Emerging Agricultural Cooperatives and The Structural Change of Crop Production in China

H. Liu[1]; H. Deng[2]; Z. Xu[3]; W. Lu[3]

1: University of Waterloo, , Canada, 2: Fujian Agricultural & Forestry University, , China, 3: Nanjing Agricultural University, , China

Corresponding author email: h445liu@uwaterloo.ca

Abstract:

With the rapid development of agricultural cooperatives in China, a substantial number of them exist without any operation or service. To identify the true impact of agricultural cooperatives on crop production, we ought to parse out cooperatives that were registered but do not function properly. This paper analyzes the role of agricultural cooperatives in changing crop production structure in rural China, focusing on their status of activity. The data are from village surveys in three provinces (Jiangsu, Jilin, Sichuan) collected by the authors in years 2003, 2009 and 2014. Results show that agricultural cooperatives do not affect the production of grain crops, but do increase the size and share of farmland allocated to high-value crops. The effect only manifests in villages with well-functioning cooperatives. This indicates that strict monitoring system and incentive mechanisms need to be implemented to improve the performance of the cooperatives.

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JEL Codes: Q18, C13

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Keywords: Agricultural Cooperative; Production Structure; Impact Evaluation; China

JEL Classification: Q13, Q18, C13, Q15

1. Introduction

In the past three decades, China's agricultural GDP increased at an average annual rate of 3.98% (World Bank 2017b), which is five times that of the national population growth (Figure 1) (World Bank 2017a). While industrialization and urbanization has led to substantial population and labor outflow from agriculture, the Chinese agricultural sector is still dominated by very small farms with less than one hectare of land. Ji et al. (2016) showed that the average operational farm size was merely 0.68 hectare in 2013 for households with farming in rural China. The relationship between farm size and labor productivity is not clearly established (Fan and Chan-Kang 2005), however, increased farm size is definitely associated with higher income (Adamopoulos and Restuccia 2014). Besides, smallholder farming is vulnerable to numerous risk, including pest and disease outbreaks, extreme weather events and market shocks (Harvey et al. 2014) and non-climate-related stressors (Morton 2007) which often undermine farmers' household food security.

To manage the risk associated with smallholder farming and improve the agriculture-food system, Chinese government has strongly encouraged the development of agricultural cooperatives or farmers' professional cooperatives (FPCs) throughout the country over the past 15 years. Many policies have been issued to support the development of FPCs lately, particularly the release of Farmers' Professional Cooperative Law in 2006 which became effective from July 1st, 2007. By the end of November 2017, total number of registered FPCs reached 1.99 million with

a capital investment of more than 110.44 billion RMB (Zhang 2018). Meanwhile, some concerns have emerged regarding the impacts of agricultural cooperatives in China. Particularly, researchers wonder whether FPCs will contribute to the transition of China's agriculture to a high-value-crop dominating agriculture, and what are the possible impacts of FPCs on China's grain production and food security. Answers to these questions not only have important implications for China, but also for the rest of world in the era of globalization.

Existing literature on China's agricultural cooperatives are mainly qualitative research and focus on understanding their development path and structure. Deng et al. (2010) and Garnevska et al. (2011) analyzed the factors for agricultural cooperatives and found that policy support measures and, most likely, the new legal setting in China after the issue of the 2006 Farmers' Professional Cooperatives Law, accounted for most of the growth of FPC. Huang et al. (2008), Bijman and Hu (2011), and Xiangping et al. (2012) summarized the services provided by the cooperatives which are primarily supplying members with inputs for agricultural production and marketing farm products. Using a household survey data from Jilin province, Zheng et al. (2012) found that educational attainment, risk comfort level, farm expansion, operational costs, geographic location and crop types are significant factors that influence producers' perception of cooperatives and their participation behavior.

On the other hand, the impacts of Chinese farmers' cooperatives have rarely been investigated, especially on agricultural production and its structure. Ito et al.

(2012) examined the treatment effects of agricultural cooperatives on watermelon-producing farm's income in rural Nanjing. Ma and Abdulai (2016) found that cooperative membership exerts a positive and significant impact on apple yields, farm net returns and household income from three provinces in China: Gansu, Shaanxi, and Shandong. Given that there are a substantial number of cooperatives that do not really operate (Pan 2011), using data from a single sector would likely bias the real impact. Liao et al. (2016) analyzed the income distribution effects of agricultural cooperatives on China's smallholders producing vegetables and fruits. However, there has not been any research studying how farmers' specialized cooperatives affect agricultural production and its composition in China.

This paper aims to evaluate the impacts of agricultural cooperatives on the structure of crop production in China's rural villages. To address limitations in available data, the authors conducted village surveys in three provinces over the years 2003 – 2014. Based on data from three rounds of national survey of 302 villages, we find that farmers' cooperatives aid in the transition of China's agriculture to a mode where cash crops account for a large proportion of agricultural products.

The article proceeds as follows. The next section describes the conceptual framework. Section 3 introduces the sampling methods and the data collection process. In Section 4, we present a descriptive analysis of the evolution of agricultural cooperatives and crop production during our sample period. Section 5 explains the

empirical model and reports the quantitative results. Finally, we conclude with our major findings in Section 6.

2. Conceptual Framework

Institutional innovations such as agricultural cooperatives can play a crucial role in helping farmers overcome market failure, achieve economies of scale, and strengthen bargaining power (Hazell et al. 2010). Therefore, FPCs are deemed as a strategy to upgrade smallholder' production and enhance their competitiveness in markets, and there are three possible explanations of the effectiveness of this strategy. The first is that participation in FPCs can give smallholders' access to markets of high-value crops. With deeper urbanization and higher income, people's dietary pattern shifts from staple grains dominated towards more balanced diets, with the demand for high-value crops such as vegetables and fruits increasing significantly. High-value crops are generally sold in urban areas where market access is difficult for smallholders, thus, farmers' collective action can reduce transaction cost and achieve economies of scale. Agricultural cooperatives can also act as information dissemination centers by sharing market condition with their members to reduce smallholders' information searching costs and the extent of information asymmetry. Besides, smallholders are vulnerable to market risk associated with high-value crops due to their disadvantaged position along the value chain. Agricultural cooperatives, however, can stabilize the price by contracting with downstream buyers (Guo and Jolly 2008).

Second, when production focus changes from staple grains to high-value crops, farmers need to adopt new technologies which can be taught by agricultural cooperatives along with extension services (Abebaw and Haile 2013, Francesconi and Heerink 2010, Verhofstadt and Maertens 2014). Considering the perishable nature of high-value crops, consumers tend to impose more stringent food safety standards on these crops and cases in which smallholders fail to meet these requirements have been well documented (Ghezán et al. 2002). Better management and quality control such as cold storage and processing services are needed and farmers' cooperatives can make it possible by reducing the average cost during and after production (Narrod et al. 2009).

Third, reputation and consumers' trust are of extreme importance in selling high-value crops. Branding the products to assure quality is a common practice for FPCs to achieve price premium and sales expansion (Gruère et al. 2009). In an informal market full of smallholders, it is difficult for consumers to distinguish the products, while products in the name of well-known agricultural cooperatives bear certain credibility. This practice often needs skills of corporate management which smallholders do not possess (Narrod et al. 2009), hence, FPCs could help farmers market their high-value crops. Theoretically, grain products are undifferentiated commodities with low price volatility, and the supply chains are characterized with low transaction costs, consequently, the benefits of farmers' organization do not outweigh the organizational costs (Berdegué Sacristan 2001). However, Coulter

(2007) argue that there are certain agricultural cooperatives that have successfully helped farmers market their grains and root crops. It seems that whether FPCs could stimulate farmers' grain production is still an empirical issue.

3. Data

This study uses a unique panel data collected by the authors in 2003, 2009 and 2014. At the end of 2003, we conducted the first round of survey in 6 provinces (Jilin, Shaanxi, Gansu, Hebei, Jiangsu, Sichuan) and 36 counties in a nearly nationally representative sample. We further selected our villages using the following process in each of the sample county. Six counties were selected from each province, two from each tercile of a list of counties arranged in descending order of gross value of industrial output per capita (GVIO/capita). GVIO/capita was used on the basis of the findings in Rozelle (1996) that GVIO is one of the best predictors of standard of living and development potential, often making it more reliable (in a statistical sense) than net rural per capita income (although it is highly correlated with per capita income; the correlation coefficient between per capita GVIO and per capita rural income is higher than 0.75). Within each county, we also chose six townships, following the same procedure as the county selection. When our enumerator teams visited each of the 216 townships (6 provinces × 6 counties × 6 townships), officials asked each village to send two representatives (typically the village leader and accountant) to a meeting in the township. On average, enumerators surveyed 11 villages in each township. In total, we collected data from 2,459 villages.

In the 2009 survey we conducted a second round of data collection in 380 villages, all of which were chosen from the previous 2,459 villages that were surveyed in 2003. We reduced the sample size of the villages because in the second round we wanted to conduct intensive interviews with the FPC managers in addition to repeating the village leader survey. The detailed survey procedure regarding the subsample selection and questionnaire design can be found in a series of research papers by Deng and his colleagues (Deng et al. 2010). Within the selected towns, as before, we surveyed all the villages to ensure that we include all the cooperatives. In total, the second-round survey in 2009 covered five provinces (Jilin, Shaanxi, Hebei, Jiangsu, Sichuan), fifteen counties, thirty townships and 380 villages.

The third-round survey was implemented in 2014. With the rapid development of FPCs in most area of each province, it is a huge challenge to conduct a wide extensive filed survey considering human resources and budget. Thus, we chose three provinces (Jiangsu, Jilin and Sichuan) following the preceding survey, each representing one agro-ecological region. Jilin represents agricultural provinces with abundant natural resource, Jiangsu represents developed provinces with vast off-farm opportunities and high population intensity, and Sichuan represents underdeveloped provinces with less local off-farm opportunities and abundant migrant labor. In total, the third round of the survey in 2014 collected data from three provinces, nine counties, eighteen townships and 302 villages.

The survey procedure in 2014 regarding the FPCs was almost the same as that in the 2009 survey. In addition to questions on economic, political and demographic conditions of the villages in the previous year, we also asked the respondent if there was an FPC in their village. If the answer was "yes, there is an FPC in our village", we asked the respondents to list all the FPCs in their village and answer a set of questions about the main activities of the FPCs. The questionnaire elicited information on the size of the FPCs, its coverage, its main functions, information about its charter, registration rules and internal organization. The survey also asked how the actions of government agencies affected the start and operation of the FPCs.

After completing the survey with village leaders (during which we gathered general information about villages and their economic/policy environment), we made appointments with the managers of every FPC in all the 302 villages. In total, we interviewed 500 cooperative managers and collected information on the start-up of the FPC, its management style, governance structure, finance, and business activities.

4. Agricultural Cooperatives and Crop Production in Rural China

4.1 Development of Agricultural Cooperatives Over Time

Figure 2 shows the evolution of the number of agricultural cooperatives over the years 2003 – 2013 in our sample, including all types of agricultural cooperatives. Before 2003, there were only 10 registered agricultural cooperatives in all the 302 villages in Jilin, Jiangsu, and Sichuan. This number increased to 73 in 2008, and 500 in 2013, a 600% increase. At the village level, our sample data shows that there were 1.3 FPCs

on average in each village during 2008-2013 while only 0.19 cooperative existed in a village in 2008. Policy support, especially the issue of Farmers' Professional Cooperative Law in 2007, has been widely acknowledged as the main driver of such exponential growth in rural China (Bijman and Hu 2011, Deng et al. 2010). The strong policy support of the National Committee resulted in some provinces even listing the development of FPCs as one of the indicators when evaluating local official's political performance. During the survey, we found that some village leaders registered FPCs without any entity, only to fulfill the assessment tasks assigned by government officials of higher levels. Although these cooperatives are registered with the local Bureau of Industry and Commerce, they do not have established offices, and some have yet to come up with a brand name. Some FPCs are simply intermediary organizations, engaged in technical services or logistics, and do not have the economic capabilities to engage in business.

However, establishing a viable organization is a complex task, and numerous failures of developing an agricultural cooperative have been documented worldwide (Key and Runsten 1999, Pan 2011). In addition to political factors, there are many inherent challenges of successfully managing a farmers' cooperative, such as the difficulty of establishing collectively agreed rules, implementing the rules, as well as monitoring and enforcing compliance (Hellin et al. 2009). Therefore, the numbers of agricultural cooperatives in Figure 2 should be interpreted with caution since they include all FPCs that were registered, regardless of their status of activity.

To identify active FPCs, we evaluate their functions from three aspects. First and foremost, we look at the marketing services provided by the FPC, where we check whether the FPC normally acts as a commissioner to gather farmers' products and sell them collectively or not. Second, we check whether the FPC provides technical assistance in helping farmers select new variety, control diseases, and manage the quality of the products. Finally, we inspect if the cooperative provides input factors since cooperatives with large groups of members can buy inputs (e.g. seeds and fertilizers) from upstream suppliers or even manufacturers at a wholesale price. During the survey, we found that almost 50% the cooperatives in our sample did not provide any service, meaning that they simply registered with the government without real operation. We believe that these FPCs have no impact on agricultural production and need to be excluded to attain the genuine effects. Considering that our main interests are crop production and its structural change, we only include crop cooperatives in further analysis. In total, we have a sample of 138 crop FPCs that were actively operating.

Table 1 shows the types of crop cooperatives in the 302 villages sampled from Jilin, Jiangsu, and Sichuan over time. In 2003, there were only three cooperatives providing services to the production of flowers, fruits and other minority crops. The number increased to 32 by the end of year 2008 and half of them were in the sectors of grain, vegetables, and tea and medicine. Grain and fruit cooperatives each account for 28% of the total, followed by vegetables cooperatives with a 19% share. By the

end of year 2013, there were 138 crop cooperatives in the 302 villages. In addition to the change in the number of cooperatives, the distribution of them across sectors also changed dramatically. 58% of the crop cooperatives in 2013 offered services to grain production, 12% each were consisted of vegetable and fruit farmers, and less than 2% of them were in the tea and medicine industry.

4.2 Production Structure and FPCs at Village Level

In this paper, we group all crops into three categories: grains, high-value crops, and other crops. Grains include cereals, tuber crops, and beans (mainly soybean). High-value crops are vegetables, fruits, tea trees, and flowers and nursery plants. Most of the high-value crops are horticultural crops which are increasingly demanded in China in recent years with the rising household income. Other crops are all crops except grains and high-value crops. In our sample, they are mostly cotton, peanut and rapeseed. Table 2 displays the composition of agricultural production in all villages between 2003 and 2013. As expected, most of the land was for grain production with a share of the crop sown area being 82%. This percentage decreased slightly during 2003 - 2008, and then increased back to 83% by 2013. High-value crops accounted for a small part of the sown area, however, the share increased steadily from 3% to almost 6% during the 10 years. Other crops on average constitute 14% of the growing area, and the share changed in an inverse U shape.

Table 3 describes the structural change of crop production in our sample villages by the existence of farmers' cooperative. The share of grain sown area in

villages with agricultural cooperatives is larger than that in villages without cooperatives, however, the difference is not statistically significant even at 10% level. For high-value crops, the sown area in villages with FPCs was 5.74% over the years 2003 - 2013, while that in villages without FPCs was only 4.12%. A t-test shows that the former is statistically larger than the latter. Also, the proportion of farmland used for other crops (mainly cotton, peanut and rapeseed) in villages with farmers' cooperatives is significantly smaller than that in villages without cooperatives. Together, it seems that the existence of agricultural cooperatives and the composition of crops grown in a village might be correlated. We further test this relationship with an econometric model.

5. Econometric Model, Estimation and Results

5.1 Econometric model

As hypothesized in the conceptual framework, China's changing dietary pattern demands more high-value crops including fruits and vegetables and less grain products, therefore, we focus on the impacts of farmers' cooperatives on the production of these two types of crops in this section and use an econometric model to test the statistical significance. Considering that there were very few cooperatives founded before and in 2003, we only use data collected in 2009 and 2014 for the model estimation[1]. Data in 2003 is also used to create lagged terms which we explain

[1] In the 2003 survey, we asked information for the year of 2003. In the 2009 and 2014 surveys, we asked information of the previous year, that is year 2008 and 2013.

later. Based on the two rounds of surveys, we create a panel data of 302 villages. The econometric model is specified as:

$$Y_{cit} = \alpha + \beta \times FPC_{cit} + \gamma \times \boldsymbol{X}_{it} + \mu_p + v_t + \epsilon_{it} \qquad (1)$$

In equation (1), Y_{cit} is the share of sown area for crop *c* (grain and high-value crops) in village *i* in year *t*. We also estimate a model where the dependent variable is the absolute sown area. FPC_{cit} is the number of FPCs for crop *c* in village *i* in year *t*, used to measure the status of the cooperatives' development in a village. $\boldsymbol{X}$ is a vector of explanatory variables. It includes the average farm size in the village to control for the village's land endowment, share of off-farm labor to control for off-farm employment, distance between the village office and the nearest highway entrance to measure infrastructure condition, distance between the village office and the town office to measure the location advantage of each village, and the number of agricultural brokers in the village to measure the village's business environment and people's awareness of market information. Because off-farm employment might be endogenous, we lag it by 5 years. We also include a province fixed effect μ_p to control for any time-invariant unobservable characteristics at the province level, and a temporal fixed effect v_t indicating the year of the survey to control for time-varying unobservables at the macro level. ϵ_{it} is the idiosyncratic error term. The parameters to be estimated are α, β, and γ. Table 4 displays the summary statistics of the dependent and independent variables.

Before estimating the model, several empirical issues need to be addressed. First, there might be reverse causation between the production structure and the number of agricultural cooperatives of a certain type. The development of FPCs can cause agricultural production structure to change, meanwhile, the production scale of certain crops can affect the founding of certain FPCs. One solution is to use IV estimation. However, a highly efficient instrument variable is not available in our case. Thus, we use the lagged number of FPCs instead, that is the number of FPCs in the village three years ago. We choose three years because there were very few crop cooperatives in our sample villages before 2005. Another potential issue is corner solution since there were no farmers cultivating grain or high-value crops in some villages. We use Tobit model to address this concern.

5.2 Results

We estimate model (1) with a panel data collected in 2009 and 2014 from 302 villages in Jilin, Jiangsu, and Sichuan provinces, controlling for year and province fixed effects. Results are presented in Table 5. The marginal effect of the number of cooperatives on the share of grain sown area is not statistically significant, however, there is a significant and positive relationship between high-value crop cooperatives and the share of high-value crop sown area. This suggests that high-value crop cooperatives are more effective at changing crop producing structure, consistent with existing studies regarding the heterogeneity effect of different types of FPCs on the performance of smallholders. Hellin et al. (2009) and Bernard and Spielman (2009)

show that agricultural cooperatives could play a fundamental role in improving smallholders' production performance and the impacts on high-value crops such as horticultural crops are much larger than that on low-value crops.

Results on the control variables are also consistent with expectation. Average farm size is negatively associated with the share of high-value crop sown area. This might be because high-value crops such as vegetables and fruits are normally labour-intensive and farmers with large farms often lack the labor in operating the farms. The share of off-farm labor five years ago has a significant and positive impact on the share of grain area while a significant and negative impact on the share of high-value crop area. This result is in line with former studies who found that off-farm employment or migration reduces the likelihood and intensity of the production of labor-intensive crops such as vegetables and fruits since grain crops could be easily mechanized while horticultural crops cannot (Huang et al. 2009, Li et al. 2013). The distance to the nearest highway entrance is positively correlated with the share of grain area and negatively correlated with the share of high-value crops at 1% significance level. Such finding is consistent with existing literature regarding the effect of transportation and infrastructure conditions on farmers' producing decisions (Jacoby 2000). Brokers can help farmers get involved in the market, yet our result shows that the number of brokers has no significant impact on the share of farmland used for high-value crops and grains.

In addition to the structure of crop production, we are also interested in the impacts of agricultural cooperatives on the absolute sown area of grain and high-value crops. Results are presented in Table 6 and we can see that they are largely consistent with that for the share model in Table 5. The number of crop cooperatives has no significant impact on the sown area of grains but is significantly and positively associated with the sown area of high-value crops. Average farm size is significantly related to the grain sown area but not for high-value crops. While the percentage of off-farm labor five years ago has a significant effect on the share of grain and high-value area, it does not affect sown area itself. The impacts of village location on crop sown area is quite similar to that on the share of the sown area, besides that the closer the village is to the town office, the more farmland is used for high-value crops. With respect to agricultural brokers in the village, decisions for grain and high-value crop production are not affected at all at traditional significance levels.

6. Conclusion and Implications

In the past ten years, the number of agricultural cooperatives in rural China has increased rapidly with strong policy support both nationally and locally. However, a large number of them exist without any operation and provide no service to registered farmers. This paper analyzes the impact of crop cooperatives on the structure of agricultural production, with a focus on the status of the cooperative's activity. Using a primary panel data at the village level in 2008 and 2013 from three provinces in rural China, we find that cooperatives contribute to the expansion of high-value crops.

One additional high-value-crop cooperative in a village increases the share of farmland allocated to high-value crops by 4.21% on average. However, this effect is not significant for the growing decision of grains. This suggests that cooperatives may play an important role in transforming the traditional smallholder farming system and shifting agricultural production to be more commercial and market-oriented while not affecting grain production and food security.

Our findings have several policy implications. First, given that agricultural cooperatives have no impact on the expansion of grain crops, the intention to expand food production and strengthen food security would not be reached by promoting grain cooperatives. Therefore, we may need to rethink about the effectiveness of allocating large amount of subsidies to grain cooperatives. Second, more attention and support may be given to cooperatives that participate in high-value crop production. Our findings show that these cooperatives facilitated the adjustment of farmers' production structure. This might help increase farmers' income while meeting the huge demand for horticulture products created by the recent changes in China's dietary pattern. Third, considering that there were many registered agricultural cooperatives that do not actively operate, the development of FPCs somewhat deviates from the original intention to transform Chinese agriculture. Therefore, policy makers should be cautious in designing supporting instruments since agricultural cooperatives had been established purely to fulfill political needs.

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Table 1. Types of Crop Cooperatives in China Over Time

	2003		2008		2013	
	Number	Share (%)	Number	Share (%)	Number	Share (%)
Total Crop Cooperatives	3	100	32	100	138	100
Grain	0	0	9	28.13	80	57.97
Vegetables	0	0	6	18.75	16	11.59
Tea and medicine	0	0	1	3.13	2	1.45
Flowers and nursery stock	1	33.33	3	9.38	14	10.14
Fruits	1	33.33	9	28.13	16	11.59
Other crops	1	33.33	4	12.5	10	7.25

Notes: Calculated by authors based on survey data from 302 villages in Jiangsu, Jilin, and Sichuan.

Table 2: Production Structure Over Time at Village Level

	2003	2008	2013
Share of grain area	81.86%	79.67%	82.83%
Share of high-value area	3.32%	4.03%	5.60%
Share of other crop area	14.82%	16.30%	11.57%

Notes: Calculated by authors based on survey data from 302 villages in Jiangsu, Jilin, and Sichuan. Area of the crops is in Mu which is 1/15 of a hectare.

Table 3: Production Structure and FPCs in China During 2003 - 2013

	Villages with FPCs	Villages without FPCs	t-test
Share of grain area (%)	83.16	81.22	0.1628
Share of high-value area (%)	5.74	4.12	0.0907
Share of other crops (%)	11.10	14.65	0.0119

Notes: Calculated by authors based on survey data from 302 villages in Jiangsu, Jilin, and Sichuan. Data from the 2009 and 2014 surveys are pooled together. Area of the crops is in Mu which is 1/15 of a hectare. P-value for the two-sample t-test of the means are reported in the "t-test" column.

Table 4. Summary Statistics of Village Characteristics

	Mean	Std. Dev.	Min	Max
Dependent Variables:				
Share of grain area (%)	81.25	20.07	0	100
Share of high-value crops area (%)	4.82	12.76	0	100
Grain sown area (100 Mu)	43.75	47.12	0	745.50
High-value crops area (100 Mu)	1.42	3.79	0	39.15
Explanatory Variables:				
Number of crop cooperatives in the village	0.28	0.78	0	6
Number of crop cooperatives in the village three years ago	0.10	0.39	0	3
Average farm size (Mu)	7.33	7.44	0.17	46.36
Share of off-farm labors away from home (%)	30.69	17.37	22.84	85.00
Distance between village office and the nearest highway entrance (km)	28.04	22.85	0	150
Distance between village office and the town office (km)	30.21	21.22	5	200
Numbers of brokers in the village	9.53	25.06	0	307

Notes: Calculated by authors based on survey data from 302 villages in Jiangsu, Jilin, and Sichuan. Data from the 2009 and 2014 surveys are pooled together.

Table 5: Estimation of Shares of Grain and High-Value Crop Areas (Empty FPCs Excluded)

	Share of Grain Area	Share of HVC Area
Numbers of crop FPCs 3 years ago	-2.43	4.21*
	(1.65)	(2.36)
Average farm size	0.16	-0.93***
	(0.17)	(0.31)
Percent of off-farm labor 5 years ago	8.83**	-10.09*
	(4.20)	(6.01)
Distance to highway entrance	0.16***	-0.20***
	(0.03)	(0.06)
Distance to the county office	-0.17***	0.09
	(0.04)	(0.07)
Number of brokers in the village	-0.02	0.02
	(0.03)	(0.03)
Constant	84.68***	-0.73
	(2.69)	(3.93)
Province Fixed Effect	Yes	Yes
Year Fixed Effect	Yes	Yes
Observations	604	604
Wald Stat	200.32	42.41
Prob> Chi-Squared	0.0000	0.0000

Notes: Standard errors are shown in parentheses. ***, **, * indicate statistical significance at 1%, 5% and 10%, respectively.

Table 6: Estimation of Grain and High-Value Crop Sown Areas (Empty FPCs Excluded)

	Grain Sown Area (100 Mu)	HVC Sown Area (100 Mu)
Numbers of crop FPCs 3 years ago	-3.82	1.36*
	(3.40)	(0.74)
Average farm size	1.01***	0.02
	(0.07)	(0.02)
Percent of off-farm labor 5 years ago	-1.03	-1.23
	(6.89)	(1.80)
Distance to highway entrance	0.22***	-0.04**
	(0.06)	(0.02)
Distance to the county office	-0.18***	0.05***
	(0.07)	(0.02)
Number of brokers in the village	0.02	0.02*
	(0.05)	(0.01)
Constant	20.00***	-3.29***
	(4.98)	(1.24)
Province Fixed Effect	Yes	Yes
Year Fixed Effect	Yes	Yes
Observations	604	604
Wald Stat	726.73	30.04
Prob> Chi-Squared	0.0000	0.0004

Notes: Standard errors are shown in parentheses. ***, **, * indicate statistical significance at 1%, 5% and 10%, respectively.

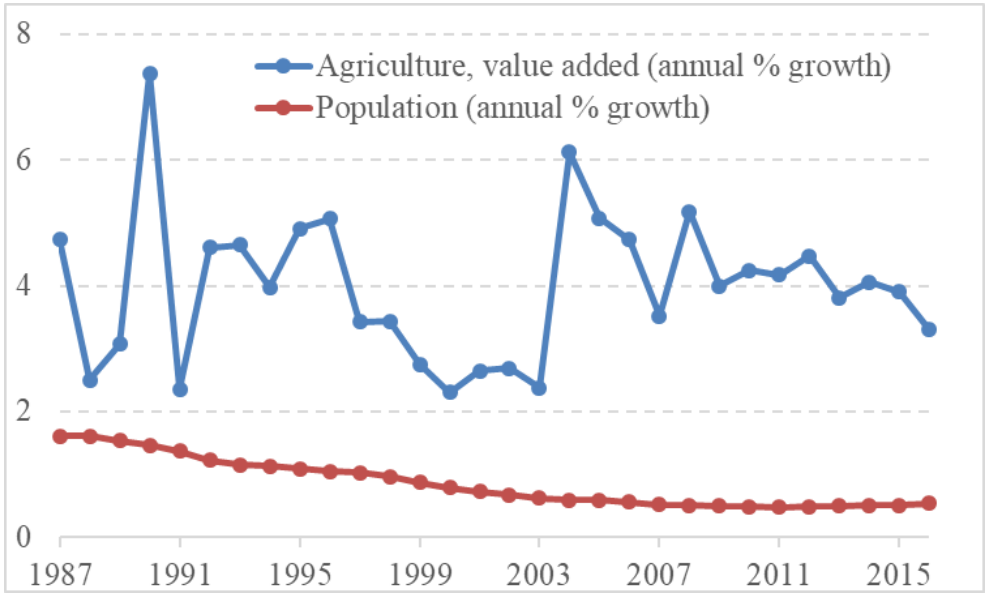

Figure 1. Agriculture and Population Growth in China Over 1987 – 2016

Source: Data on the annual growth rate of value added in agriculture is from World Bank national accounts files. Annual growth rate of population is derived from total population by the World Bank where the population source are (1) United Nations Population Division, World Population Prospects and (2) Census reports and other statistical publications from national statistical offices.

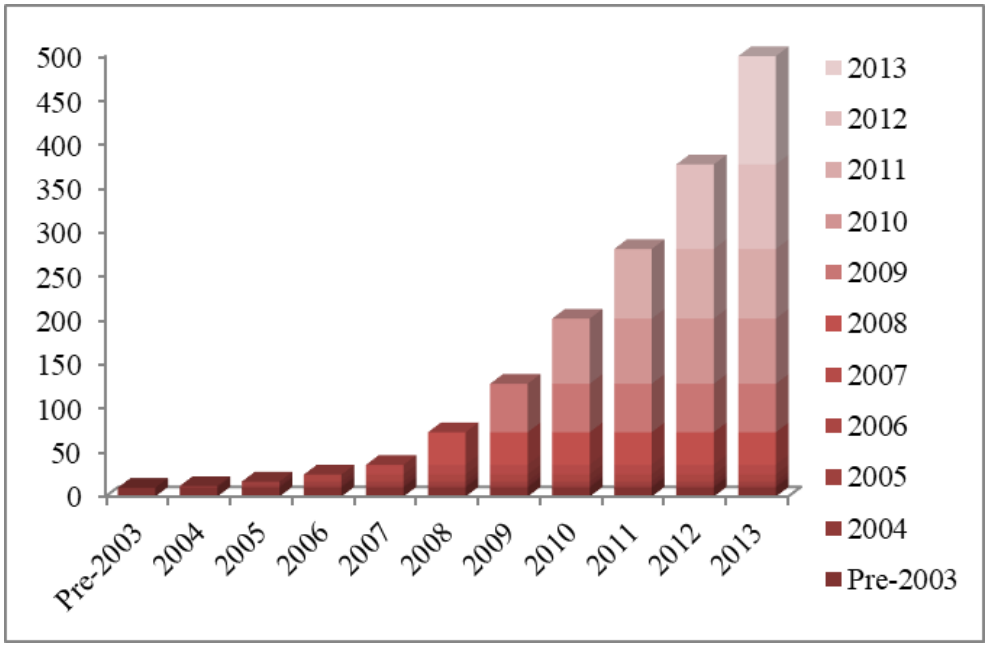

Figure 2. Accumulated Number of Agricultural Cooperatives in China by Year 2013

Source: Calculated by authors based on our survey data from 302 villages in Jilin, Jiangsu, and Sichuan. The survey collected information on when the cooperative was founded, and we use this data to calculate the number of cooperatives in each year.