schroeder 1992). The economic efficiency of cooperatives has been a hot topic in the field of agricultural economics, with a focus and debate centering on the appropriate function maximized by the cooperative (Porter and Scully, 1987). Some researches argue that cooperatives are technically and economically inefficient when compared to investor-owned firms (IOFs) due to structural inefficiencies (Clark, 1952; Porter and Scully, 1987; Sexton, 1989; Akridge and Hertel, 1992; Notta and Vlachvei, 2007). There would be some tension between social value of cooperation and efficiency since cooperative's governance was characterized by democracy, which was conceptualized as not readily compatible with efficiency (Fonte and Cucco2017). Specially, it cannot be ignored that five core problems (rider problem, horizon problem, portfolio problem, control problem and influence costs problem) facing the cooperative performance (Cook, 1995). Those who advocate cooperatives reject the argument that cooperatives are weak performers and demand a different approach to measuring the performance of cooperatives (Soboh et al., 2009). Therefore, it is a key point to find a proper way to evaluate the efficiency of cooperatives, not only focus on the financial economic efficiency, but also paying attention to non-economic societal impact.

[1]The full name is Farmer Specialized Cooperative Law of the People's Republic of China. This article refer to it as Cooperative Law or Chinese Cooperative Law.

The efficiency of agricultural cooperatives depends on their business objectives which reflect distinct social value of serving members more or less. In general, cooperatives' objectives can be divided into two classes, a single-objective and multiple-objective (Soboh et al., 2009). So far, the comparative studies on the cooperatives' performance mainly focus on single-objective. Among these various single-objective goals, there are a great amount of studies focusing on benefits of members (Helmberger and Hoss, 1962, Cook, 1995; Karantininis and Zago, 2001), such as maximizing the return to patronage for members' welfare, maximizing the size of membership. These studies view the prime objective of the cooperative is to provide stability and optimal growth conditions for its members. Although these studies differ in terms of scope and tone, they all concern about the efficiency of cooperatives' internal single output. Recently cooperatives have extended to encompass more expansive aims including bringing economics benefits to their members and contributing to improve social welfare (Wynne-Jones, 2017), which means multiple objectives. The cooperatives are also expected to make a significant contribution to its local community in addition to running a sustainable business and delivering benefits only to members (Skurnik, 2002; Liang and Hendrikse, 2013; Xu, 2014). Given these multiple-objective or more-than-economic functions, it is necessary to consider whether existing measures of efficiency without considering societal effects are sufficient to explain performance of cooperatives nowadays. The aim of the study was to explore whether and how societal value is related to cooperatives' production performance.

In China, a great number of cooperatives face inefficiency problem, which become a major challenge today. A result according to a dataset of 896 marketing cooperatives in China's Zhejiang Province in 2009 showed that the technical efficiency (TE) was only 0.46 on average (Huang et al., 2013). Furthermore, it has been estimated that perhaps 80% of the registered cooperatives in China have no or only very limited business operations (Guo, 2010), and the societal value of cooperatives benefiting members have been questioned (Deng and Wang. 2014). Even some foundation of farmer cooperatives seems to be driven only by economic strategies, that kind of farmer cooperatives are established in response to the government's call and aims for cheating the subsidy from the government or other reasons, instead of promoting farmers' welfare. These farmer cooperatives are not established because of inherent needs, and thus they are lack of incentive to operate efficiently. It is common to see non-parametric method data envelope analysis in evaluating the economic efficiency of Chinese farmer cooperative (Fu and Xu, 2013; Cui et.al. 2016), it is rare to find empirical studies by parametric method such as a stochastic frontier approach, and fewer researches examining the distinction between single output and multi-output, which takes societal output and societal value into account when evaluating performance and efficiency of cooperatives in China.

This paper aims to make an important contribution to the literature by adding non-economic social output in the measurement of farmer cooperatives, and thus to broaden knowledge of the empirical impacts of societal value relevant variables on performance of farmer cooperatives. Two components in particular are distinguished: 1) this paper estimates the performance of farmer cooperatives in Fujian province China by taking into account the role of societal output, e.g. farmers' benefits due to assistance of cooperatives. 2) we estimate whether societal value relevant variables have influence on TE. A parametric, output-oriented stochastic distance function and technical inefficiency model are estimated by using data from 164 farmer cooperatives in Fujian province collected from a field survey in 2010. Results from this analysis are expected to provide useful insights for policy-makers on how farmer cooperative's performance is influenced by societal function.

2. Hypotheses

Given cooperatives' member-oriented nature (Cook, 1995) and a range of potential social benefits (Wynne-Jones, 2017), there is a need for further evaluation of cooperatives with an appropriate way (Soboh et al., 2009; 2012), which means not only considering organization's economic contribution. As economic revenue maximization is not always the final pursuit for farmer cooperative, we assume the outputs of farmer cooperatives include both economic output and none-economic output, that is societal output, which can be understood as the societal contribution from farmer cooperatives to members, for example, providing members' service.

Hypothesis 1: Societal output of cooperatives affects its production performance.

Although there is a lack of exact definitions on societal output of farmer cooperatives, relevant concept of societal output or societal value are not rare (Nilsson, 1996; Soboh et al., 2009; 2012). Münkner (2004) held cooperatives were growing strong in social services and the healthcare sector in Europe and Canada. Cooperatives are believed to cater to farmer needs more effectively than their investor-oriented counterparts

(Akridge and Hertel, 1992). Except from direct economic revenue, farmer cooperatives are regarded as a way to link farmers more effectively to the rapidly changing markets (Huang et al., 2013; Liang and Hendrikse, 2013).

Millions of Chinese farmers including non-members obtained economic and social benefits (Liang et al, 2013; Huang et al, 2013; Yu 2012). According to an official statistic from Agriculture Department of Fujian province, there is over 33,000 farmer cooperatives at the end of 2016, and 764 cooperatives participating in agricultural standards of quality and safety to their suppliers, and more than 58.07% members obtaining training chance. More than 1.8million farmers (including nearly one million non-cooperative members' farmers) were benefiting from technological guidance, employment opportunity, secure loans and expanding businesses related to agriculture and so on. Due to the distinct members' orientation and societal characteristics, it was necessary to consider the societal output when measuring the efficiency of farmer cooperatives (Soboh et al., 2012; Cui et al., 2016).

Hypothesis 2: The societal value relevant variables represented by the extent of services provided by cooperatives in terms of training and selling affect the TE.

The members' role and objective in farmer cooperatives are indicators for empirical evaluation on performance of cooperative (Akridge and Hertel, 1992; Soboh et al., 2012), for cooperatives were described as user-owned and user-controlled organization that aims to benefit its members rather than investor-oriented firms (Sexton and Iskow, 1993; Cook, 1995; Nilsson, 1996). To accomplish members' interest, cooperatives offer a number of services to their members, which represent their societal value including marketing agricultural products, enhancing agricultural production, implementing a united production system, and providing other farm services. For example, they may introduce new technologies, provide technical consultations, trigger information exchange among farmers, or even supply financial services (Garnevska et al.2011; Mao et al.,2014), all of which can be expressed in training program. Variables related with training members are also relevant to efficiency and performance measurement of farmer cooperatives (Huang et al., 2013; Cui et al., 2016). An empirical finding by Huang et al. (2013) showed that training frequency per year was positively associated with efficiency.

Another vital proxy of a well-function cooperative for members' interest is farmers' products are marketed together (Garnevska et al., 2011), which is total sales in accounting system. Total sales measures the size of a cooperative operation for farmers, thereby represent the extent of services provided by cooperatives. It was expected to have a positive relationship with efficiency (Ariyaratne et al., 2000). However, Hailu et al. (2007) found sales volume in Grain cooperatives is negatively related to efficiency.

In this study we assume the number of training members and the extent of members' service concerning marketing are two societal value relevant variables that affect TE of farmer cooperatives.

3. Methodology and empirical model specification

A single-output production function and a multi-output production function are developed for agricultural farmer cooperatives in Fujian province in order to measure agricultural farmer cooperatives' performance.

3.1 One-output multi-input production function

For modelling farmer cooperatives' production performance, we assume cooperative use a vector of inputs by $x = (x_1, \cdots, x_K) \in \Re^{K+}$ to produce a single output y (Aigner et al., 1977). For a given i^{th} production unit, the one-output multi-input production function (Figure 1-a) is written in equation (1).

$$\mathrm{Y}_i = f(x_i; \beta)\exp(v_i - u_i) \qquad i = 1,2,\cdots,N. \tag{1}$$

The Translog function form is specified as:

$$\ln(y_i) = \beta_0 + \sum_{k=1}^{3} \beta_k lnx_{ki} + \frac{1}{2}\sum_{k=1}^{3}\sum_{l=1}^{3} \beta_{kl}\, lnx_{ki} lnx_{li} + \varepsilon_i;\ \varepsilon_i = v_i - u_i \tag{2}$$

where the term v_i is set to capture noise, v_i ~ i.i.d. $N(0, \sigma_v^2)$ and the term u_i is set to be the technical inefficiency term, u_i ~ $N(\mu_i, \sigma_u^2)^+$, $i = 1,2,\cdots,N$, where i denotes the i_{th} farmer cooperative in the sample and N is the sample size.

3.2 Multi-output multi-input production function

For modeling the multi-output multi-input production process, we adopt the output distance function introduced by Shephard (1970). Denoting a vector of inputs by $x = (x_1, \cdots, x_K) \in \Re^{K+}$ and a vector of multi-output by

$y = (y_1, \cdots, y_M) \in \Re^{M+}$, the multi-input multi-output production technology (Figure 1-b) is defined using the output possibility set *P(x)*, which can be produced using the input vector *x:* $P(x) = \{y: x \text{ can produce } y\}$. The output distance function is defined as: $D_O(x, y) = \min\{\mu: y/\mu \in P(x)\}$. The set of axioms depicted in Färe and Primont (1996) should be satified and the restrictions are required for linear homogeneity in outputs (Kumbhakar and Lovell, 2000). According to Coelli and Perelman (2000), the Translog output distance function for the case of k inputs and m outputs is specified as:

$$lnD_o(x_i, y_i) = \alpha_0 + \sum_{m=1}^{M} \alpha_m lny_{mi} + \frac{1}{2}\sum_{m=1}^{M}\sum_{n=1}^{M} \alpha_{mn}\, lny_{mi} lny_{ni} + \sum_{k=1}^{K} \beta_k lnx_{ki} + \frac{1}{2}\sum_{k=1}^{K}\sum_{l=1}^{K} \beta_{kl}\, lnx_{ki} lnx_{li} + \sum_{k=1}^{K}\sum_{m=1}^{M} \delta_{km} lnx_{ki} lny_{mi} \quad (3)$$

After the transformation (Huang et al., 2017), the stochastic output distance function is:

$$-\ln(y_{Di}) = TL(x_i, y_{mi}/y_{Di}, \alpha, \beta, \delta) + v_i - u_i \quad (4)$$

where y_D denotes the main output and y_m denotes the second output in the production process.

3.3 Technical inefficiency model

The measure of TE of the i_{th} farmer cooperative (TE_i) is defined as the ratio of the observed output to the corresponding potential output, which is expressed as equation (5).

$$TE_i = \frac{f(x_i, \beta).\exp(v_i - u_i)}{f(x_i, \beta).\exp(v_i)} = \exp(-u_i) \quad (5)$$

The TE_i takes a value between zero and one, and the technical inefficiency value equals one minus the TE_i value. A TE value of one implies the farmer cooperative is fully technically efficient. As u_i is a non-negative random error term, independently and identically distributed as $N(\mu_i, \sigma_u^2)$, truncated above zero, and it is intended to capture technical inefficiency in production. The mean μ_i is defined as the technical inefficiency model:

$$\mu_i = \tau_0 + z_i \times \tau_i. \quad (6)$$

where z_i is a vector of explanatory variables associated with the technical inefficiency, τ_0 is a constant term in the technical inefficiency model, and τ_i is a vector of unknown parameter to be estimated (Coelli and Battese, 1996; Huang et al., 2016). MLE could be used to estimate the parameters of the output oriented production function given appropriate distributional assumptions for v_i and u_i (Aigner et al., 1977). Please see the framework of technology incorporating technical inefficiency characteristics in Figure 1-c.

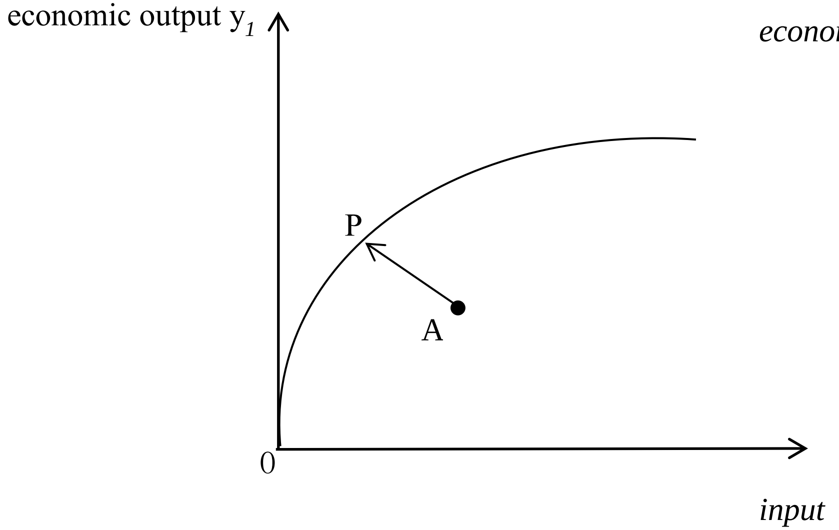

Figure 1-a. One output production frontier

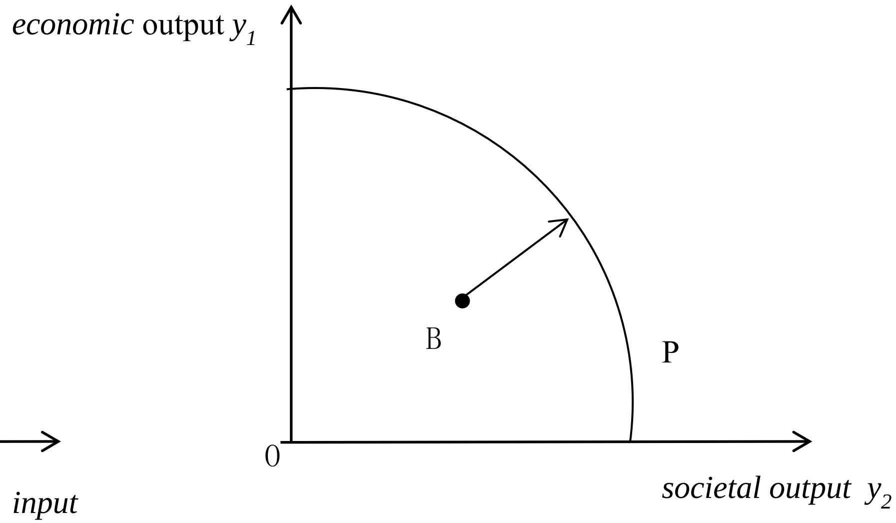

Figure 1-b. Multi-output production frontier

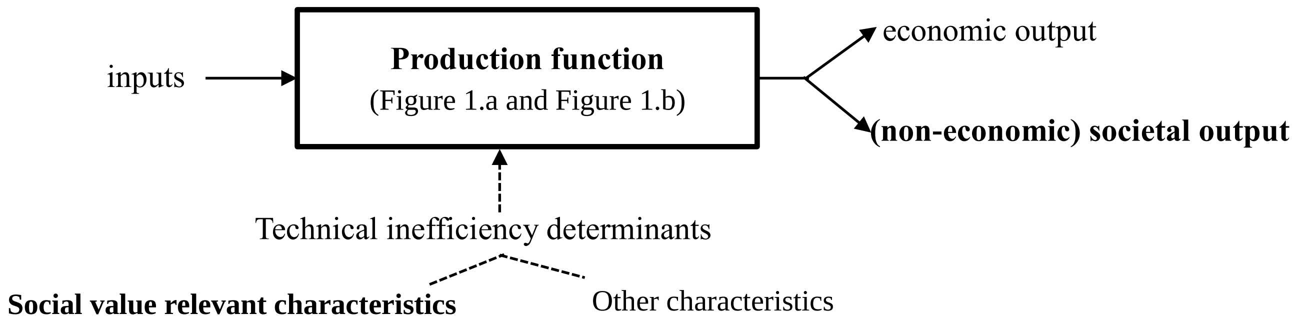

Figure 1-c. Framework of technology

Figure 1. Production frontier and the framework of technology

3.4 Empirical model specification

According to literatures and economic theory, inputs are the number of members (x_1), net fixed asset (x_2), and operating expenses (x_3) in the empirical specification of the production function of farmer cooperative. There are two outputs, the one is economic output (y_1), which is denoted by the net income (before taxes and distribution) and another output - societal output (y_2), which is the number of beneficiary farmers. In the one-output multi-input production function, we have only the economic output (y_1), as equation (7).

$$ln(y_{1i}) = \beta_0 + \sum_{k=1}^{3} \beta_k lnx_{ki} + \frac{1}{2}\sum_{k=1}^{3}\sum_{l=1}^{3} \beta_{kl}\, lnx_{ki} lnx_{li} + v_i - u_i \tag{7}$$

While we have both the economic output (y_1) and societal output (y_2) in the multi-output multi-input production function, as equation (8).

$$\begin{aligned} -ln(y_{1i}) = \beta_0 + \alpha_1\, ln({}^{y_{2i}}/_{y_{1i}}) + \frac{1}{2}\alpha_{11}\, ln({}^{y_{2i}}/_{y_{1i}})^2 + \sum_{k=1}^{3} \beta_k lnx_{ki} \\ + \frac{1}{2}\sum_{k=1}^{3}\sum_{l=1}^{3} \beta_{kl}\, lnx_{ki} lnx_{li} + \sum_{k=1}^{3} \delta_{k1} lnx_{ki} ln({}^{y_{2i}}/_{y_{1i}}) + v_i - u_i \end{aligned} \tag{8}$$

The empirical technical inefficiency model is written in equation (9),

$$\mu_i = \tau_0 + \sum_{h=1}^{8} \tau_h z_{hi} \tag{9}$$

where z_i is a vector of explanatory variables associated with the technical inefficiency. They are divided as the variables relevant with social values, the number of training member (z_1) and total sales (z_2), as discussed in hypotheses 2, and the other variables from z_3 to z_8 are profit distribution (z_3), equity concentration (z_4), government support (z_5), total asset (z_6), allocated equity (z_7) and financial leverage (z_8).

Most Chinese cooperatives' governance structure was characterized by core members' dominance, which is especially reflected in profit distribution (z_3) and equity concentration (z_4) (Xu and Wu, 2010; Liang et al., 2015; Cui et al., 2016). Profits distributed proportional to patronage was considered as one of the main principles reflecting cooperatives' uniqueness and significantly related to efficiency (Porter and Scully, 1987; Lemeilleur and Codron, 2011; Zhou and Kong, 2015; Sun and Yu, 2012). The governance structure represented by equity concentration, which was found negatively related to efficiency (Chen, 2015) and positively associated with TE of cooperatives (Cui et al., 2016).

Government support (z_5) has a positive effect on TE of cooperative (e.g. Chen et al., 2015; Cui et al., 2016).The development of farmer cooperatives in China is driven and influenced to a large extent by the government (Liang and Hendrikse, 2013), which has been regarded as one of the key factors for promoting performance of Chinese cooperatives (Chen et al., 2015; Cui et al., 2017; Garnevska et al., 2011).

The size of cooperatives measured by total asset (z_6) is an important factor influencing efficiency (Schroeder, 1992; Ariyaratne et al., 1997; Huang et al., 2013). Some studies found cooperatives' asset size has a positive effect on their TE (Ariyaratne et al., 1997; Hailu et al., 2005), for the economies of scope play a significant role in improving efficiency for most cooperatives (Schroeder, 1992). However, it was also found that it has a negative influence on TE (Huang et al., 2013; Hailu et al., 2007). When enlarging firm size increases the problem of control, cooperative firms are not expected to realize fully all scale economies present in the production process (Porter and Scully, 1987).

Financing ability is also taken into account to affect the TE of farmer cooperatives. Financing constraints is one of major serious challenges for contemporary farmer cooperatives currently facing (Barton et al., 2011). Financing ability including equity financing and debt financing would impact Chinese cooperatives' performance (Ma et al., 2011; Yu, 2012). Generally, cooperatives tend to use more equity (z_7) to finance investments (Li et al., 2015). Due to portfolio problem and horizon problem (Cook, 1995), equity capital constraint arising from members' insufficient incentive would lead to underinvestment, which results in less capital per unit of output than in the proprietary firm (Porter and Scully, 1987). Hailu et al. (2007) reveal that obtaining a sufficient equity capital is expected to improve the cooperative efficiency. Financial leverage (z_8) means the use of borrowed money to increase asset, measured as the ratio of total debt to total assets, which represents debt financing ability and had a significant relationship with efficiency of cooperatives (Ariyaratne et al., 1997, 2000; Huang et al., 2013).

4. Data and descriptive statistics

4.1 Case study area and field survey

The primary data were collected from members of farmer cooperatives in Fujian province, which is located on China's southeastern coast and is one of the more developed provinces in China. Fujian covers 124,000 km^2, of which 80% are mountainous and hilly. In 2016, it had a population of 38.74 million. The data used in this paper were drawn from field survey in nine cities at prefecture level region in Fujian province, recorded by Agricultural Department of Fujian province, where farmer cooperatives play an important role in rural economic and social development (Yu, 2012).

Data was collected through face-to-face interviews with the chairpersons at the cooperatives, while documents were provided by the agricultural department of Fujian province. For selecting the sample cooperatives, we took into account criteria such as total land area and industry distribution. According to official statistics, the number of cooperatives in eastern area of Fujian province was accounting for 54.4% of all cooperatives at the end of 2009, while 45.6% of those in west area which includes Longyan, Sanming and Nanping city. A dataset of 164 cooperatives in Fujian province was achieved in 2010, with 54.88% cases from the eastern area and 45.12% from the west. The number of cooperatives surveyed in each city at prefecture level varies from 8 as the minimum to 27 as the maximum. The surveyed farmer cooperatives are of various products, including fruits, vegetables, grains, livestock, and aquatic products. In the sample, fruit and vegetable cooperatives accounted for almost 65%, which is close to the 64% in the whole province in 2009. Livestock and aquaculture cooperatives comprised 14% and 3%, respectively. Therefore, the sample seems to be representative of Fujian province's farmer cooperatives not only in geographical terms, but also as regards production orientation.

4.2 Variables descriptive

The inputs for cooperatives are aggregated into three categories (capital, labor and material cost) in most cases (Huang et al.,2013; Ariyaratne et al., 2000; Soboh et al., 2012), and thus we inherit the three inputs in this study are fixed assets, operating expenses and number of members. Capital is measured by the net value of fixed assets. Labor is measured by the number of members. An operating expense is an expense a business incurs through its normal business operations involved in providing goods and services. The two outputs are the net financial income before taxes and the societal output. The net income before taxes represents net operating margins plus non-operating income before taxes are subtracted. The societal output in this study is proxied by the number of beneficiary farmers (including members and non-members), which is calculated by summing up the number of farmers attaining the assistance of cooperative such as providing technical support, sales channels and some social welfare. All financial items in this paper are defined according to China Farmer Cooperative Financial Accounting Regulations (Proposed)[2]. The description of outputs, inputs, and cooperative-specific variables considered is presented in Table 1.

Operational and cooperative-specific variables that were considered to affect TE of farmer cooperatives include a set of continuous values (e.g. training-member size, the amount of equity, the top three equity ratio, total asset and operating income) and dummy variables (e.g. the distribution of surplus, governmental support, and total sales). Within which, the number of training-member and total sales are treated as societal value relevant variables of farmer cooperatives, which we assume affect the TE as described in ***hypothesis 2***. Training-member size refers to the number of member who accepts training in a cooperative. Total sales combine products and service sales from members and non-members (with indicator of 1 meaning total sales of 1 million Yuan or below; 2 meaning total sales of 1 to 5million Yuan; 3 meaning total sales of 5 to 10 million Yuan; 4 meaning total sales of 10 million Yuan or more). The distribution of surplus represents the way of profits allocation (0 = no distribution of surplus; 1 = allocated by share; 2 = mainly allocated by share and others by patronage; 3 = mainly allocated by patronage and others by share; 4 = allocated by patronage). Concentration of equity, as the indicator of core members' capital contribution, is calculated by the top three capital shares divided by the total members' allocated equity. The dummy variable of governmental support means whether cooperative has got subsidy assistance. A total asset is regarded as the indicator of cooperative size, which is calculated by the sum of member equity and liabilities according to the balance sheet. As for allocated equity, it is most important part of equity accounts. In general, cooperative equity is divided into allocated and unallocated portions (retained earnings) although it is given a variety of names. Allocated equity represents member ownership in the cooperative, which is owned by specific members in the form of common stock, preferred stock, equity

[2] Source: Ministry of Finance of the People's Republic of China, Farmer Cooperative Financial Accounting Regulations (Proposed), http://www.mof.gov.cn/zhengwuxinxi/caizhengwengao/caizhengbuwengao2008/caizhengbuwengao20082/200805/t20080519_29065.html

certificates and so on. Financial leverage is the degree to which a cooperative uses debt, and it is calculated by ratio of debt to assets in this study. Thus the more debt financing a cooperative uses, the higher its financial leverage.

Table 1. Descriptive characteristic of sample variables

Variable	Unit	Symbol	Mean	Std. Dev.	Min.	Max.
Continuous variable						
Net income before taxes and distribution	10,000 CNY	y_1	69.39	267.22	-16.00	3000.00
The number of beneficiary farmers	person	y_2	741.13	2616.02	3.00	28500.00
The number of members	person	x_1	68.59	104.38	5.00	986.00
Net fixed asset	10,000 CNY	x_2	162.70	367.70	0.50	3000.00
Operating expenses	10,000 CNY	x_3	605.64	1285.53	1.57	8407.72
The number of training member	person	z_1	594.54	1571.36	0.00	12030.00
Concentration of equity (The top three to total equity ratio)	%	z_4	0.39	0.25	0.01	1.00
Size of cooperative (Total asset)	10,000 CNY	z_6	309.21	632.02	5.00	6000.00
Allocated equity	10,000 CNY	z_7	133.04	447.96	1.50	5494.00
Financial leverage (debt to assets ratio)	-	z_8	0.50	0.36	0.00	1.00
Category variable						
Variable	*Symbol*	No. of 0	No. of 1	No. of 2	No. of 3	No. of 4
Total sales (1 = 1 million Yuan or below; 2 = 1 to 5 million Yuan； 3 = 5 to 10 million Yuan; 4 = 10 million Yuan or more),	z_2	-	57.00	53.00	26.00	28.00
The distribution of surplus (0 = no distribution of surplus; 1 = allocated by share; 2 = mainly allocated by share and others by patronage; 3 = mainly allocated by patronage and others by share; 4 = allocated by patronage)	z_3	50.00	16.00	29.00	51.00	18.00
Dummy variable						
Variable	*Symbol*	No. of 0		No. of 1		
Governmental support (Yes=1; No=0)	z_5	79.00		85.00		

5. Results and discussion

5.1 Model specification test

Before deciding on the specifications for the final version of the model, we consider more model specifications according to the literature (Table 2). First we test the hypothesis for the production function selection (Test-1), whether to choose a Cobb-Douglass production function or a Translog production function. The null hypothesis is that Cobb-Douglass production function is better than Translog production function. The likelihood value is -145.614 from the estimation of the Cobb-Douglass production function with degree of freedom (DF) of 15, while that is -136.350 from the Translog production function with DF of 25. According to likelihood ratio test, Translog production function is preferred.

The Test-2 is designed for comparing the one-output production function and multi-output production function, which aims to see the necessity and improvement of societal output in the production function. The null hypothesis is one-output model can better represent the data. The likelihood value is -169.054 with DF of 20 in the one-output production function, while that is -132.416 with DF of 25 in the multi-output production function, given the likelihood ratio test, the multi-output model is better to represent the data, which confirm us to select societal output as a second output in production function.

Both the Test-3 and the Test-4 are designed for technical inefficiency model setting. According to the likelihood ratio tests, setting technical inefficiency model with production function can improve the whole performance of production. In the basic multi-output production function, which is setting without technical inefficiency model, the δ_u is estimated to be 0.009 and the δ^2 is estimated to be 0.365, meaning that the variance in the cooperative specific error term is greater than the variance in the stochastic error term. This result reveals that the one-sided random inefficiency component dominates the measurement error and other random disturbances, which supports the one-step estimation for production function incorporating with technical inefficiency model.

Table 2. Hypothesis tests for model specification and statistical assumptions

Test	Null hypothesis	Log-likelihood	D.F.	AIC	BIC
For selection of production function (without setting technical inefficiency model)					
Test-1	H_0: Cobb-Douglass production function.	-145.614	15	321.228	367.726
	H_1: Translog production function	-136.347	25	322.693	400.190
Testing for selection of one-output or multi-output model					
Test-2	H_0: one-output (economic output) technical inefficiency model	-169.054	20	378.107	440.105
	H_1: multi-output (economic output and societal output) technical inefficiency model	-132.416	25	314.832	392.328
Testing for specification of technical inefficiency model (one-output)					
Test-3	H_0: No technical inefficiency	-178.975	12	381.949	419.148
	H_1: Technical inefficiency	-169.054	20	378.107	440.105
Testing for specification of technical inefficiency model (multi-output)					
Test-4	H_0: No technical inefficiency	-149.971	17	333.943	386.641
	H_1: Technical inefficiency	-136.347	25	322.693	400.190

5.2 Stochastic frontier analysis for farmer cooperative production function

Maximum likelihood estimates for the production function are presented in Table 3, the Model 1 is the one-output production function, Model 2 is the multi-output production function, both of them are estimated without specifying the technical inefficiency model. By adopting multi-output production function, we specify the final model as Model 3, where we estimate the multi-output production function with specification of technical inefficiency model to measure the overall performance of farmer cooperatives and to see the determinant factors for technical inefficiency. In order to facilitate the interpretation of the parameter estimates, all output variables and input variables are divided by their respective sample means. Thus, the estimated first-order parameters of the Translog production frontier can be interpreted as partial production elasticities at the sample mean (Huang et al., 2016).

In model 3, the societal output is estimated to be -0.298, significantly at the 1% statistical level, which means it makes sense to take societal output into account, which confirms ***hypothesis 1*** that societal output of cooperatives affects its production performance. This also indicates that it is unfair to evaluate the performance of farmer cooperatives if only take them as a single economic role in market economy, for farmer cooperatives combine economic success with democratic governance and concern for community, which makes cooperatives significant social and economic actors. The purpose of obtaining maximum total profit for the firm should be subordinated in the cooperative due to its distinctive objective of servicing members (Clark, 1952). Cooperatives enable weaker actors in the market to develop businesses that are beneficial both for themselves as users as well as for the larger national society (Normark, 1996). Although many researchers focus on the economic output when evaluate cooperatives' efficiency, in the perspective of pursuing members' interests, cooperatives contribute to the overall social and economic welfare of the communities in which they operate (Fonte and Cucco, 2017). That is, the cooperative also performs a vital social function (Zhang et al., 2014; Liu, 2017). Currently, Chinese cooperatives, as one of most vital new agricultural business entities, are playing an important role to help the government promote social policies such as food security, generating rural paid employment for surplus labor, optimized utilization of rural land, investing in rural public goods and agricultural technology promotion and so on[3], which greatly contribute to social stability. For farmers, farmers' participation in cooperatives not only increase their income but also significantly enhance their sense of happiness (Liu, 2017). All these positive social benefits or contribution are called *societal output* here. Although the role of cooperatives as a social unit can have impact on their performance (Krasachat and Chimkul, 2009), it's rare to be valued empirically. According to Clark (1952, p36) "*Because the owners of cooperatives are also the patrons, their interest is in maximizing their returns as sellers of farm products or in minimizing their costs in the purchase of supplies"*. The key point is the efficiency of cooperatives could be influenced when considering members' interests (Soboh, 2012). Regarding this perspective we argue for a reconsideration of the traditional economic criterion of cooperatives' efficiency.

The three first order estimates of inputs are estimated to be statistically significant with the expected signs, which are also consistent with estimations from the specification of model 2. A partial production elasticity of 0.150 is observed for the number of members, meaning that a 1% membership will increase cooperative performance by 0.150%. The partial production elasticity of net fixed asset is estimated to be 0.147, which means a 1% increase of net fixed asset will increase cooperative output by 0.147%. The biggest partial production

[3] Source: New Agricultural Business Entities Research Group of China Economic Trend Research Institute , Investigation Report on Development Index of New Agricultural Business Entities (Phase II)--
The Social Performance of New Agricultural Business Entities, Economic Daily, 7th February, 2017.

elasticity comes from the input of operating expenses, which is estimated to be 0.256, significantly at the 1% statistical level. All of the third order coefficients of the inputs have positive signs as expected and those results are consistent with standard production theory. Particularly the input of net fixed asset and operating expenses, which is found to be statistically significant for production in both production functions across all first order and second order coefficients.

5.3 Determinants estimation for farmer cooperative technical inefficiency

The determinants of a farmer cooperatives' technical inefficiency are estimated by the technical inefficiency model (the lower part of Model 3). Technical inefficiency is the dependent variable in the model, therefore, a negative parameter coefficient for the variables indicates a negative effect on technical inefficiency, while a positive effect on TE.

The one variable of ***societal value*** z_1 represented by the number of training member is estimated to be 0.139, significantly in the 5% statistical level, implying that the more the number of training member, the lower TE of farmer cooperatives. This result is contrary to the finding that more training provided to members can enhance TE of farmer cooperatives (Huang et al., 2013). This can be explained as the return of investment in member training reflecting a kind of social value usually is not immediate (Nilsson et al., 2012). Specifically, more training numbers means more expenses paid by cooperatives, thereby decrease total profits in a short term. Both practitioners and researchers within the field of cooperative considers farmers' cooperation in cooperatives as more-than-economic motivations (Nilsson, 1996; Fonte and Cucco, 2017). That is why so many cooperatives pay for training fees for members even it reduces profits in the short run.

Table 3. Estimates for stochastic distance function and technical inefficiency model

Parameters	Symbol	Model 1		Model 2		Model 3	
		Dependent variable: $ln(y_1)$			Dependent variable: $-ln(y_1)$		
		Coef.	Std. Err	Coef.	Std. Err	Coef.	Std.Err
Estimates for production function							
Constant	β_0	-0.257	0.565	0.503	0.341	0.863***	0.138
$ln(y_2/y_1)$	α_1			0.298***	0.048	0.298***	0.051
$ln(x_1)$	β_1	0.104	0.074	-0.240***	0.065	-0.150*	0.079
$ln(x_2)$	β_2	0.252***	0.064	-0.197***	0.061	-0.147**	0.062
$ln(x_3)$	β_3	0.33401***	0.054	-0.308***	0.047	-0.256***	0.053
$0.5ln(y_2/y_1)^2$	α_{11}			-0.038**	0.018	-0.007	0.020
$0.5ln(x_1)^2$	β_{11}	0.010	0.038	-0.039	0.042	-0.027	0.044
$0.5ln(x_2)^2$	β_{22}	0.044***	0.016	-0.034**	0.014	-0.0243*	0.013
$0.5ln(x_3)^2$	β_{33}	0.0416**	0.016	-0.048***	0.014	-0.035**	0.014
$ln(x_1)ln(x_2)$	β_{12}	0.107***	0.036	-0.054	0.037	-0.087**	0.037
$ln(x_1)ln(x_3)$	β_{13}	-0.015	0.029	-0.016	0.029	0.018	0.029
$ln(x_2)ln(x_3)$	β_{23}	-0.020	0.019	0.019	0.016	0.015	0.016
$ln(x_1)ln(y_2/y_1)^2$	δ_{11}			0.057	0.039	0.043	0.039
$ln(x_2)ln(y_2/y_1)^2$	δ_{21}			-0.030	0.028	0.021	0.031
$ln(x_3)ln(y_2/y_1)^2$	δ_{31}			0.075***	0.023	0.021	0.027
lnsig2υ							
Constant		-0.655	0.112	-1.009***	0.111	-1.435***	0.172
lnsig2μ		-8.276	87.345	-9.444	91.546	0.139	0.069
Estimates for technical inefficiency model							
Constant	τ_0					-1.257	1.255
The number of training member	τ_1					0.139**	0.069
Total sales	τ_2					1.057*	0.622
The distribution of surplus	τ_3					-0.264	0.391
Concentration of equity	τ_4					-0.844*	0.489
Governmental support	τ_5					-0.409	0.286
Total asset	τ_6					0.265*	0.146
Allocated equity	τ_7					-0.560	0.547
Financial leverage	τ_8					-0.266	0.366
δ_v		0.721	0.040	0.604	0.033	0.488	0.042
δ_u		0.016	0.697	0.009	0.407		
δ^2		0.519	0.059	0.365	0.041		
γ		0.022	0.703	0.015	0.411		
Statistics							
Number of observation		164.000		164.000		164.000	
$Wald\ chi^2(14)$		110.000		226.260		108.180	
Log likelihood		-178.975		-149.971		136.347	
$Prob\ > chi^2$		0.000		0.000		0.000	

The second variable of ***societal value*** measured by the total value of marketing products for farmers mainly member-farmer (z_2) is also evaluated to be efficiency reducing. Different from IOFs, a main objective of cooperatives is to benefit members, one obligation of cooperatives is to process all their members' supplies (Soboh et al., 2012). However, the dual-objective creates potential cost in terms of conflicts of interest between an individual member and a collective cooperative. Specifically, the volume of members' supplies may be beyond the optimal level of supplies the cooperative needs (LeVay, 1983), that is cooperatives are more restricted in choosing their optimal size (Soboh et al., 2012). Oustapassidis et al. (1998) argued that cooperatives are less scale-efficient due to their organizational characteristics which endorse over-supply of members' inputs. In addition, some farmer members in Chinese cooperative receive above-market price for their agricultural products, which is higher expenses for cooperatives (Xu, 2005). To cater to farmer needs, cooperatives pay little regard for the profitability of services related to farmer-patrons (Akridge and Hertel, 1992). Thereby, the more sale for farmers, the high possibility over-supply of inputs for cooperative, thereby decreasing the TE. The ***hypothesis 2*** is significantly confirmed because both these two societal value relevant variables demonstrate that social benefits for members could influence performance of cooperatives. .

Governance structure measured by equity concentration (z_4) was proved to be positively related to technical inefficiency. This variable represents the extent of concentration of equity in the hands of a few shareholders named core members in China. In our sample, there is nearly 39% of total equity controlled by three shareholders, which signifies core members hold substantial rights over common members (Liang et al., 2015). The results with respect to equity concentration were consistent with results reported by Cui et al. (2016) that higher concentration in terms of equity share would increase TE of farmer cooperative. The result has reinforced earlier findings that Chinese cooperative characterized by skewed allocation of property rights are no necessary inefficient or loss of cooperatives' function.

Cooperative size in terms of total asset (z_6) is estimated to be positively related with technical inefficiency. The finding with respect to cooperative size is conformed to the result reported by Huang et al. (2013) that total asset a negative influence on TE. The total asset coefficient estimate is positive and highly significant, meaning larger size of cooperative contributes to higher technical inefficiency in cooperative. This could be explained by the reason that most cooperatives in China including in Fujian province are still at the early development stage, and the quality of management as well as entrepreneurship is low. Therefore, it is difficult for large-size cooperatives to utilize resources reasonably, whereas it is relatively easier for small-size cooperatives (Huang et al., 2013, p 278).

5.4 Farmer cooperative efficiency analysis

Following estimation of the stochastic distance function and technical inefficiency model, we calculate the TE scores for each farmer cooperative based on model 3. The average estimated TE scores for farmer cooperatives is 0.747 (Table 4), indicating that on average, agricultural farmer cooperative can improve the output to be 25.3% more, given the present state of technology and the input level, which can be achieved in the short term by adopting the practices of the best performing agricultural farmer cooperative. While the average estimated TE for farmer cooperative is 0.754 in the one-output production function, which is higher than the average TE of 0.747 by taking into account societal output, which confirms that incorporating the societal output into account will affect the estimated TE scores of farmer cooperative, and change the rankings.

Table 4. Summary of TE

Efficiency item	Mean	Std. Dev.	Min.	Max.
TE estimated from multi-output production function (both societal output and economic output)	0.747	0.156	0.060	1.000
TE estimated from one-output production function (only economic output)	0.754	0.144	0.171	1.000

The different range of TE (with and without societal output) scores for farmer cooperatives is showed in Figure 2. When considering societal output in TE, about 7.32% of farmer cooperatives have a TE score greater than 0.90 whereas 39.63% of farmer cooperatives have efficiency scores greater than 0.80 and less than or equal to 0.90. About 27.44% of farmer cooperatives have efficiency scores more than 0.70 and less than or equal to 0.80, 9.15% of the farmer cooperatives have efficiency scores more than 0.60 and less than or equal to 0.70, 9.76% of the farmer cooperatives have efficiency scores more than 0.50 and less than or equal to 0.60, and 6.71% farmer cooperatives operate with a TE score equal to or below 0.50. On the other hand, the distribution of TE without taking societal output into account is displayed in Table 2. The highest percentage (29.88%) of farmer cooperatives shows TE score between 0.70 and 0.80 rather than between 0.8 to 0.9 in group 1. It is necessary to take societal output into account when evaluating efficiency of Chinese farmer cooperatives based on the differences in range distribution of efficiency scores.

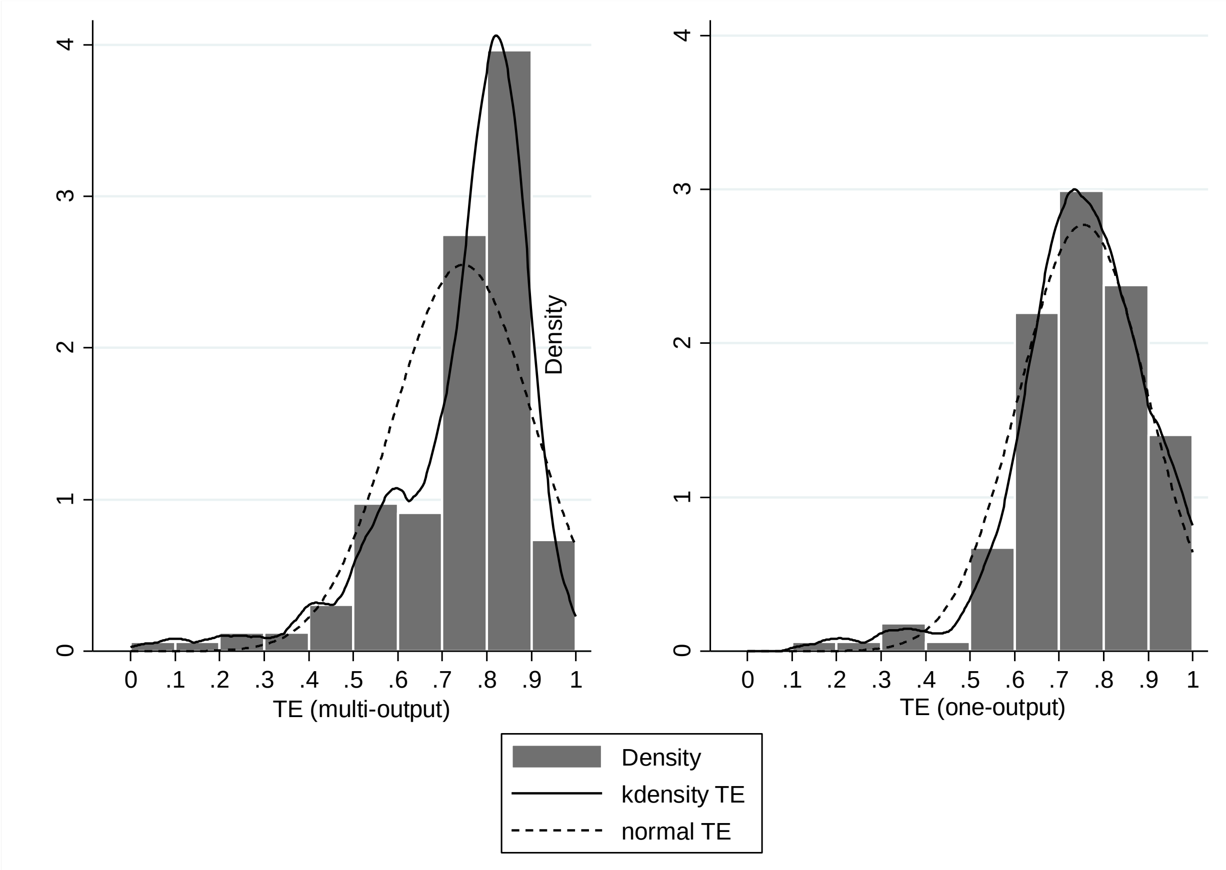

Figure 2. Range of overall TE with and without social output in agricultural cooperatives

6. Conclusion

This paper analyses TE of farmer cooperatives and its inefficiency determinant factors by highlighting the role of societal output in the production function and the influence from societal values in efficiency in inefficiency determinants. It is interesting in this study to find that cooperatives' efficiency scores and its ranking are significantly different when we take both economic output and societal output into account, which indicates that social output created by the number of beneficial farmers' (member and non-members) cannot be ignored when evaluating farmer cooperative's performance, that is, demonstrating strong support for societal impact of cooperatives. This has led some to caution that overemphasis on economic gains may lead to the neglect of social contribution made by cooperatives and reduce farmers' capacity to work within groups for genuinely collective purposes (Emery, 2015). We suggest that the government should intensify its efforts to encourage and support farmer' cooperatives those make positive social effects. Chinese cooperatives should intensify its confirmation of social value, even if their current efficiency were adversely affected.

Furthermore, the societal value relevant variables measured by the extent of services provided by cooperatives in terms of training and selling has negatively influence on TE of cooperatives. Due to dual-objective of cooperatives, it is hard to balance both interests between individual member and collective cooperative, which may indicate an advanced requirement of social responsibility is raised for cooperative especially their chairmen or core members, that is, whether they are willing to provide service to farmers continually at the expense of the immediate interest. If the answer is yes, their sustainable development is the precondition. Considering cooperatives' social contribution, it also confirms that the government support is indispensable, for what cooperatives' supply is beneficial for farmers who was regarded as fragile group, that means cooperative provide public goods for government to some extent. But the further question need to be on the research agenda is what kind of form of governmental support that can be more effective, cost efficient and sustainable?

References

Aigner, D., Lovell, C.A.K. and Schmidt, P. 1977. “Formulation and estimation of stochastic frontier production function models.” *Journal of Econometrics* 6:21–37.

Akridge, J. T., and T. W. Hertel. 1992. “Cooperative and investor-oriented firm efficiency: A multiproduct analysis.” *Journal of Agricultural Cooperation* 7: 1-14.

Ariyaratne, C.B., A.M. Featherstone, M.R. Langemeier, and D.G. Barton. 1997. “An analysis of efficiency of midwestern agricultural cooperatives.” In *Western Agricultural Economics Association Selected Paper*.

Ariyaratne, C.B., A.M. Featherstone, M.R. Langemeier, and D.G. Barton. 2000. “Measuring X-efficiency and scale efficiency for a sample of agricultural cooperatives.” *Agricultural and Resource Economics Review* 29(2):198–207.

Barton, D., M. Boland, F. Chaddad, and E. Eversull. 2011. “Current challenges in financing agricultural cooperatives.” *Choices* 26(3).

Borgen, S.O. 2001. “Identification as a Trust Generating Mechanism in Cooperatives.” *Annals of Public and Cooperative Economics* 72(2):209–228. Available at: http://onlinelibrary.wiley.com/doi/10.1111/1467-8292.00165/abstract.

Chaddad, F.R., and M.L. Cook. 2004. “Understanding new cooperative models: An ownership-control rights typology.” *Review of Agricultural Economics* 26(3):348–360.

Clark, E. 1952. “Farmer cooperatives and economic welfare.” *Journal of Farm Economics* 34(1):35–51.

Coelli, T.J., and G.E. Battese. 1996. “Identification of factors which influence the technical inefficiency of Indian farmers.” *Australian Journal of Agricultural Economics* 40(2):103–128.

Coelli, T., and S. Perelman. 2000. “Technical efficiency of European railways: a distance function approach.” *Applied Economics* 32(15):1967–1976. Available at: http://www.tandfonline.com/doi/abs/10.1080/00036840050155896.

Cook, M.L. 1995. “The future of U.S. agricultural cooperatives: a neo-institutional approach.” *American Journal of Agricultural Economics* 77(5):1153–1159.

Cui,B.Y., Y.T. Xu, and P. Jian. 2016. “Farmer 's specialized cooperatives: efficiency measurement and "paradox" in improvement.” *China Rural Economy*, (1): 69-82. (In Chinese)

Chen,J.H., D.H. Li, X.L. Kang, and M.E. Tu. 2015. “Study on the operating efficiency of farmers’ professional cooperatives and its influencing factors.” *Journal of South China Agricultural University (Social Science Edition)* 14 (4),37-47. (In Chinese)

Deng, H.S., and W.L. Wang, 2014. “The nature of cooperatives: theoretical analysis and examination of the reality-Are there aunthentic Farmers’ Cooperatives on Earth in China？ ” *China Rural Economy*, (7), 15-26. (In Chinese)

Enke, S. 1945. “Consumer Coöperatives and Economic Efficiency.” *The American Economic Review* 35(1):148–155.

Färe, R., and D. Primont. 1996. “The opportunity cost of duality.” *Journal of Productivity Analysis* 7(2–3):213–224.

Fonte, M., and I. Cucco. 2017. “Cooperatives and alternative food networks in Italy. The long road towards a social economy in agriculture.” *Journal of Rural Studies* 53:291–302.

Fu, Y.Z., and X. Xu. 2013. “Technical Progress, Technical Efficiency, and Productivity Growth of Farmer Cooperatives.” *Finance and Trade Research*,(6):46-55. (In Chinese)

Garnevska, E., G. Liu, and N.M. Shadbolt. 2011. “Factors for successful development of farmer cooperatives in Northwest China.” In K. White, ed. *International Food and Agribusiness Management Review*. Official Journal of the International Food and Agribusiness Management Association, pp. 69–84.

Guo, X.H. 2010. “Eighty Percent of Cooperatives Being Accused of "Shell"”, the Ministry of Agriculture Set the Threshold to Push the Model Cooperatives, National Business Daily, http://www.nbd.com.cn/articles/2010-06-30/303314.html.(In Chinese)

Hailu, G., E.W. Goddard, and S.R. Jeffrey. 2005. “Measuring efficiency in fruit and vegetable marketing co-operatives with heterogeneous technologies in Canada.” In *American Agricultural Economics Association Annual Meeting*. Providence, Rhode Island, pp. 24–27.

Hailu, G., S. R. Jeffrey, and E. W. Goddard. 2007. “Efficiency, economic performance and financial leverage of agribusiness marketing co-operatives in Canada”. In Cooperative Firms in Global Markets. Emerald Group Publishing Limited, pp. 47-77.

Helmberger, P., and S. Hoos. 1962. “Cooperative enterprise and organization theory.” *Journal of Farm Economics* 44(2):275–290.

Hind, A.M. 1999. “Cooperative performance- Is there a dilemma?” *Journal of Cooperatives*:30–43.

Huang, W., B. Bruemmer, and L. Huntsinger. 2017. “Technical efficiency and the impact of grassland use right leasing on livestock grazing on the Qinghai-Tibetan Plateau.” *Land Use Policy* 64:342–352.

Huang, W., B. Brummer, and L. Huntsinger. 2016. “Incorporating measures of grassland productivity into efficiency estimates for livestock grazing on the Qinghai-Tibetan Plateau in China.” *Ecological Economics* 122:1–11.

Huang, Z.H., Y.Z. Fu, Q. Liang, Y. Song, and X. Xu. 2013. “The efficiency of agricultural marketing cooperatives in China's Zhejiang province.” *Managerial and Decision Economics* 34(3-5):272-282.

Jensen, M.C. 1986. “Agency costs of free cash flow, corporate finance, and takeovers.” *American Economic Review* 76(2):323–329.

Karantininis, K., and A. Zago. 2001. “Endogenous membership in mixed duopsonies.” *American Journal of Agricultural Economics* 83(5):1266–1272.

Kirezieva, K., J. Bijman, L. Jacxsens, and P.A. Luning. 2016. “The role of cooperatives in food safety management of fresh produce chains: Case studies in four strawberry cooperatives.” *Food Control* 62:299–308. Available at: http://dx.doi.org/10.1016/j.foodcont.2015.10.038.

Krasachat, W., and K. Chimkul. 2009. “Performance measurement of agricultural cooperatives in Thailand: an accounting-based data envelopment analysis.” In J.-D. Lee and A. Heshmati, eds. *Productivity, Efficiency, and Economic Growth in the Asia-Pacific Region*. Physica-Verlag A Springer Company, pp. 255–266.

Kumbhakar, S. and C.A.K. Lovell,2000. “Stochastic Frontier Analysis.” Cambridge University Press, Cambridge, UK.

Lemeilleur, S., and J.M. Codron. 2011. “Marketing cooperative vs. commission agent: The Turkish dilemma on the modern fresh fruit and vegetable market.” *Food Policy* 36(2):272–279.

LeVay, C. 1983. “Agricultural cooperative theory: a review”. *Journal of Agricultural Economics,* 34 (1):1-44

Li, Z., K.L. Jacobs, and G.M. Artz. 2015. “The cooperative capital constraint revisited.” *Agricultural Finance Review* 75(2):253–266.

Liang Q, H.G. 2013. “Core and common members in the genesis of farmer cooperatives in China.” *Managerial and Decision Economics* 34(3–5):244–257.

Liu, T.S. 2017. “The Happiness Effect of Farmers’ Cooperatives: An Endogenous Switching Regression Analysis.” *China Rural Survey* (4):1-11. (In Chinese)

Ma, W., A. Abdulai, and R. Goetz. 2017. “Agricultural Cooperatives and Investment in Organic Soil Amendments and Chemical Fertilizer in China.” *American Journal of Agricultural Economics* 0(January):1–19. Available at: http://academic.oup.com/ajae/advance-article/doi/10.1093/ajae/aax079/4670688.

Mazzarol, T., R. Simmons, and E.M. Limnios. 2014. “A conceptual framework for research into co-operative enterprise.” *Research Handbook on Sustainable Co-Operative Enterprise: Case Studies of Organisational Resilience in the Co-Operative Business Model*:22–50.

McCain, R.A. 2008. “Cooperative games and cooperative organizations.” *The Journal of Socio-Economics* 37:2155–2167.

Münkner, H.H. 2004. “Multi-stakeholder co-operatives and their legal framework.” In C. Borzagand and R. Spear, eds. Trends and challenges for Co-operatives and Social Enterprises in developed and transition countries. pp. 49–69.

Ma. D.C., F.Y. Liu, L.J. Yang, and W.L. Wang. 2011. “An empirical study on the relationship between development of farmer’s specialized cooperatives and their financing by credit —based on survey to demonstrative farmer’s specialized cooperatives in Gansu province.” *China Rural Economy* (7): 34-41. (In Chinese)

Mao, F., Wang, X., and X.Z. Kong. 2014. “Analysis on provision of farmer cooperatives' finance services and its influencing factors”. *China Soft Science* (7): 26–39. (In Chinese)

Nilsson, J. 1996. “The nature of cooperative values and principles: Transaction cost theoretical explanations.” *Annals of Public and Cooperative Economics* 67(4):633–653.

Nilsson, J., G.L.H. Svendsen, and G.T. Svendsen. 2012. “Are large and complex agricultural cooperatives losing their social capital?” *Agribusiness* 28(2):187–204.

Normark, P. 1996. “A role for cooperatives in the market economy.” *Annals of Public and Cooperative Economics* 67(3):429–439.

Oustapassidis, K., A. Vlachvei, and K. Karantininis. 1998. “Growth of investor owned and cooperative firms in Greek dairy industry.” *Annals of Public and Cooperative Economics* 69(3):399–417.

Porter, P.K., and G.W. Scully. 1987. “Economic Efficiency in Cooperatives.” *The Journal of Law and Economics* 30(2):489–512.

Schroeder, T.C. 1992. “Economies of Scale and Scope for Agricultural Supply and Marketing Cooperatives.” *Review of Agricultural Economics* 14(1):93–103.

Sexton, R.J., and J. Iskow. 1993. “What do we know about the economic efficiency of cooperatives : an eEvaluative survey.” *Journal of Agricultural Cooperation* 8:15–27.

Skurnik, S. 2002. “The role of cooperative entrepreneurship and firms in organising economic activities – past , present and future.” *The Finnish Journal of Business Economics* 1:103–123.

Soboh, R.A.M.E., A.O. Lansink, G. Giesen, and G. van Dijk. 2009. “Performance measurement of the agricultural marketing cooperatives: The gap between theory and practice.” *Review of Agricultural Economics* 31(3):446–469.

Soboh, R., A. O. Lansink, and G. Van Dijk. 2012. “Efficiency of cooperatives and investor owned firms revisited”. *Journal of Agricultural Economics* 63(1): 142-157.

Sun,Y.F. and H.P. Yu. 2012.“The Impact of Farmer's Specialized Cooperative System on the

Members Behavior and organizational Performance.” *Journal of Nanjing Agricultural University (Social Sciences Edition)* 12(4): 61-69. (In Chinese)

Wang, J.L., V. Jeng, and J.L. Peng. 2007. “The impact of corporate governance structure on the efficiency performance of insurance companies in Taiwan.” *The Geneva Papers on Risk and Insurance Issues and Practice* 32(2):264–282.

Wynne-Jones, S. 2017. “Understanding farmer co-operation: Exploring practices of social relatedness and emergent affects.” *Journal of Rural Studies* 53:259–268.

Xu, X.C. and B. Wu. 2010. “The impact of governance mechanism to performance of farmers’ specialized cooperatives-an empirical study based on 526 farmers’ specialized cooperatives in Zhejiang.” *Chinese Rural Economy* (5): 43-55. (In Chinese)

Xu, X. 2014. “The government’s action logic in the development of farmer cooperatives in China: Based on the perspective of empower theory.” *Issues on Agricultural Economy* (1):19–29. (In Chinese)

Yu, L.Y. (2012). “Research on financing of farmer specialized cooperatives.” PhD Dissertation. *Shaanxi, China: Northwest Agriculture and Forestry University*. (In Chinese)

Zhang, C.G., L.P. Jia, and G.B. Qi. 2014. “Rural public space: as unintended consequences of farmers' specialized cooperative development.” *Journal of Nanjing Agricultural University (Social Sciences Edition* 14(2):8-14. (In Chinese)

Zhou,Z. and X.Z. Kong. 2015. “Surplus distribution and performance of cooperatives: a case study of Renfa Agricultural Machinery cooperative in Keshan county, Heilongjiang province.” *Chinese Rural Survey* (5):19-30. (In Chinese)