DECISION MAKEING AMONG HETEROGENEOUS MEMBERS: A STUDY ON ECONOMIC EFFICIENCY UNDER THE CENTRALIZED STRUCTURE OF CHINESE FARMER PROFESSIONAL COOPERATIVES

Meilin Ma: mma@primal.ucdavis.edu
Heng Zhu: zhu@primal.ucdavis.edu

Both authors are Ph.D. students from Department of Agricultural and Resource Economics, University of California, Davis

Selected Paper prepared for presentation at the Agricultural & Applied Economics Association's 2014 AAEA Annual Meeting, Minneapolis, MN, July 27-29, 2014.

The authors are grateful to Kevin Novan, Rachael Goodhue, Pierre Mérel, Alexander F. McCalla, James Chalfant and Sherman Hardesty for their comments on the earlier versions of the article.

Decision Making Among Heterogeneous Members: A Study on Economic Efficiency under the Centralized Governance of Chinese Farmer Professional Cooperatives

Abstract

Farmer cooperatives are playing an increasingly crucial role in the current reform of the agricultural sector in China. Two features of these organizations have stood out amidst the undergoing, rapid development. One is the highly concentrated decision-making structure, while the other being the high level of member heterogeneity in terms of production capacity and ownership portion. Current literature has few quantitative models for analyzing the effects of governance centralization and member heterogeneity on cooperative economic efficiency. This article focuses on evaluating the efficiency of decisions made under different voting structures when members are highly heterogeneous. We use a net income model for a two-stage investment decision. We find that members with a larger ownership in a Chinese cooperative tend to have better aligned interest with the organization and can make more efficient decisions relative to those with less ownership. When heterogeneity among members is high, a more centralized decision making structure can lead to higher economic efficiency. Additionally, because the optimal level of centralization is determined by the redistribution policy of cooperative profits and properties of member heterogeneity, different cooperatives would accordingly have different optimal degrees of centralization.

Keywords: Chinese Farmer Professional Cooperatives, economic efficiency, centralized decision power, member heterogeneity

JEL Classification: Q13, D71

1. Introduction

Farmer cooperatives have been regarded as a crucial linkage between farmers and markets and had great impact on modern agricultural development, especially in Europe and North America (Deng, et al., 2011). In developing countries, farmer cooperatives have played a key role in enhancing small-scale farmers' access to market and credits and strengthening their bargaining power in the increasingly globalized agricultural market (The World Bank, 2006). In principle, the primary goal of farm cooperatives is to serve the interest of all member farmers (Liang & Hendrikse, 2013). Hence, concerns over equity within cooperatives have been of central importance for long.

In Mainland China (hereafter China), the term "cooperative" was used to mean different organizations throughout the past century (Hu, et al., 2007). The evolution of farmer cooperatives did not enter a new era until the central planning was gradually abandoned and market-oriented economy started to function in the mid-1980s (Deng, et al., 2010). Starting from 2002, a series of policies that encourage the development of farmer cooperatives have been announced in China. Most crucially, in 2006, the Law of Farmer Professional Cooperatives (the Co-op Law) was promulgated. Under the Law, the legal status of cooperatives was recognized for the first time. The cooperatives have enjoyed a remarkable growth since then. By the end of 2012, the number of registered cooperatives was over 689,000, nearly a fourfold increase since 2007and covering about 91.2% Chinese villages (Lou , 2013). It is worth mentioning that the numbers could be rather misleading since a good portion of these *newly* registered cooperatives existed in various forms previously but were not recognized legally. Regardless of this complication, these cooperatives have registered over 43,000,000 members, accounting for 17.2% of total rural households (Xu, 2012).

The rapid development of cooperatives in China has received considerable attention from both the central and local governments (Kong & Shi, 2009) and become a key part of the recent push to promote economic growth in the poor rural regions of China (Zhang, 2009). As cooperatives start to play an increasingly important role in rural China, a region largely left behind in the past three decades of impressive economic growth, a more systematic understanding of their influence and operations becomes crucial in assessing the efficiency and fairness of these budding institutions (Huang & Yu, 2010). Owing largely to the institutional setting in which they evolve, Chinese cooperatives have established a set of salient characteristics in response to the unique challenges they face (Deng, et al., 2011). One striking feature noticed by many scholars is the extremely high percentage of cooperatives that have a highly centralized governance structure, even though the Co-op Law requires a one-person-one-vote governance (Lou , 2013; Xu, 2006). Moreover, there exists a significantly wider gap in resource endowments (such as land and capital) and equity ownership amongst members within Chinese cooperatives compared with the well-developed ones in western countries (Shao & Xu, 2013). This feature allows us to distinguish the two types of cooperative members, the *core members* who are dominant in resource ownership and control rights, and the *common members* who mainly concerned with obtaining higher prices and tend to delegate most decisions to the core members who act as the managers, the directors or the board. (Liang & Hendrikse, 2013). This core-periphery internal structure further distinguishes Chinese cooperatives from the more democratic governance structure of their western counterparts.

Given that there has not been a rigorous economic model interpreting such issues, our research aims to investigate the mechanism of the highly centralized decision making system in Chinese cooperatives, from the perspective of economic efficiency and welfare distribution. The rest of the article is structured into four sections. The next section presents a summary of current

literature on relevant topics and bring up the research question of the research. The third section develops the theoretical model to evaluate the distributional and efficiency effect of the centralized governance structure. Interpretations are presented in the fourth section. Several propositions are derived from these interpretations. Finally, a concise recapitulation of the article is drawn.

2. Literature Review

Broadly speaking, centralized governance structure and member heterogeneity in cooperatives have been a topic of interest for economists and policy makers for decades. Most of those articles focus on investigating the relation between collective action and member composition in an organization, either a cooperative or an investor owned firm (IOF). Several classic works are highly relevant to our research and worth mentioning.

Firstly, regarding the impact of heterogeneity on a cooperative's operational structure, it has been argued that within farm cooperatives, inequality of asset ownership affects relative control rights of different groups of member, according to the rent-transfer theory (Banerjee, et al., 2001). It is found that heterogeneity among members affects the optimal size of a cooperative (Karantininis & Zago, 2001). Indeed, cooperative policy is determined by trading off gains due to membership size, which is mostly due to the wider sharing of fixed cost and economies of scale, against the costs of member diversity, which refer to decision costs (Zusman, 1992). Secondly, efficiency of collective action in cooperatives is compared with that of IOFs. Collective actions tend to fail in achieving a socially optimal outcome due to myopic bias of members or the views of the decisive voter is not necessarily aligned with the cooperative as a whole (Hart & Moore, 1996; Zusman & Russer, 1994). Despite this shortcoming, cooperatives can yield Pareto improvements compared to uncoordinated private action and thus are still advisable. Hart and

Moore (1996) point out that, on a one-member-one-vote basis, a cooperative becomes less efficient than an IOF as member variation becomes more skewed and when the organization is faced with more competition. Their article approaches the issue from the perspective of pricing and voting design. They claim that a cooperative is first-best efficient if and only if the median voter has the average preference. Note that we have drwan a fairly different conclusion which we shall talk through later.

Regarding the research on Chinese cooperatives, centralized decision making and member heterogeneity have been studied on since early years. Most scholars agree that an imbalanced decision-making structure and heterogeneity among members widely exist in cooperatives (Lin & Huang, 2007; Zhang & Feng, 2008). In terms of decision-making, though individual production decisions within cooperatives could be fairly decentralized, marketing, branding and other control rights are highly collective (Jia, et al., 2010). On the other side, surveys have shown that members display high levels of heterogeneity in land size (production capacity), services needed, production scale, distribution of shareholding and so on (He, et al., 2012). For instance, one study shows that the largest member often contributes over twenty times the production of the smallest member (Ma & Meng, 2008). Ownership is not uniformly distributed with the top five largest shareholders generally holding over half of the total equity. This feature is believed to be correlated with the seriously unbalanced distribution of control rights and often cited as a major issue when examining organizational operations of Chinese cooperatives (Lou , 2013).

In particular, Liang and Hendrikse (2013) point out that core members who are with high levels of ownership and/or production capacity, tend to be the initiators as well. They are usually better at managing and marketing, or have social networks with downstream buyers and processors and hence control the operation of the cooperative largely. In contrast, the participation rate of common members regarding decision making is generally extremely low. In

92% of the cooperatives surveyed, common members who have low levels of ownership and production capacity, do not participate in management. They argue that this fact points to the formation of cooperatives in China being a top-down approach, with local entrepreneurs or local governments organizing farmers into cooperatives. This effect reinforces the rigid locality of Chinese cooperatives, which further pushes up the level of centralization. Yet granting the core members with dominant power can encourage them to make greater contribution with respect to human, capital and social resources they own and enhance the performance of the cooperative as a whole, which can be an effective arrangement (Kong & Jiang, 2010).

Therefore, whether the one-person-one-vote system is beneficial has been debated extensively. As an economic organization, it is crucial for the cooperatives to maintain a high level of economic efficiency to compete and grow in the markets. Note that, throughout the article, the term *(economic) efficiency* is achieved if a decision maximizes the total profit of the cooperative. According to an earlier research (Schultz & Albaek, 1997), there is no reason to presuppose that a one-person-one vote system is less efficient in investment decision making. However, Schultz and Albaek's analysis is limited to a one-stage business structure. In general, it is held that applying a one-person-one-vote system increases decision costs and lowers efficiency (Cao & Yao, 2008; Lin & Wang, 2002).

Insights into the relationship between member heterogeneity and decision making efficiency are important for understanding the evolvement of cooperatives. Yet to the best of our knowledge, no article has applied rigorous and specifically-designed economic analysis to the rationale and impacts of governance centralization on economic efficiency of a cooperative in China. Nor is there an economic model explaining the formation of the centralized governance structure in these cooperatives. The few works that do discuss this question use mostly descriptive methodologies. Some of current research argue that common members give up their decision

power in order to balance interests with core members to stay in the cooperative (Xu, 2006); others believe that Chinese farmers have little concept of democracy and are used to being controlled rather than rule themselves (Shao & Xu, 2013; Zhao, 2010). A closer inspection into the causes, impacts, and interaction of member heterogeneity and centralization from an economic point of view remains much to be desired. This article aims exactly on proposing such an economic model to look into the efficiency and redistribution effects of governance centralization, given the high levels of member heterogeneity in Chinese cooperatives.

3. Model

In China, business of producer cooperatives typically include two main stages, the raw production of agricultural commodities and the value-adding processing. In *Stage 1*, or the *production stage*, members produce raw products which are sold to the cooperative at a price set ex ante. Generally, this price is either equal to or slightly above the best, accessible market price of the commodity. Such a pricing scheme is used to ensure that members sell their products to the cooperatives as opposed to selling on market on their own. In the *Stage 2*, or the *value-adding stage*, the cooperative processes the raw commodities, then packages, brands, and sells them on the market. Then, a fixed portion of the net profit made on the second stage is redistributed to members, according to the Co-op Law.

In the following, we develop a theoretical model to demonstrate how members' investment preferences are influenced by their relative production and ownership, and how their preference differ from the optimal choice for the cooperative as a whole.

1) Individual Member Decision

Consider a static setup where the cooperative needs to make an investment decision on how it would like to allocate the investment budget between the two operational stages.

It is assumed that the investment budget, *I*, for each round of decision is fixed under the static setup. The budget can be continuously allocated to either the initial *production stage* as a yield enhancing investment, or in the *value-adding stage* to bring up the price of the final products through processing and marketing. Because transfer and lease of land is extremely difficult in rural China (Brandt, et al., 2002), we model investments in *Stage 1* as only revolving around purchases of high yield varieties and fertilizers rather than land expansion. Members are assumed to be equally productive and differ in production capacity due to farm sizes along. This assumption is justified for two reasons. First, most members are small scaled, including the larger producers in a cooperative. Second, many producer cooperatives provide their members with inputs, basic infrastructure, and agrarian training (i.e. technologies) so that member productivity is highly similar (Deng, et al., 2011). Hence, without achieving economies of scale, similar producing method would lead to similar productivity.

Mathematically, member *i*'s output is expressed as $q_i = y \times l_i$, where q_i denotes individual production, y is the common productivity parameter and l_i is land owned. Yield, y, is changed by the investment in *Stage 1*, or I_1. To avoid being bogged down in notation, we express it in an equivalent way by using q_i as the factor that is directly affected by I_1. Define P_2 as the final price for processed products. We express the effect of investment in *Stage 2, or* I_2 exclusively on this price. We additionally posit that the two investment functions $q_i(I_1)$ and $P_2(I_2)$ are both establish diminishing return to investment (i.e. concave functions).

$$\frac{\partial q_i}{\partial I_1} \geq 0,\ \frac{\partial^2 q_i}{\partial I_1^2} \leq 0,\ \frac{\partial P_2}{\partial I_2} \geq 0,\ \frac{\partial^2 P_2}{\partial I_2^2} \leq 0 \qquad (1)$$

The nature of yield-enhancing investment under the above setup is that the production elasticity of investment in *Stage 1* is the same for all members. Thus, no matter how the production quantity is changed by the investment for each member, his/her production share out

of the total production of the cooperative remains the same. In other words, a yield-enhancing investment raises the productivity of all members by the same percentage. Denoting Q as the total production of the cooperative, we express the equality of production-investment elasticity as

$$\frac{\partial q_i/q_i}{\partial I_1/I_1} = \frac{\partial Q/Q}{\partial I_1/I_1} \Longrightarrow \frac{\partial q_i}{\partial I_1}\frac{I_1}{q_i} = \frac{\partial Q}{\partial I_1}\frac{I_1}{Q} \qquad (2)$$

For simplicity, we assume that the marginal costs for all members in *Stage 1* and *2* are constants, denoted as *c* and *C*, respectively. Thus, the individual costs for *Stage 2* is expressed as $c.q_i(I_1)$, while that in *Stage 2* as $C \cdot Q(I_1)$. This reflects the commonly observed fact that there is little difference among members within an cooperative in terms of their technologies and key inputs used, especially given that capital of an cooperative is usually pooled and used by all (Huang, et al., 2010). Noticeably, it leads to the same conclusions if assuming C to be any non-decreasing function of $Q(I_1)$ (see **Appendix 1**). Lastly, define P_1 as the price of internal purchase where the cooperative buys raw products from the members. As mentioned, P_1 is exogenous, approaching the highest available price on market for the raw product.

Weights making up the redistribution rate of cooperative net profits for members are denoted by α and β. Here α is the percent of net profits redistributed based on production contribution and β the portion based on ownership. Because the redistribution rate is weighted on α and β only, it must be that $\alpha + \beta = 1$. Denote s_i as the ownership for an individual, and $k_i = \frac{q_i(I_1)}{Q(I_1)}$ as his/her the production share. The redistribution rate is denoted as γ which ranges from 0 to 1.

Hence for each member, $(\alpha k_i + \beta s_i)\gamma$ represents the portion of cooperative net profits he/she gets by the end of the fiscal year. For clearer presentation, denote $(\alpha k_i + \beta s_i)\gamma$ as Z_i, called as the *total percentage of net profit* a member acquires from distributable profit. Because of *Equation (2)*, Z_i does not change when I_1 varies.

With individual net income as the objective function, the income maximizing model can be set up as

$$\max \Pi^i = P_1.q_i(I_1) - c.q_i(I_1) + Z_i[(P_2(I_2) - P_1 - C)Q(I_1)] \quad (3)$$

$$s.t. I_1 + I_2 \leq I,\ I_1 \geq 0,\ I_2 \geq 0$$

Because the objective function is concave and the constraint sets are convex, the first-order conditions (FOCs) are sufficient for finding the optimal point. Thus, the FOC is

$$\frac{\partial Q(I_1)}{\partial I_1} k_i (P_1 - c) + \frac{\partial Q(I_1)}{\partial I_1} \gamma Z_i (P_2(I_2) - P_1 - C) = Q(I_1)\gamma Z_i \frac{\partial P_2(I_2)}{\partial I_2} \quad (4)$$

Equation (4) states that each individual wants his/her marginal benefit from investing an additional dollar in *Stage 1* to be equal to the marginal benefit of investing one more dollar in *Stage 2*. Rewrite *Equation (4)* as a ratio showing how each individual prefers the investment to be allocated in *Stage 2* and *Stage 1*.

$$R^i = \frac{\partial P_2(I_2) / \partial I_2}{\frac{\partial Q(I_1)}{\partial I_1} / Q(I_1)} = \left(\frac{P_1 - c}{\gamma Z_i} + \frac{P_2(I_2) - P_1 - C}{k_i}\right) \frac{q_i(I_1)}{Q(I_1)} \quad (5)$$

Denote the two profit margins as $P_1 - c \equiv m$, and $P_2(I_2) - P_1 - C \equiv M$. Hence, given that $Z_i \equiv \alpha k_i + \beta s_i$

$$R^i = \frac{\partial P_2(I_2) / \partial I_2}{\frac{\partial Q(I_1)}{\partial I_1} / Q(I_1)} = \left(\frac{m}{\gamma Z_i} + \frac{M}{k_i}\right) k_i = m \frac{1}{\gamma\left(\alpha + \beta \frac{s_i}{k_i}\right)} + M \quad (5')$$

Equation (5') indicates a unique, optimal allocation of the budget to maximize member *i*'s net profit. Note that individuals with a smaller k_i relative to s_i would have a larger R^i. A larger R^i essentially means a larger $\frac{\partial P_2(I_2)}{\partial I_2}$ and a smaller $\frac{\partial Q(I_1) / Q(I_1)}{\partial I_1}$ due to the concavity assumption of *(1)*.

Given that $I_1 + I_2 = I$ and *(1)*, a larger R_i indicates a preference for investment in *Stage 1* relative to *Stage 2*.

2) Cooperative Decision

To compare an individual's investment preferences with the interest of an cooperative as a whole, we setup the cooperatives profit maximization problem and solve for the optimal investment allocation.

The crucial difference is that the cooperative internalizes what it buys from its members at P_1 in the objective function. Hence, the total net profits of the cooperative equals exactly the revenue generated from value-adding activities after deducting both production and processing costs. Therefore, the cooperatives profit maximizing problem is set up as

$$\max \Pi^C = [P_2(I_2) - c - C]Q(I_1) \qquad (6)$$

$$s.t. I_1 + I_2 \leq I,\ I_1 \geq 0,\ I_2 \geq 0$$

Solving the constrained optimization problem, the optimal allocation demonstrates that marginal return from investing in both stages must be equal

$$\frac{\partial Q(I_1)}{\partial I_1}[P_2(I_2) - \sum_{i=1}^{N} c.\left(\frac{\partial q_i}{\partial I_1}\right) - C] = Q(I_1)\frac{\partial P_2(I_2)}{\partial I_2} \qquad (7)$$

Similarly, *Equation (7)* is rewritten in a ratio form for more direct interpretation as

$$R^C = \frac{\partial P_2(I_2)/\partial I_2}{\frac{\partial Q(I_1)}{\partial I_1}/Q(I_1)} = P_2(I_2) - c - C = m + M \qquad (7')$$

Comparing *Equation (7')* with *Equation (5')*, it is clear that $R^C = R^i$ if and only if

$$\gamma(\alpha k_i + \beta s_i) = k_i \rightarrow \frac{s_i}{k_i} = \frac{1-\gamma\alpha}{\gamma\beta} = \frac{1-\gamma\alpha}{\gamma-\gamma\alpha} \qquad (8)$$

Only the member with a particular $\frac{s_i}{k_i}$ that is determined by redistribution policy perfectly aligns with the organization's interest.

4. Interpretation

1) Compare Core and Common Member Decisions

From *Equation (5')* and *Equation (7')*, we find that, given certain redistribution parameters, the smaller $\frac{s_i}{k_i}$ is the larger portion is desired to be invested into *Stage 1*. In other words, if a member is a larger producer than an owner, he/she would prefer to invest more into *Stage 1*.

In general, we are not able to say much about what a member's $\frac{s_i}{k_i}$ should be. However, taking Chinese characteristics into consideration, we are able to draw several interesting conclusions from the simple equations we have. As observed in most cooperatives, the smaller a member is as a producer, the even smaller he/she tends to be as a shareholder, and vice versa (Jia, et al., 2010; Liang & Hendrikse, 2013). Therefore, a member with a small production share (k_i) usually has an even smaller ownership (s_i), or his/her $\frac{s_i}{k_i} < 1$, while a member with large k_i usually has an even larger s_i, or his/her $\frac{s_i}{k_i} > 1$. Given the fact that the heterogeneity between core members who have large ownership, and common members who own little equity, is fairly considerable, their ownership-production-portion ratios (i.e. $\frac{s_i}{k_i}$ and hereafter, the *OPP*) would be quite different.

Consequently, the model predicts that the common members generally prefer more investment in *Stage 1* but less in *Stage 2*, while the core members prefer the opposite. In particular, we could see that when decision power is equally distributed (i.e. one-person-one-vote), it shall be difficult for a cooperative to invest in value-adding activities due to the majority common members' preference towards *production stage* investment. This insight may also help us to understand why many cooperatives in China find it difficult to integrate forward, especially

regarding advanced processing (Kong & Huang, 2013), as it has trouble in balancing interests among core and common members who tend to have very different preferences.

Proposition 1: *For any given redistribution policy, the common members (small shareholders) of a Chinese cooperative would prefer more investment in the production stage, while the core members (large shareholders) would desire more in the value-adding stage.*

2) Compare Member and cooperative Decisions

Now, we compare individual preference with the cooperative's optimum. Hereafter, we refer to a member who has exactly the same preference as the cooperative as the *representative member* (*RM*). The RM's investment allocation preferences perfectly aligns with that of the cooperative and thus could make the most efficient investment decision if granted the complete power.

In other words, should it be possible to grant the full power to members with such a value of OPP^R, the cooperative could be making the optimal investment decision. The RM's OPP^R is defined as

$$OPP^R = \frac{s^R}{k^R} = \frac{1-\gamma\alpha}{\gamma-\gamma\alpha} \geq 1, 0 \leq \gamma \leq 1 \qquad (9)$$

Proposition 2-1: *The representative member of a cooperative is the one who has an ownership-production-portion ratio that is larger than one and determined by redistribution parameters.*

Again, referring to the fact that small producers in Chinese cooperatives tend to be even smaller shareholders, $OPP^R \geq 1$ points out to that

Proposition 2-2: *Given the current member heterogeneity features of most Chinese cooperatives, the core members, rather than the common ones, generally have better aligned preferences with the cooperative and hence could make more efficient decisions from the cooperative's perspective.*

Therefore, applying the one-person-one-vote system would result in a loss in economic efficiency compared with a more centralized decision system, because the majority voters (Hu, et al., 2007), or the common members, would win. As shown, the common members' preferences tend to be farther off from the cooperative's optimum.

More specifically, our survey and literature show that most cooperatives in China calculate member dividend distribution portion according to the Co-op Law which requires the cooperatives to redistribute at least 80% of their net profits to members ($\gamma \geq 0.8$). The remaining 20% of net profits can be kept as retained earnings and accumulated as the internal fund for future investment or insurance for risks. Additionally, the Co-op Law requires that at least 60% of the redistributed profits need to be based on members' production contribution ($\alpha \geq 0.6$), while up to 40% could be redistributed based on ownership ($\beta \leq 0.4$). In most cases, cooperative controllers have the intention to and would keep as much retained earnings and redistribute as much based on ownership. Thus, cooperative usually obey the regulations precisely at bound values as a *legally standard* cooperative. Based on *Equation (8)*, the RM of the *legally standard* cooperative would have

$$OPP^R = \frac{s^R}{k^R} = \frac{1-\gamma\alpha}{\gamma\beta} \approx 1.626 \qquad (10)$$

Interestingly though, the RM is not necessarily the largest, the median, or smallest member, but the one with a particular ownership-to-production-portion. As stated earlier, $\frac{s^R}{k^R} > 1$ or a higher share ownership than his/her production share indicates that the RM would b e a core member rather than a common one.

Of course, it is not always possible to allocate the RM exactly in a cooperative, because the distribution of production portion and ownership is not always continuous. Yet this ratio does indicate that core members would align cooperatives interest better than the common ones. Also,

the ratio indicates the ideal, optimal centralization degree of the cooperative governance, because cooperatives would ideally centralize decision power to members with such OPP values.

3) Impact of Redistribution Policy on Ideal Centralization Degree

Next, we assess how changing redistribution policies would affect the ideal degree of centralization by calculating comparative statistics as follows.

$$\frac{\partial OPP^R}{\partial \gamma} \leq 0,\ \frac{\partial OPP^R}{\partial \alpha} \geq 0,\ \frac{\partial OPP^R}{\partial \beta} \leq 0 \qquad (11)$$

It means that for a cooperative with a smaller γ or a larger α and a smaller β, centralization of decision power tends to generate a greater return of investment, and vice versa. When the total redistribution rate (γ) decreases, the RM tends to have a smaller or more skewed OPP^R. In contrast, when the redistribution weight of production (α) increases, the RM's OPP^R goes up. As mentioned earlier, the larger the member is as a shareholder the larger his OPP would be. Similarly, when the weight of share ownership (β) increases, OPP^R would increase. Hence the smaller β is, the larger the RM is expected to be. To sum up, a smaller redistribution rate results in a larger RM, and so does a larger weight of production in the redistribution share.

Intuitively, a smaller γ means that a smaller portion of a member' net income is determined based on his/her ownership in the form of dividends of the cooperative. Hence, if the percentage of net earnings being redistributed decreases, individual members gain less from *Stage 2*, thus less consideration of *Stage 2* profit is taken. Yet according to *Equation (6), Stage 2* profit is the key to maximizing cooperatives profit. From the cooperatives view, consequently, the bias of a member is larger due to a more biased preference towards investing in *Stage 1*. Consequently, to maintain an efficient balance of investment, the RM must be an even larger shareholder. Similarly, a larger emphasis on α essentially means more emphasis on *Stage 1* profit or a more insufficient

consideration of *Stage 2* profit, creating another situation where a larger shareholder is desired for efficient allocation.

We also highlight that cooperatives' OPP^R is determined by the redistribution policy it applies. Thus, if a strict redistribution policy required by the Co-op Law is implemented, all cooperatives would actually have their RMs with the same OPP^R regardless of other features of the organizations.

Proposition 3: *The redistribution policy applied by a cooperative determines the optimal ownership-production-potion ratio. The smaller the portion of cooperative profit is redistributed and the larger weight of redistribution is based on production, and the larger the RM is as a shareholder.*

Finally, we sum up what we find in the previous two interpretations as follows.

Proposition 4*: The implied optimal centralization degree of a cooperative is jointly determined by its redistribution policy and properties of member heterogeneity in production and ownership.*

4) Visualizing the Findings

To illustrate our findings more intuitively, consider the special case where the cooperative redistributes all of its net earnings ($i.e\ \gamma = 1$), then the RM would have the $OPP^R = \frac{s^R}{k^R} = 1$. That is, the RM has production share equal to ownership share. As follows, we graph this special case for more direct illustration.

Without loss of generality, we rank the cooperative members on a [0, 1] interval and rank them based on production share (k_i) from smallest to largest. We shall call the horizontal axis values as *member location* (m_i), assuming the continuity of the distribution. As shown in **Figure 1**, the leftmost member is the smallest landholder, with the corresponding height of the curve

representing his/her production share. The solid curve of k_i is strictly increasing and the area under it sums to one (due to the fact that the sum of k_i equals 1). Here the curve is set linearly increasing for the ease of exposition. For the ranked members, we then graph the curve of their ranked ownership (s_i). It could well be the case that some small producing members have relatively larger s_i. In most Chinese cooperatives, however, the smaller producers own even smaller portions of shares, vice versa. Thus, to avoid unnecessary complications of the model, the s_i curve of the ranked members is also monotonically increasing by assumption.

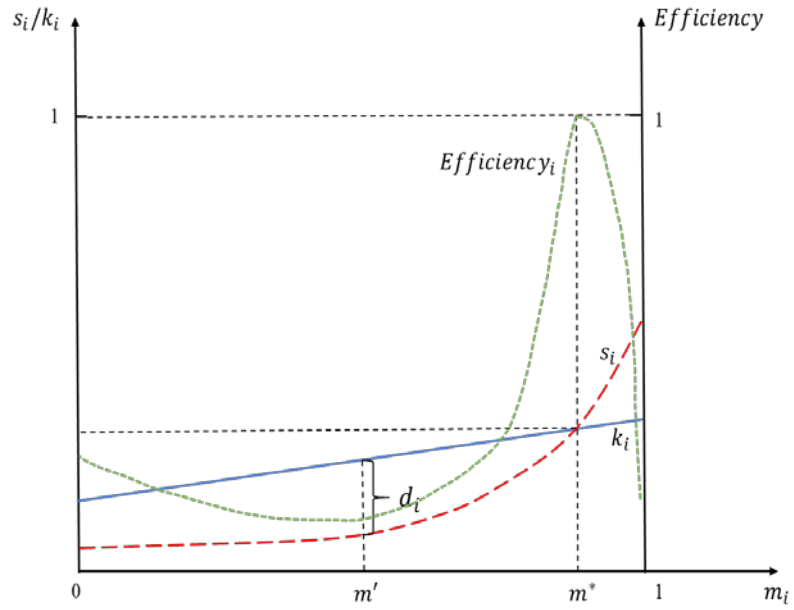
Given that $\gamma = 1$, the RM (m^*) is found where the two curves intersect (i.e. $\frac{s^R}{k^R} = 1$). Any other members with the k_i larger than s_i prefer to allocate more investment in *Stage 1,* and vice versa. Denote the vertical distance between the k_i and s_i curves as d_i. The larger $|d_i|$ is the farther a member's preference deviates from the optimum of the cooperative. For more direct understanding, define the efficiency of an investment allocation

$$E_i(d_i) = \frac{1}{|d_i|+1} \qquad (12)$$

Hence, the highest efficiency is 1 when $|d_i| = 0$. Draw the normalized *efficiency curve* of the cooperative as a dotted curve which peaks at m^*.

Clearly, efficiency suffers a loss for any member to allocate the budget other than m^*. It depends on the shape of the production and ownership distribution to determine the precise location of RM. Moreover, the optimum tends to be found somewhere among the large owners. Finally, it shows that the least efficient member could either be somewhere among the small shareholders or the largest ones. Thus, neither complete democracy (one-person-one-vote) nor autarchy necessarily enhances efficiency (see **Appendix 2**). All such observations well reconciles with the propositions.

Figure 1 Relationship between Decision Efficiency and Member Production Capacity and Ownership Distribution



5. Concluding Remarks

Centralized governance structure and high member heterogeneity are two major features of most Chinese cooperatives today. This article aims to acquire more insights regarding the relationship between these two features and how they interact with economic efficiency of an cooperative. This analysis provides a new perspective for understanding the *loss of democracy* in the cooperatives.

A model of typical cooperatives with the two-stage business structure is setup, regarding a decision on investment budget allocation. The model reveals that, given the current member composition of most Chinese cooperatives, applying the one-person-one-vote system sacrifices the economic efficiency of decisions made by the cooperative. The reason is that smaller members, who usually are the majority, tend to have less aligned preferences with the cooperative

than the core members do. Therefore, a so-called *representative member* (*RM*), who has the perfectly aligned preference as the cooperative does, is generally found to be a core member or large shareholder. In other words, granting the core members with more decision power can lead to more efficient decisions in such cooperatives. As highlighted in the article, cooperatives redistribution policy and properties of member heterogeneity in production capacity and ownership fundamentally determine the optimal centralization level. Hence, different cooperatives have different optimal degrees of centralization in decision making, accordingly.

We have to admit that the research has several limitations, including the use of static model, and not considering members' exit nor uncertainty. Being fully aware of the shortcomings, we still believe that this research can add to our understanding the complexity and uniqueness of Chinese cooperatives. More importantly we hope the research stimulate more interest and ideas on the relevant topics in the future.

Appendix 1 Investment Allocation with Increasing Marginal Cost in *Stage 2*

If $\frac{\partial C(Q(I_1))}{\partial Q(I_1)} \geq 0$, set $\widetilde{R_\iota}$ as

$$\widetilde{R_\iota} = \frac{\partial P_2(I_2)/\partial I_2}{\frac{\partial Q(I_1)}{\partial I_1}/Q(I_1)} + \frac{\partial C(Q(I_1))}{\partial Q(I_1)} = \left(\frac{P_1 - c}{\gamma Z_i} + \frac{P_2 - P_1}{k_i}\right)\frac{q_i(I_1)}{Q(I_1)} \qquad (13)$$

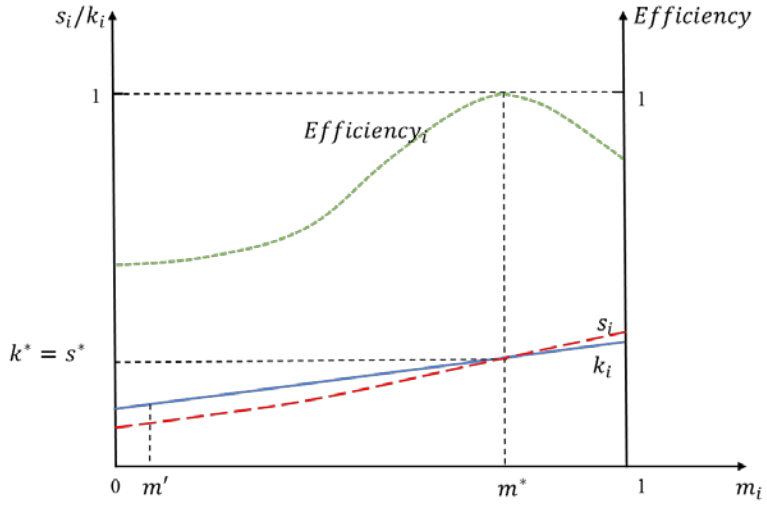
Denote $P_1 - c \equiv m'$, $P_2(I_2) - P_1 - C \equiv M'$ and rewrite *Equation (12)* as

$$\widetilde{R_\iota} = m' \frac{1}{\gamma\left(\alpha + \beta\frac{s_i}{k_i}\right)} + M' \qquad (13')$$

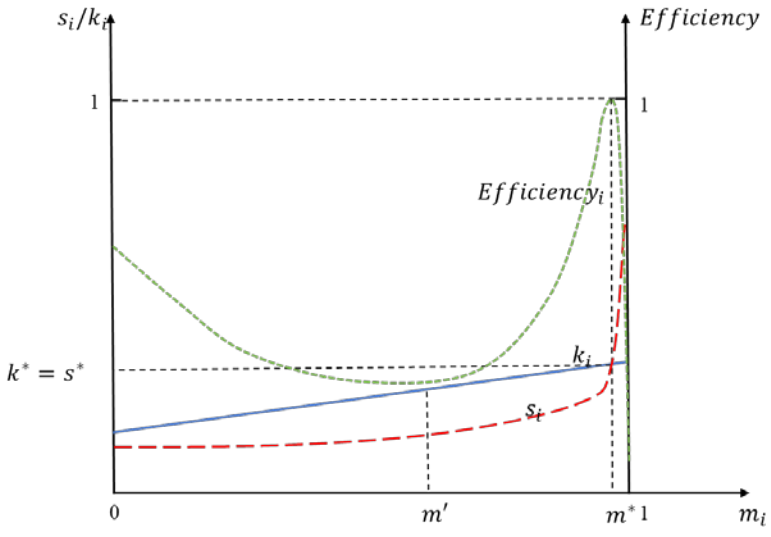
A larger $\widetilde{R_\iota}$ means a larger $\partial P_2(I_2)/\partial I_2$, a smaller $\frac{\partial Q(I_1)/Q(I_1)}{\partial I_1}$ and a larger $\frac{\partial C(Q(I_1))}{\partial Q(I_1)}$. Since $\frac{\partial C(Q(I_1))}{\partial Q(I_1)} \geq 0$, a larger I_1 would hence result in an $\widetilde{R_\iota}$, which is the same with the case shown in the main content.

Appendix 2 Relationship between Decision Efficiency and Member Production Capacity and Ownership Distribution (Continue)

Case where the RM is with extremely high level of ownership and least efficient decision maker is with medium level.



Case where the RM is with medium level of ownership and least efficient decision maker is with extremely low level.



References

Banerjee, A., Mookherjee, D., Munshi, K. & Ray, D., 2001. Inequality, Control Rights, and Rent Seeking: Sugar Cooperatives in Maharashtra. *Journal of Political Economy,* 109(1), pp. 138-190.

Brandt, L., Huang, J., Li , G. & Rozelle, S., 2002. Land Rights in Rural China: Facts, Fictions and Issues. *The China Journal,* Issue 47, pp. 67-97.

Cao, Y. & Yao, R., 2008. Free Exit, Organizational Stability and Efficiency: Why Farmer Professional Cooperatives Have not Become the Mainstream form of Rural Economy. *Journal of Huazhong Normal University* , Volume 7, pp. 46-50.

Deng, H., Huang, J., Xu, Z. & Rozelle, S., 2010. Policy Support and Emerging Farmer Professional Cooperatives in Rural China. *China Economic Review,* Issue 21, pp. 495-507.

Deng, H., Xu, Z., Huang, J. & Song, Y., 2011. The Role of Potential Profit in the Formation and Development of Farmers' Professional Cooperatives. *China Economic Quarterly,* 10(4), pp. 1515-1532.

Gerichhausen, M., Berkhout, E., Hamers , H. & Manyong, V., 2009. A Quantitative Framework to Analyze Cooperation between Rural Households. *Agricultural Systems,* Issue 101, pp. 173-185.

Hart, O. & Moore, J., 1996. The Governance of Exchanges: Members' Cooperatives versus Outside Ownership. *Oxford Review of Economic Policy,* 12(4), pp. 53-69.

He, A., Shao, F. & Kong, X., 2012. Heterogeneity of Resources and Interest Distribution in Cooperatives: A Case Study. *Jianghuai Forum,* Issue 1, pp. 11-18.

Huang, J., Deng, H. & Xu, Z., 2010. Determinants of the Services Provided by Chinese Farmers' Cooperatives. *World of Management,* Issue 5, pp. 75-81.

Huang, Z., Xu , X. & Song, Y., 2006. Cogovernance Based on Abilities and Relations. *Society and Economy,* 28(2), pp. 207-217.

Huang, Z. & Yu, N., 2010. Agricultural Operators in New Forms. *China's Rural Economics,* Volume 10, pp. 16-26, 56.

Hu, Y., Huang, Z., Hendrikse, G. & Xu, X., 2007. Organization and Strategy of Farmer Specialized Cooperatives in China. In: G. Cliquet, G. Hendrikse, M. Tuunanen & J. Windsperger, eds. *Economics and Management of Networks: Franchising, Strategic Alliances, and Cooperatives.* New York: Physica-Verlag HD, pp. 437-462.

Jia, X., Hu, Y., Hendrikse, G. & Huang, J., 2010. *Centralized versus Individual: Governance of Farmer Professional Cooperatives in China.* Halle (Saale), IAMO Forum 2010.

Karantininis, K. & Zago, A., 2001. Endogenous Membership in Mixed Duopsonies. *American Journal of Agricultural Economics,* 5(83), pp. 1266-1272.

Kong, X. & Huang, B., 2013. Experience of Establishing Processing Business in Cooperatives from Other Nations. *The Chinese Cooperative Econoic Review,* 1(11), pp. 61-64.

Kong, X. & Jiang, C., 2010. Impact of Member Heterogeneity on Management of Cooperatives. *Rural Economics,* Issue 9, pp. 8-11.

Kong, X. & Shi, B., 2009. Current Determinants of Farmer Cooperative's Operation, Functions and Impacts. *Rural Economics,* Issue 1, pp. 3-9.

Liang, Q. & Hendrikse, G., 2013. Core and Common Members in the Genesis of Farmer Cooperatives in China. *Managerial and Decision Economics,* Issue 34, pp. 244-257.

Lin, J. & Huang, S., 2007. Member Heterogeneity and Ownership Structure of Farmer Professional Cooperatives. *Journal of Agricultural Economic Issues,* Volume 10, pp. 12-17.

Lin, J. & Wang, N., 2002. Fairness and Efficiency: Core Concepts and Institutional Arrangement in Cooperatives. *Agricultural Economics Issues,* Volume 9, pp. 46-49.

Lou , D., 2013. Review of Research on Heterogeneity of Cooperative Members. *The Chinese Cooperative Economic Review,* 11(1), pp. 39-48.

Ma , Y. & Meng, C., 2008. Double-Agent-Principal Relationships in China's Farmer Professional Cooperatives. *Topics of Agricultural Economics,* Volume 5, pp. 55-60.

Mi, X., 2008. Comments on the Profit Distribution System of Farmer Professional Cooperatives. *Legal Science,* Issue 6, pp. 89-96.

Schultz, C. & Albaek, S., 1997. One Cow, One Vote?. *Scandinavian Journal of Economics*, pp. 597-615.

Shao, K. & Xu, X., 2013. Participation of Cooperative's Members: Concept, Role and Behavior. *The Chinese Cooperative Economic Review*, 11(1), pp. 30-38.

The World Bank, 2006. *China - Farmers Professional Associations Review and Policy Recommendations*, Washington: The World Bank.

Xu, X., 2006. Farmers' Professional Cooperatives: Property Right Arrangement Based on Organizing Capability. *Zhejiang Journal*, Issue 3, pp. 177-182.

Xu, X., 2012. An Analysis of Farmer Specialized Cooperatives: A Domestic Literature-based Discussion. *China Rural Survey*, Issue 5, pp. 2-12.

Zhang, X., 2009. An Analysis of Developing Trend of Chinese Farmers' Professional Cooperatives. *Management World*, Issue 5, pp. 89-96.

Zhang, X. & Feng, K., 2008. Game of Decision Power Distribution in Cooperatives. *Chinese Agricultural Economics*, Volume 8, pp. 61-69.

Zhao, Q., 2010. Civil Consciousness of Peasants and Development of Chinese Rural Incorporation Economy Organization. *Social Sciences*, Issue 8, pp. 28-36.

Zusman, P., 1992. Constitutional Selection of Collective-choice Rules in a Cooperative Enterprise. *Journal of Economic Behavior and Organization*, Issue 17, pp. 353-362.

Zusman, P. & Russer, G., 1994. Intraorganizational Influence Relations and the Optimlity of Collective Action. *Journal of Economic Behavior and Organization*, Issue 24, pp. 1-17.