Study on the Chinese farmer cooperative economy organizations and agricultural specialization

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Abstract: Under the background of the Chinese Household Contract Responsibility System (HCRS), farmers have to pay higher transaction costs and encounter a huge trading risk if they engage in agricultural production only through the market transaction. Since the special properties of agricultural production limit the formation and development of agricultural enterprises, farmer cooperative economy organizations with the main functional characteristics of transaction coordination begin to flourish. By building a new classical economics model, this paper demonstrates the theoretical assertion that the generation of a farmer cooperative economy organization is accompanied by the evolution of the division of labour, the improvement of farmers' effectiveness and the development of agricultural specialization. Furthermore, this paper does an empirical analysis with the micro-survey data to verify this theoretical assertion. Therefore, this article effectively explains the generation condition of a farmer cooperative economy organization and the internal mechanism of how it promotes the development of agricultural specialization. So this paper provides a strong theoretical and practical evidence for the development of a farmer cooperative economy organization and agricultural specialization.

Key words: farmer cooperative economy organization; division of labour; agricultural specialization; inframarginal analysis

The implementation of the Chinese Household Contract Responsibility System (HCRS) has greatly improved the China's agricultural productivity, but with the development of market economy and the intensification of the international competition, the limitation of this institutional arrangement begins to emerge gradually. The Chinese Household Contract Responsibility System (HCRS) is characterized by the farmland fragmentation and an ultra-small scale of agricultural production, which not only increases transaction costs, but it also makes it difficult for the individual farmer to bear the enormous market risk, and then sets back the development of agricultural specialization. In this system environment, farmers begin to feel the demand of an socialized service institution, and then the supply of socialized services systems for agriculture begins to form. From the emergence of the first Chinese Rural Professional Technology Associations (RPTA) in 1980, a new type of agricultural business organizations are sprouting in China, and it is flourishing with various forms. Then the promulgation of the "Law of the People's Republic of China on Specialized Farmers Cooperatives" gave an important opportunity to the development of the Farmer Cooperative Economy Organization (FCEO), and the farmer cooperative economy organization becomes the new type of the rural management organization system which suits the rural economic and social development at this stage. The hitherto studies did not give a clear answer to these questions: Why does the farmer cooperative economy organization become the necessary organization form for the current rural production and management? Can the farmer cooperative economy organization promote the development of agricultural specialization? What characteristics of the farmer cooperative economy

organization can better promote the development of agricultural specialization?

The literature about agricultural specialization show that the development of agricultural specialization is mainly affected by the market transaction costs (Omamo 1998), price risk and market scope (Emran and Shilpi 2008), transportation cost (Winsberg 1980), material and technical resources (Ekonomiki 1968), agricultural policy (Carter and Lohmar 2002) and other factors. The literature on the farmer cooperative economy organization shows that one of the important roles of the farmer cooperative economy organization is to reduce the farmers' transaction cosst. This literatures is mainly based on the Williamson's (1985) view that transaction costs mainly come from the asset specificity, the transaction uncertainty, the transaction frequency, the number of parties of the transaction. They argue that the farmer cooperative economy organization can reduce the farmers' transaction costs through reducing the actual impact of these factors. For example, agricultural investment has a high asset specificity (Caves and Petersen 1986; Staatz 1987; Schaffer 1987; Hendrikse and Veerman 2001), the farmer cooperative economy organization can reduce the transaction cost caused by the asset specificity (Royer 1995); the farmer cooperative economy organization can better deal with the influences of uncertain factors in agricultural production, such as weather, market price, trading conditions and so on (Shaffer 1987; Fulton 1995); the farmer cooperative economy organization has a lower transaction frequency and a higher market developing ability than an individual farmer, so it can reduce the transaction risk and transaction costs, and ensure that the farmers get a relatively stable income (Sexton and Iskow 1988; Ollia and Nilsson 1997); the farmer cooperative economy organization can reduce the opportunistic behaviour in introduction new varieties, new technology and business training (Staaz 1984), and it also can produce the power of objection to the market monopoly (Bijman and Hendrikse 2003), to reduce the transaction cost. In addition, the studies have shown that the farmer cooperative economy organization can provide various services, including credit, etc., and reduce the transaction cost and improve the bargaining power of small farmers (Sharma 2007); the farmer cooperative economy organization can also achieve the agriculture industrialization by reducing the transaction cost and risk and establishing the trust of vertical cooperation (Hoeffler 2006). Contract farming or contract arrangements can enhance rural productivity via additional income and knowledge (Arumugam et al. 2010); governments' support policies (Deng et al. 2010), members' trust (Artukoglu 2008; Golovina and Nilsson 2009) also play a very important role in thethe development of farmer cooperative economy organization; the fact whether it can participate in decision-making is a key factor for farmers to participate in the farmer cooperative economy organization (Bernard and Spielman 2009). Although the current study finds that the farmer cooperative economy organization can reduce the influences of factors restricting the development of agricultural specialization, few study focus on the impact of the farmer cooperative economy organization to agricultural specialization directly. For instance, Bachev (2004, 2008) argues that the farmer cooperative economy organization promotes the development of agricultural specialization through saving transaction costs. (1956) finds that the farmer cooperative economy organization can promote the development of agricultural specialization through providing effective agricultural information to farmers. Chisholm (1979) finds that the sales-oriented farmer cooperative economy organization can promote the development of agricultural specialization. Some Chinese scholars also propose that the transaction coordination mechanism of farmer cooperative economy organization is contribute to the improvement of the degree of division of labour (Xu 2008), it is an effective way to promote agricultural specialization that development of farmer cooperative economy organization (Gao 2007). But these studies draw their conclusions only based on the description of the experience and judgments, without any theoretical and empirical test.

Therefore, under the background of the Chinese Household Contract Responsibility System (HCRS) and the development of the farmer cooperative economy organization, this paper builds a new classical economics model to prove that the generation of the farmer cooperative economy organization goes along with the evolution of the division of labour, the upgrade of farmers' utility level and the development of agricultural specialization. This paper then does the empirical test with the micro-survey data from six provinces of the rural China. So it can improve the research framework and enrich the content of the farmer cooperative economy organization and agricultural specialization. The content of this paper is as follows: the second part of this paper is a new classical economics model and the propositions deduced from it, the third part includes the empirical test of the proposition with the micro-survey data, and the last part offers the conclusions and policy implications.

THEORETICAL MODEL AND PROPOSITIONS

The basic assumption and description madel

According to the neo-classical economy (Yang 1999), this paper assumes that the farmer is both producer and consumer with same production function and time constraint in the economy. This paper also assumes that there are two agricultural products for final consumption produced and consumed in the economy, one is grain (x), the other is vegetables (y), and all farmers have consumer preferences to these two agricultural products. In order to meet consumption, farmers can produce grain (x) and vegetables (y) by themselves, or to buy them from the market, or to exchange them through the coordination of the farmer cooperative economy organization.

x, y ($x, y \geq 0$) means the amount of self-sufficiency of grain or vegetables produced by farmers as producers. x^s, y^s ($x^s, y^s \geq 0$) denotes the amount of sale (or supply) of grain or vegetables produced by farmers as producers. x^d, y^d ($x^d, y^d \geq 0$) means the amount of purchase (or demand) of grain or vegetables by farmers as consumers. So two agricultural production functions are as follows:

$$x^p \equiv x + x^s = (l_x - c_x)^{a_x}$$

$$y^p \equiv y + y^s = (l_y - c_y)^{a_y}$$

In these functions, x^p and y^p denotes the output of grain or vegetables; the parameter c_x and ($c_x, c_y > 0$) represents the fixed costs of the grain or vegetables production; a_x and a_y ($a_x, a_y > 1$) represents the economics of the specialization degree of grain or vegetables; the decision variable l_x and l_y ($l_x, l_y \geq 0$) represents the share of labour that the farmer produces grain or vegetables, namely the professional quality. Given that the total labour force of each individual farmer is equal to 1, so the endowment constraint of the individual farmer is:

$$l_x - l_y = 1 \qquad l_x, l_y \in [0,1]$$

The budget constraint of the individual farmer is:

$$p_x x^s + p_y y^s = p_x x^d + p_y y^d$$

If the agricultural products produced by farmers are traded in the market, the individual utility level can be denoted by the Cobb-Douglas utility function:

$$U = (x + kx^d)^\alpha (y + ky^d)^\beta$$

In this function, the parameter k ($k \in [0,1]$) means the efficiency of market transaction, so $1 - k \in [0,1]$

is the market transaction cost, such as transportation cost, administration fee, bargaining cost, market information gathering cost including market price and counter party, and so forth.

If the agricultural products produced by farmers are exchanged through the coordination of the farmer cooperative economy organization, the individual utility function depicted by the Cobb-Douglas function is:

$$U = (x + tx^d)^\alpha (y + ty^d)^\beta$$

In this function, the parameter $t \in [0,1]$ means the coordination efficiency of the farmer cooperative economy organization, so $1 - t$ ($1 - t \in [0,1]$) is the coordination cost. It is defined as the cost to guarantee the contract fulfilment. As we know, the farmer cooperative economy organization is based on a series of contracts between the members of it, so it will not continue to exist if these contracts are not able to be fulfilled.

The Cobb-Douglas utility function can ensure the diversity of the individual consumer's preferences, this paper uses α and β to measure the farmer's preference to grain or vegetables. Given α = β = 1, the farmer has the same preference for grain and vegetables, so the utility function can be simplified as:

$$U = (x + kx^d)(y + ky^d) \quad U = (x + tx^d)(y + ty^d)$$

Corner equilibriums of three different structure modes

According to the Kuhn-Tucker condition of the individual optimal decision-making, one farmer sells no more than one product, and does not buy, sell or self-support the same product. Based on the above assumption and description, and the Wen theorem (Wen 1998), we can analyze the following three structures to get the corner solution of each structure.

1. Autarky (A). In the mode A, farmers produce grain and vegetables for their own consumption without exchange. We can get $x^s = x^d = y^s = y^d = 0$. Therefore, the individual farmer's optimization decision is:

Max. $U_a = xy$

s.t. $x = (l_x - c_x)^{a_x}$

$y = \left(l_y - c_y\right)^{a_y}$

$l_x + l_y = 1$

In order to get the solution of it, given $\partial U_A / \partial l_x = 0$, $\partial U_A / \partial l_y = 0$

$$l_x^* = \frac{a_x - a_x c_y + a_y c_x}{a_x + a_y} \ , \quad l_y^* = \frac{a_y - a_y c_x + a_x c_y}{a_x + a_y}$$

$$x^* = \left(\frac{a_x - a_x c_y - a_y c_x}{a_x + a_y} \right) a_x ,$$

$$x^* = \left(\frac{a_y - a_y c_x - a_y c_y}{a_x + a_y} \right) a_y$$

So the maximum utility value of a individual farmer who produces grain or vegetables by himself/herself in the mode A is:

$$U_A^* = a_x{}^{a_x} a_y{}^{a_y \left(\frac{1 - c_x - c_y}{a_x + a_y} \right) a_x + a_y}$$

2. Specialized Production and Trade in Market (D).

The mode D consists of two kinds of the individual farmer's optimization decision:

(1) Farmer is specialized on the production of grain (x), sells grain (x) and purchases vegetables (y) in market. It is the decision of type (x/y). So $y = x^d = y^s = 0$, the farmer's optimal decision is:

Max $U_x = x k y^d$

s.t. $x + x^s = (l_x - c_x)^{a_x}$

$l_x = 1$

$p_x x^s = p_y y^d$

In order to get the solution of it, given $\partial U_x / \partial x^s = 0$,

$$x^{s*} = x^* = \frac{(1 - c_x)^{a_x}}{2} \ , \quad y^{d*} = \frac{(1 - c_x)^{a_x}}{2} \frac{p_x}{p_y}$$

Given $p = p_y / p_x$, that is to denote the price of vegetables with grain, so we can get the maximum utility value of the farmer who is specializing in the production of grain (x):

$$U_x^* = \frac{k}{4p} (1 - c_x)^{2 a_x}$$

(2) Farmer is specializing in the production of vegetables (y), sells vegetable (y) and purchases grain (x) in the market. It is the decision of type (y/x). So $x = x^s = y^d = 0$, the farmer's optimal decision is:

Max $U_y = y k x^d$

s.t. $y + y^s = (l_y - c_y)^{a_y}$

$l_y = 1$

$p_x x^d = p_y y^s$

In order to get the solution of it, given $\partial U_y / \partial y^s = 0$,

$$y^{s*} = y^* = \frac{(1 - c_y)^{a_y}}{2}, \quad x^{d*} = \frac{(1 - c_y)^{a_y}}{2} \frac{p_y}{p_x}$$

Given $p = p_y / p_x$, that is to denote the price of vegetables (y) with grain (x), so we can get the maximum utility value of the farmer who is specializing in the production of vegetables (y):

$$U_y^* = \frac{kp}{4} (1 - c_y)^{2 a_y}$$

According to the equilibrium condition $U_x^* = U_y^*$, we can get:

$$p^* = \frac{p_y}{p_x} = \frac{(1 - c_x)^{a_x}}{(1 - c_y)^{a_y}}$$

This relative price p^* under the equilibrium condition reveals the interaction between farmers in the Walrasian mechanism. The relative price p^* is formed exogenously in the perfect competition and free choice, the individual farmer is the taker of market price, and contacts other farmers under this relative price. The individual farmer improving the productivity or reducing learning cost will not lead to the changes of the relative price in the whole market. So farmers can have a stronger market competitiveness and a higher utility level if they can increase their productivity or reduce their learning cost. The formation of the equilibrium price under the Walrasian mechanism is decided by each farmer's free entry and exit, the single farmer's change of demand and supply, the entry or exit will not affect the overall market pricing mechanism, and it will not affect the market price, even not lead to the market failure.

So the maximum utility value of the individual farmer who is specialized in production and trade in the market in the mode D is:

$$U_D^* = \frac{k(1 - c_x)^{a_x}(1 - c_y)^{a_y}}{4}$$

3. Specialized production and coordination through the farmer cooperative economy organization (C).

Since the character of the mode C is coordination through the farmer cooperative economy organization, its essence is the strategic decision-making behaviour among the members of the farmer cooperative economy organization. Both the farmer's decision and interaction, the transaction price are determined by the Nash bargaining mechanism, therefore, we should use the Nash bargaining model to find the corner solution. Assume that there is a Nash bargaining game between two farmers. The

1st farmer is specialized in the production of grain (x), supplies grain (x) and demands vegetables (y) through the coordination of the farmer cooperative economy organization, so $y_1 = y_1^s = x_1^d = 0$; while the 2nd farmer is specialized in the production of vegetables (y), supplies vegetable (y) and demands grain (x) through the coordination of the farmer cooperative economy organization, so $x_2 = x_2^s = y_2^d = 0$. Then we can get the net income for the division of labour of these two farmers:

$$V_{1x} = U_{1x}^C - U_A = (x_1 t y_1^d) - U_A$$

$$V_{2y} = U_{2y}^C - U_A = (y_2 t x_2^d) - U_A$$

Therefore, the optimal decision of the farmer cooperative economy organization formed by two farmers is essentially the programming problem to maximize the Nash product:

$$Max\ V_C = V_{1x}V_{2y} = [(x_1 t y_1^d) - U_A][(y_2 t x_2^d) - U_A]$$

$$s.t.\quad x_1 + x_1^s = (l_{1x} - c_x)^{a_x}$$

$$y_2 + y_2^s = (l_{2y} - c_y)^{a_y}$$

$$l_{2y} = 1,\ l_{1x} = 1$$

$$x_1^s = x_2^d,\ y_1^d = y_2^s$$

$$p_x' x_1^s = p_y' y_1^d$$

$$p_x' x_2^d = p_y' y_2^s$$

Given $p'^* = p_y'/p_x'$, this relative price p'^* reveals the interaction between farmers under the Nash bargaining mechanism. Since the Nash bargaining is carried on among farmers in the farmer cooperative economy organization, the relative price p'^* is determined endogenously. Because certain cost $(1 - t)$ should be paid to ensure the performance of the contract, the coordination efficiency of the farmer cooperative economy organization is t, which is the farmers' common expectation as the members of the farmer cooperative economy organization, and the basis of the existence of the farmer cooperative economy organization which consists of a series of contracts. Only if $t > k$, the farmer cooperative economy organization will be able to replace the market to ensure the evolution of the division of labour and to increase the farmers' utility. But it must be noted that the supply and demand balance of the farmer cooperative economy organization under the Nash bargaining mechanism is only between the members. It is required by the prior contract. It will lead to the destruction of the Nash bargaining mechanism if demand and supply changes or if any of the parties exits.

So we can get the maximum utility value of the farmer cooperative economic organization in the mode C to find the solution of this optimal decision problem:

$$U_{1x}^{C*} = U_{2y}^{C*} = \frac{t(1 - c_x)^{a_x}(1 - c_y)^{a_y}}{4}$$

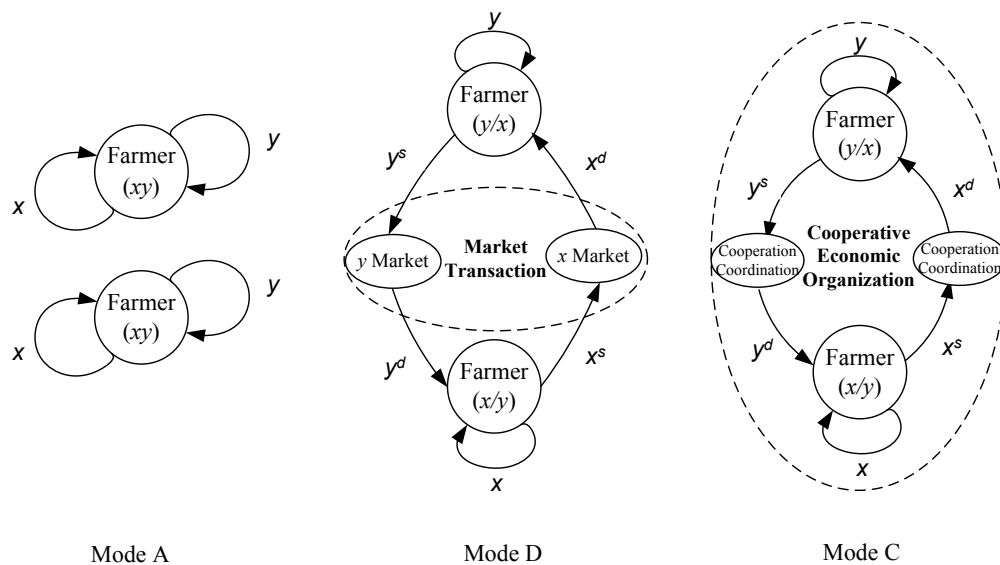These three different structure modes are shown in Figure 1.

Figure 1. Three different structure modes

Comparative static analysis and propositions

To meet $U_D^* > U_A^*$, it needs to meet:

$$\frac{k(1-c_x)^{a_x}(1-c_y)^{a_y}}{4} > a_x{}^{a_x} a_y{}^{a_y}\left(\frac{1-c_x-c_y}{a_x+a_y}\right)^{(a_x+a_y)}$$

Namely,

$$k > \left(\frac{a_x}{1-c_x}\right)^{a_x}\left(\frac{a_y}{1-c_y}\right)^{a_y}\left(\frac{1-c_x-c_y}{a_x+a_y}\right)^{(a_x+a_y)}$$

To meet $U_C^* > U_D^*$, it needs to meet:

$$\frac{t(1-c_x)^{a_x}(1-c_y)^{a_y}}{4} > \frac{k(1-c_x)^{a_x}(1-c_y)^{a_y}}{4}$$

That is, $k < t$

So we can get the generation condition of the farmer cooperative economy organization:

$$\left(\frac{a_x}{1-c_x}\right)^{a_x}\left(\frac{a_y}{1-c_y}\right)^{a_y}\left(\frac{1-c_x-c_y}{a_x+a_y}\right)^{(a_x+a_y)} < k < t$$

Then we can get the following proposition:

Proposition 1. When the market transaction efficiency is high enough, the economic structure will develop from the self-sufficient natural economy to the division of labour gradually. Because the transaction coordination efficiency of the farmer cooperative economic organization, which is formed through a series of contracts and on the principle of reciprocity, is higher than the market transaction efficiency, the farmer cooperative economic organization can promote the economic structure development from the division of labour organized by the market to the division of labour coordinated by the cooperative organization further, and it leads to the farmers' higher utility level.

To get the marginal value of the generation of the farmer cooperative economy organization and the evolution of the division of labour, given

$$k_0 = \left(\frac{a_x}{1-c_x}\right)^{a_x}\left(\frac{a_y}{1-c_y}\right)^{a_y}\left(\frac{1-c_x-c_y}{a_x+a_y}\right)^{(a_x+a_y)}$$

Given $a = a_x = a_y$, we can get:

$$\frac{\partial k_0}{\partial a} < 0$$

It shows that the greater a, the smaller k_0, that is, the lower the threshold to meet $k_0 < k < t$, which means the evolution of the division of labour through the transaction coordination by the farmer cooperative economic organization, namely, the easier the farmer cooperative economic organization generates. So we can get the following proposition:

Proposition 2. The higher degree of the economics of specialization the farmer specialized on the production of certain agricultural product has obtained, the easier the farmer cooperative economic organization generates. It can help the farmer to get more benefit of the economics of specialization to coordinate the division of labour by the farmer cooperative economic organization, and then to promote the development of agricultural specialization.

EMPIRICAL TEST

This article uses the micro-survey data from 6 provinces of the rural China to do the empirical test on these two theoretical propositions.

DATA SOURCE

The data is from the survey by the "Agriculture Regional Specialization" research group in 2010. The

Table 1. Distribution of sample counties (cities or districts)

Province (city)	Sample counties (cities or districts) distribution
Chongqing	Bishan County, Jiangbei District, Nanchuan District, Qijiang County, Fuling District, Rongchang County, Shizhu County, Wanzhou District, Hechuan District, Beibei District
Yunnan	Mengzi County (Honghe Autonomous Prefecture), Jianshui County (Honghe Autonomous Prefecture), Mile County (Honghe Autonomous Prefecture), Eshan County (Yuxi City)
Sichuan	Shuangliu County (Chengdu City), Emeishan City (Leshan City)
Guizhou	Kaiyang County (Guiyang City), Xifeng County (Guiyang City), Shuicheng County (Liupanshui City)
Hebei	Longhua County (Chengde City)
Gansu	Qinzhou District (Tianshui City)

Note: The place in brackets is the prefecture-level city of the sample counties (cities or districts)

questionnaire consisted of three parts, the household questionnaire, the organization questionnaire and the village questionnaire. The content of the household questionnaire is made up of the farmer's basic information, production and management (including the farmers' desire and behaviour regarding the specialized production, household income, etc.), the participation in the farmer cooperative economy organization and so forth; the organization questionnaire includes the basic situation, management, services of the farmer cooperative economy organization and so on; the village questionnaire is composed of the village's basic condition (including the production and management, infrastructure, etc.), the development of the farmer cooperative economy organization in the village and so on.

The research group modified the questionnaire after the pre-survey in Chongqing City June 2010. Then the research group surveyed formally in the Chongqing City, Yunnan, Guizhou, Sichuan, Hebei, Gansu province in order to reduce the regional difference from July to September 2010. The research group use the stratified random sampling survey method to select randomly the villages which have the farmer cooperative economy organizations among 6 provinces, and then to select 1 or 2 farmer cooperative economic organizations in each village, and then to select 5 to 10 farmers who participated in the farmer cooperative economy organization and 5 to10 farmers who did not participate in the farmer cooperative economy organization in each village. Finally, the research group got 465 valid questionnaires, including 25 village questionnaires, 45 organization questionnaires and 395 farmer questionnaires. The distribution of sample counties (cities or districts) is shown in Table 1.

Variables selection and measurement

To test the proposition 1, this paper studies the factors impacting the farmers participation in the farmer cooperative economy organization. So the dependent variable is whether the farmer participated in the farmer cooperative economy organization. The variable value which equals to 1 indicates that the farmer participated in the farmer cooperative economy organization. The independent variables include the division of labour between the household members, that is, whether the household member is a migrant worker; the household labour and the land endowment, such as the household labour force, the household farmland area, the household farmland transfer; and the farmer's demographic characteristics, such as age, gender, years of education, whether he/she is a member or the head of the household.

To test the proposition 2, this paper studies the impact of the farmer cooperative economy organization to agricultural specialization. Bachev (2008) pointed out that agricultural specialization is to produce specific agricultural products such as the livestock, fruits, grains, or work in a specific part of agricultural production, such as plant protection, harvesting and sales. The farmers' agricultural specialization desire is defined by whether the farmer will reduce the number of varieties of agricultural production. This variable value equaling to 1 means that the farmer will reduce the number of varieties of agricultural production. The farmers' agricultural specialization behaviour is defined by two aspects: one is the commercialization rate of the farmer's agricultural products, since the specialization caused by the division of labour is opposite to self-sufficiency; the other one is the division of agricultural production process link, which means whether the farmers reduced the link of their agricultural production process through hiring workers. The bigger the value of the variable of the farmers' agricultural specialization behaviour, the higher the degree of agricultural specialization. The main independent variable is whether the farmer participated in the farmer cooperative economy organization. In addition, this paper selects the household level control variables such as gender, age, whetherhe/she is a member or the head of household, whether the household member is a migrant worker, the number of the household labour and the household member who has a junior high school education, the per capita agricultural income and the farmland area, the household farmland transfer; and it also selects the village level control variables, such as the distance from the village to the market, whether the village provides information, if it helps farmers to bargain for the price of agricultural products.

Model specification

Because the dependent variable is whether the farmer participated in the farmer cooperative economy organization, the value of it is only 0 or 1,and we should build the following Probit model to verify the proposition 1:

$$y^* = \beta'x + \varepsilon, \ Y = 0, \ y^* \leq 0, \ Y = 1, \ y^* > 0$$

In this model, y is the variable of whether the farmer participated in the farmer cooperative economy organization; x is a vector which includes the main independent variable and other control variables.

This paper sets three different regression models according to three different dependent variables to verify the proposition 2.

Because the value of the dependent variable of the farmers' agricultural specialization desire is 0 or 1, this paper builds the following Probit model:

$$y^* = \beta'x + \varepsilon, \; Y = 0, \; y^* \leq 0, \; Y = 1, \; y^* > 0$$

In this model, y is the variable of the farmer's agricultural specialization desire; x is a vector which includes the main independent variable of whether the farmer participated in the farmer cooperative economy organization and other control variables.

Because the value of the dependent variable of the commercialization rate of the farmer's agricultural products is continuous, this paper builds the following OLS regression model:

$$y^* = \beta'X + \varepsilon$$

In this model, y is the variable of the commercialization rate of the farmer's agricultural products; x is a vector which includes the main independent variable of whether the farmer participated in the farmer cooperative economy organization and other control variables.

Because the value of dependent variable of the division of agricultural production process link is from 0 to n, this paper builds the following Tobit model:

$$y^* = \beta'x + \varepsilon, \; Y = 0, \; y^* \leq 0, \; Y = y^*, \; y^* > 0$$

In this model, y is the variable of the division of agricultural production process link; x is a vector which includes the main independent variable of whether the farmer participated in the farmer cooperative economy organization and other control variables.

Results of regression models

The results of the regression model to verify the proposition 1 is shown in Table 2.

The above regression results show that the household member who is a migrant worker can promote the farmer participation in the farmer cooperative economy organization significantly, which means that the division of labour between the non-agricultural and agricultural industries within the household can promote the farmer who stays in rural area and that specialized agricultural production demands cooperation, and then promotes the formation and development of the farmer cooperative economic organization. A larger per capita farmland area of the household and the household transferred in farmland can significantly promote the farmer participation in the farmer cooperative economy organization, which means the more farmland resource the farmers own, the higher the demand of specialized agricultural production, the more demand for cooperation,

Table 2. Regression model to test the proposition 1

Dependent variable: Whether the farmer participated in farmer cooperative economy organization (1 = yes, 0 = no)

Independent variables			
Head of household's gender	0.005 (0.016)	Head of household is a party member	0.906*** (2.953)
Head of household's age is 45–50 (under 45 as reference group)	−0.176 (−0.888)	Household member is a migrant worker	0.013* (0.081)
Head of household's age is 50–75	0.135 (0.710)	# of household labour force	−0.043 (−0.569)
Head of household's age is over75	1.021* (1.700)	# of member has over senior high school education	−0.090 (−0.805)
Head of hh's education is primary school (illiteracy as reference group)	−0.087 (−0.267)	Per capita agricultural income	0.427** (2.020)
Head of household's education is junior high school	0.443 (1.346)	Per capita farmland area	0.210*** (3.768)
Head of household's education is senior high school	0.711* (1.765)	Farmland transfer in	0.535*** (3.198)
Head of household's education is over junior college	0.966 (1.144)	Farmland transfer out	−0.191 (−0.874)
Constant	−0.822 (−1.637)	Obs	395
		R^2	0.225

*, **, *** means significant in 10%, 5%, 1% level respectively

which can promote the formation and development of the farmer cooperative economy organization. So farmers will organize the division of labour through the farmer cooperative economy organization on the basis of thedemand for saving transaction costs, and getting a higher benefit from the division of labour. So only if the efficiency of the organization coordination is higher than the market transaction, the farmer cooperative economy organization will grow up and attract more farmers to join in.

The results of the regression models to test the proposition 2 is shown in Table 3.

Based on the above results of three regression models, we can draw the conclusion that the farmers participation in the farmer cooperative economy organization can significantly promote the farmer's desire and behaviour of the specialized agricultural production. In the first model, the increase of the household per capita farmland area and the transfer in farmland can significantly increase the willingness of the farmer's specialized agricultural production. In the second model, the increase of the number of the household labour, the per capita agricultural income and the transfer in farmland can significantly increase

Table 3. Regression model to test the proposition 2

Variables	Model 1 (agricultural specialization desire)	Model 2 (commercialization rate)	Model 3 (division of agricultural production process link)
Whether joined in organization	0.607** (2.450)	9.276*** (3.143)	1.337*** (4.283)
Head of household's gender	−0.337 (−0.671)	−0.554 (−0.095)	0.875 (1.366)
Head of household's age	−0.043 (−0.587)	0.457 (0.521)	0.108 (1.121)
Square of head of household's age	0.000 (0.221)	−0.007 (−0.760)	−0.001 (−1.322)
Whether he/she is a party member	0.178 (0.413)	3.563 (0.756)	0.616 (1.381)
Whether he/she is a migrant worker	0.022 (0.088)	−10.421*** (−3.535)	0.107 (0.356)
# of household's labour force	−0.007 (−0.053)	3.156** (2.062)	−0.023 (−0.142)
# of household member over junior high school	0.226 (1.370)	−0.182 (−0.094)	0.321 (1.642)
Per capita agricultural income	0.210 (0.711)	4.932** (2.540)	0.131 (0.721)
Per capita farmland area	0.155** (2.045)	−0.027 (−0.094)	0.106*** (4.067)
Whether transfer in farmland	0.556** (2.034)	14.024*** (4.469)	0.721** (2.314)
Whether transfer out farmland	−0.169 (−0.511)	−8.767** (−2.318)	0.269 (0.706)
Distance from village to market	0.047** (1.989)	1.215*** (5.441)	−0.001 (−0.026)
Whether village provides information	0.187 (0.544)	6.871* (1.699)	−0.102 (−0.250)
Whether village bargains	0.358 (1.457)	0.980 (0.343)	0.864*** (3.014)
Constant	0.606 (0.334)	34.348 (1.583)	−5.022** (−2.083)
Obs	386	386	386
R^2	0.139	0.274	0.101

*, **, *** means significant in 10%, 5%, 1% level respectively. There are 386 valid samples after merge because of the missing data in the village samples

the commercial rate of the farmer's agricultural product. In the third model, the increase of the number of the household members who have passed the junior high school education, the per capita farmland area and the transfer in farmland can significantly promote the division of the agricultural production process link. These results all show that the farmer who has more farmland and labour endowments can promote agricultural specialization. In addition, the first and second model show that the distance from the village to the market can promote the farmer's agricultural specialization desire and the commercialization rate of agricultural products. It is consistent with the results of the former literature. In the second model, the village providing the market and technical information to farmers can significantly increase the farmer's commercialization rate of agricultural products, in the third model, the villages helping farmers to bargain can significantly promote the farmer's division of the agricultural production process link. These results show that the village can help farmers to save transaction costs through providing the market and technical information and bargaining, and then helping farmers to obtain more benefits from the division of labour. Therefore, these three models verify the proposition that the farmer cooperative economy organization can promote the development of the agricultural specialization from three different aspects.

CONCLUSIONS AND POLICY IMPLICATIONS

Under the background of the Chinese Household Contract Responsibility System (HCRS), the farmers' trading only through market should pay higher transaction costs, which sets back the development of agricultural specialization, while the farmer cooperative economy organization formed by a series of contracts and on the principle of reciprocity can reduce transaction costs, so it is the valid way to promote the development of agricultural specialization through the development of the farmer cooperative economy organization. This paper builds a neo-classical economy model to propose two propositions: First, when the market transaction efficiency is high enough, the economic structure will evolve from the self-sufficient natural economy to the division of labour gradually. Because the transaction coordination efficiency of the farmer cooperative economic organization, which is formed through a series of contracts and on the principle of reciprocity, is higher than the market transaction efficiency, the farmer cooperative economic

organization can promote the economic structure evolution from the division of labour organized by the market to the division of labour coordinated by the cooperative organization further, and lead to the farmers' higher utility level. Second, the higher degree of the economic specialization the farmer specialized in the production of a certain agricultural product has obtained, the easier the farmer cooperative economic organization is generated. It can help farmers to get more benefit from the economics of specialization to coordinate the division of labour by the farmer cooperative economic organization, and then to promote the development of agricultural specialization. Then this paper builds regression models with the micro-survey data from 6 provinces of the rural China to verify these two theoretical propositions. Therefore, this article gets to the conclusion that the farmer cooperative economy organization formed by a series of contracts and on the principle of reciprocity can coordinate the transaction validly among farmers who are specialized in agricultural production, to reduce the farmers' transaction risk, to protect the farmer' household safety, to help farmers get more benefits from the economics of specialization, and thus to promote the development of agricultural specialization.

The policy implications of this study are as follows: First, the farmer cooperative economy organization on the principle of reciprocity is an effective organization form under the current Chinese Household Contract Responsibility System (HCRS). It can reduce transaction costs through the coordination of trade and promote the evolution of the division of labour and then help farmers to get a higher real income. So the government should take measures to develop the farmer cooperative economy organization. It can organize the dispersive small farmers to save transaction costs, to obtain the benefits from agricultural specialization and scale, to realize the effective convergence between small farmers and the large market. Second, the important goal and direction of the farmer cooperative economy organization development is to promote the development of agricultural specialization. It should enhance the farmers' capacity of the specialized production and anti-risk, and improve the farmers' bargaining position, to help farmers to get more net income from the division of labour through providing the help to farmers on agricultural production and operation, such as providing the market and technical information, helping farmers in bargaining on the purchase of agricultural resources and sales of agricultural products and so on. Third, the formation and development of the farmer cooperative economy organization should be based on the labour force and farmland endowments which the farmers have.

So, on one hand, the government should provide the agricultural professional and technical training to improve the farmers' labour quality; on the other hand, the government should improve the rural labour market to protect the rational and effective flow of rural labour; and the government should focus on protecting the farmland, and developing the farmland transfer market to allocate the farmland optimally. So the good institution and market environment can ensure the development of the farmer cooperative economy organization and agricultural specialization, and promote the development of rural economy.

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