INSTITUTE OF DEVELOPING ECONOMIES

IDE Discussion Papers are preliminary materials circulated
to stimulate discussions and critical comments

IDE DISCUSSION PAPER No. 578

# Participation in Farmer's Cooperatives and Its Effects on Agricultural Incomes: Evidence from Vegetable-producing Areas in China

Hisatoshi Hoken[1]

March 2016

**Abstract**

Chinese agricultural cooperatives, called Farmer's Professional Cooperatives (FPCs), are expected to become a major tool to facilitate agro-industrialization for small farmers through the diffusion of new technologies, the supply of high-quality agricultural inputs and the marketing of their products. This study compares FPC participants with vegetable-producing non-participants and grain farmers in vegetable-producing areas in rural China to investigate the treatment effect of participation in FPCs as well as implementation of vegetable cultivation. I adopt parametric and nonparametric approaches to precisely estimate the treatment effects. Estimated results indicate no significant difference between participants and non-participants of FPCs on agricultural net income in both parametric and non-parametric estimations. In contrast, the comparison between vegetable and grain farmers using propensity score matching (PSM) reveals that the treatment effect of vegetable cultivation is significantly positive for total and agricultural incomes, although vegetable cultivation involves more labor-intensive efforts. These results indicate that it is the implementation of vegetable cultivation rather than the participation in an FPC that enhances the economic welfare of farmers, due to the non-excludability of FPCs' services as well as the risks involved in vegetable cultivation.

**Keywords:** small farmers, agricultural cooperatives, propensity score matching, treatment effect

**JEL classification:** Q12, Q13, O13

[1]Associate Senior Research Fellow, Development Studies Center, IDE (E-mail: hoken@ide.go.jp)

The Institute of Developing Economies (IDE) is a semigovernmental, nonpartisan, nonprofit research institute, founded in 1958. The Institute merged with the Japan External Trade Organization (JETRO) on July 1, 1998. The Institute conducts basic and comprehensive studies on economic and related affairs in all developing countries and regions, including Asia, the Middle East, Africa, Latin America, Oceania, and Eastern Europe.

---



---

**INSTITUTE OF DEVELOPING ECONOMIES (IDE), JETRO**
**3-2-2, WAKABA, MIHAMA-KU, CHIBA-SHI**
**CHIBA 261-8545, JAPAN**

# Participation in Farmer's Cooperatives and Its Effects on Agricultural Incomes: Evidence from Vegetable-producing Areas in China

Hisatoshi Hoken*

March 2016

**Abstract:** Chinese agricultural cooperatives, called Farmer's Professional Cooperatives (FPCs), are expected to become a major tool to facilitate agro-industrialization for small farmers through the diffusion of new technologies, the supply of high-quality agricultural inputs and the marketing of their products. This study compares FPC participants with vegetable-producing non-participants and grain farmers in vegetable-producing areas in rural China to investigate the treatment effect of participation in FPCs as well as implementation of vegetable cultivation. I adopt parametric and nonparametric approaches to precisely estimate the treatment effects. Estimated results indicate no significant difference between participants and non-participants of FPCs on agricultural net income in both parametric and non-parametric estimations. In contrast, the comparison between vegetable and grain farmers using propensity score matching (PSM) reveals that the treatment effect of vegetable cultivation is significantly positive for total and agricultural incomes, although vegetable cultivation involves more labor-intensive efforts. These results indicate that it is the implementation of vegetable cultivation rather than the participation in an FPC that enhances the economic welfare of farmers, due to the non-excludability of FPCs' services as well as the risks involved in vegetable cultivation.

***Keywords***: small farmers, agricultural cooperatives, vegetable, propensity score matching, treatment effect

***JEL Classification Numbers***: Q12, Q13, O13

* Development Studies Center, Institute of Developing Economies, Japan External Trade Organization, 3-2-2 Wakaba, Mihama-ku, Chiba-shi, Chiba, 261-8545, Japan. Tel: 81-43-299-9597; Fax: 81-43-299-9729. E-mail address: hoken@ide.go.jp.

## 1. Introduction

Rapid and prolonged economic development and the globalization of the Chinese economy have dramatically changed the structure of agricultural production and farm management in rural China. In coastal areas, such as Shandong and Zhejiang provinces, many agribusiness enterprises that possessed abundant management resources began in the mid-1990s to integrate farmers through contract farming to produce standardized, high-quality, and safe products, covering all processes from cultivation and processing to marketing (Lingohr 2007, Miyata et al. 2009, Lingohr-Wolf 2011). Central and local governments in China evaluated these attempts by the agribusiness enterprises highly and initiated a new agricultural policy called "Agro-industrialization" (*nongye chanyehua*) in the late 1990s. According to this policy, the establishment of agricultural conglomerates through contract farming is expected to increase the profitability of agricultural products and improve the economic standards of rural people (World Bank 2006, MoA eds. 2008).

It has been thought that small farmers in developing counties tend to be inferior to agribusiness enterprises in terms of bargaining power on pricing and contract enforcement (Key and Runsten 1999, Singh 2002). In particular, a large number of small farmers engage in agricultural production in China.[1] Due to the transaction costs involved in monitoring and managing numerous, geographically dispersed, small farmers, agribusiness companies might be reluctant to engage in contract farming with small farmers.

However, small farmers are not necessarily excluded from vertical coordination with agribusiness enterprises in developing countries, and the inclusion of small farmers has been extensively reported (Reardon et al. 2009, Barrett et al. 2012, Abebe et al. 2013). This reflects the fact that small farmers are able and willing to follow the higher labor-intensive field management practices needed by these integrators, and they can reduce transaction costs by forming effective agricultural cooperatives (Reardon et al. 2009, Bolwig et al. 2009, Fischer and Qaim 2012). The inclusion of small farmers through the establishment of agricultural cooperatives is widely practiced in China. Since the 1990s, a significant number of agricultural cooperatives, called Farmer's Professional Cooperatives (*nongmin zhuanye hezuoshe*, hereafter FPCs), have been established by large farmers, agribusiness enterprises, and local governments to reduce conflict as well as to improve the balance of benefit and risk between agribusiness enterprises and farmers.

---

[1] According to *Second Chinese Agricultural Census* conducted in 2006 and the *Rural Social Economic Survey*, the number of farm households engaged in agricultural production totaled 200.16 million households in 2006, and the average areas of cultivated land in 2006 and 2011 were 0.577 and 0.598 hectares per household, respectively.

FPCs are a new type of agricultural cooperative organization that are expected to mediate between the agribusiness enterprises and farmers in terms of diffusion of agricultural technologies, monitoring of farm cultivation, procurement of farm products, and redistribution of the profits produced by the differentiated products. The establishment of FPCs is intimately related to the malfunction of formal agricultural extension organizations due to entrenchment of budget allocation as well as lack of knowledge regarding more commercialized products after the introduction of the Household Responsibility System (HRS) for agricultural production (Hu and Huang 2001, Huang et al. 2009, Hu et al. 2012).

Since the promulgation of the "Law of Farmers Professional Cooperatives" on July 1, 2007, FPCs have developed rapidly. A total of 111,000 FPCs were registered at the Ministry of Commerce in 2008, rising to 982,700 organizations in 2013. During this period, the number of farm households participating in FPCs also increased from 12 million to 74 million, constituting 28.5% of all rural households (*China Agricultural Development Report* (various issues), MoA eds, 2011, Ministry of Agriculture HP, http://www.moa.gov.cn/, Feb.13th, 2013).

Regarding the development of FPCs, an increasing number of investigations are examining the ability of FPCs to overcome small farmers' inherent inefficiency regarding adoption of new technology and pricing of their products. The World Bank (2006) and Shen et al. (2007) comprehensively reviewed the characteristics of FPCs and clarified the importance of FPCs for facilitating agro-industrialization in China. Based on panel data collected from villages across China, Deng et al. (2010) revealed that policy initiatives, such as the issue of official documents, financial support, and tax exemption, significantly promote the establishment of FPCs within villages. Jia and Huang (2011) and Jia et al. (2012) examined the determinants of marketing channels or contract farming adopted by FPCs. These studies revealed that the adoption of modern marketing channels such as direct sales to supermarkets is positively related to transactions with government-driven agribusiness, and that the implementation of contract farming correlates positively with the scale of production by FPCs.

On the other hand, most of the existing literature focusing on specific FPCs appears to focus less on the endogeneity of participation in FPCs, instead conducting simple comparisons of agricultural profits or household income between FPC participants and non-participants. The exceptional studies include those by Miyata et al. (2009) and Ito et al. (2012). Miyata et al. (2009) employed a Heckman selection-correction model to compare contract and non-contract growers of apples and onions in Shandong province. Focusing on

a watermelon-producing cooperative in Nanjing, Ito et al. (2012) employed the propensity score matching (PSM) method to reveal that the treatment effect of participation in a cooperative is highly heterogeneous and is significant only for small-scale farms.

However, these studies focus on China's relatively developed coastal areas. Few studies emphasize the functions of FPCs in China's less developed inland provinces, where local farmers tend to depend more heavily on agricultural income, and the introduction of new varieties seems to be more crucial for enhancing household economic welfare. In addition, although most of the farmers face the decision of whether to introduce new agricultural varieties, existing studies focus less on the disparities between traditional farmers, who continue to cultivate traditional varieties, and innovative farmers, who have introduced new varieties. These comparisons seem to misevaluate the effects of implementing new varieties as well as FPC participation.

Thus, the contributions of this study are twofold. First, I focus on the less-developed inland areas in China to examine the effects of FPC participation using parametric and non-parametric estimation methods. A farm household survey was conducted in a less-developed inland county, namely Xinjiang in Shanxi province, a known center for vegetable production in inland China. Since the mid-2000s, local governments have strongly promoted the establishment of FPCs as well as the introduction of vegetable production to enhance local farmers' living standards. The process of agro-industrialization in this area is closely analogous to that of Sichuan, which was examined by Lingohr (2007). Therefore, a case study in Xinjiang County can be regarded as a good example to investigate the mechanisms of economic development through agro-industrialization in inland China.

Second, I estimate not only the treatment effect of participation in FPCs by comparing participant and non-participant households but also explore the effect of initiating vegetable production by comparing the households that continue to cultivate traditional varieties and those that began cultivating greenhouse vegetables through PSM. I concentrate on vegetables, especially eggplant cultivation, because existing studies on FPCs have tended to be biased toward special varieties, such as watermelons, apples, honey, and Chinese gooseberries. Cultivating these products require lump sum investments and are less closely relevant to traditional cultivation techniques. On the other hand, vegetable cultivation itself is familiar to local farmers, but lump sum investments, such as greenhouse construction, appear to be necessary to cultivate high-quality eggplant during winter and spring seasons. Thus, in comparing famers according to whether they initiated vegetable cultivation it is also necessary to identify the determinants of commencing vegetable cultivation. In order

to implement multilateral comparisons, I have introduced a unique sampling design to classify farmers into three categories; FPC participants, non-participants but mainly engaged in vegetable cultivation, and traditional farmers principally cultivating grain crops. This sampling design enables me to distinguish the effects of FPC participation from those of vegetable cultivation.

The remainder of this study proceeds as follows. Section 2 presents a brief overview of agricultural production and FPC activities in Xinjiang county. Section 3 presents the estimation framework used to discuss the impacts of FPC participation as well as the implementation of vegetable cultivation. Section 4 employs parametric and nonparametric measures to perform an econometric analysis of those impacts. Section 5 summarizes the results and discusses the policy implications for FPC development and agro-industrialization in China.

## 2. Description of surveyed area and sampling methods

### 2.1. Overview of agriculture in Xinjiang county[2]

Xinjiang County, located in the southeast of Shanxi Province, is a rural county famous for wood-block prints and old castles. Its economy was mainly dependent on traditional agricultural production, such as grain (wheat and maize) and cotton cultivation, as well as tourism. Faced with stagnating grain prices since the early 1990s, the county government began promoting the structural adjustment of agriculture from traditional products to more commercialized varieties, such as eggplants, cucumbers, and tomatoes, at the end of the 1990s, earlier than other areas in Shanxi province. Due to persistent effort by farmers as well as extensive support from the local government, the county became a major vegetable cultivating area by the end of the 2000s.

Lately, agriculture in Xinjiang has principally depended on vegetable cultivation. Vegetables cultivated in the county are distributed not only within Shanxi Province but also sold in adjoining large cities, such as Xi'an (Shaanxi Province) and Luoyang (Henan Province). The county is officially acknowledged as one of the "Top 10 fruit and vegetable production cities in China" and a "National food safety model county," and the vegetables

[2] The descriptions in Section 2.1 are based on field interviews with the staff of the Bureau of Agricultural Management, the cadre of village committees, and the managers of FPCs in Xinjiang conducted in June 2012 by the author. I also refer to the website of the Xinjiang County government (http://www.jiangzhou.gov.cn/index.htm) and the website of Chinese Agricultural Management Information (http://www.caein.com).

produced in the county are certified as "Xinzhou Green Brand" by the provincial government. According to a document published by the government in 2010[3], vegetables are planted across 11,000 hectares, covering approximately 32% of total cultivated land in the county. Of this total, the area devoted to greenhouse vegetables reached 5,240 hectares. Vegetable production totals 543 thousand metric tons, worth 718 million yuan, and constitutes nearly 60% of the whole crop-raising value of the county. A total of 34,000 farmers are primarily cultivating vegetables in the county, constituting 55% of total rural households.

The total number of FPCs established has increased rapidly with the development of vegetable cultivation and the intensive support offered for the establishment of FPCs by the local government since the mid 2000s. By 2011, a total of 369 FPCs existed in the county. Of these, 121 cooperatives were registered as vegetable FPCs, the greatest of all types of cooperative. FPC membership in Xinjiang tends to be restricted to within villages, and several FPCs can be established in a single village. Approximately 8,900 households were official members of an FPC, constituting nearly 14% of total households in Xinjiang's rural areas in June 2011[4]. Along with the development of agro-industrialization and FPCs in the county, transactions involving farmland are also becoming more prevalent. Specifically, 28.7% of all cultivated land is rented out, and 38.0% of all farmers are engaged in farmland transactions[5]. One of the principal reasons for increased farmland transaction is to merge adjoining farmlands to enable farmers to construct a greenhouse. In such a situation, as will be discussed below, FPCs and the village committee tend to mediate between farmers to facilitate land transactions fairly as well as effectively.

### 2.2. Sampling design

A questionnaire survey was conducted among rural households in December 2011, concerning 2010 data with international joint research between IDE and the Rural Development Institute, Chinese Academy of Social Sciences, to examine the effects of

[3] *"The Five-year Agricultural Development Plan (2011–2015) for the 'A Product from Every Village Campaign' in Xinjiang County"* (*Xinjiang Xian Yi-cun Yi-pin Wu nian guihua (2011 zhi 2015))* published by Xinjiang county government in April 2011 (http://www.jiangzhou.gov.cn/index.htm).

[4] Data on FPCs are based on an interview with the vice director of Xinjiang Bureau of Agricultural Management held in May 2012. According to the Chinese Agricultural Management Information website (http://www.caein.com/), FPCs now total 514 cooperatives, containing 175 vegetable cooperatives, and participant numbers reached nearly 12,600 households at the end of October 2013.

[5] The amount of cultivated land rented across all of China is nearly 18 million hectares, constituting 21.5% of the country's total cultivated land at the end of 2012 (*People's Daily*, March 5th, 2012).

vegetable FPCs on farm income. Since most FPCs in Xinjiang county restrict their membership to village members, two villages were selected where economic conditions, such as income level and agricultural conditions, are almost identical, along with highly similar cropping patterns of vegetables (mainly eggplant) and FPC management features.

Table 1: Characteristics of Surveyed Villages and FPCs in 2010

| | Village No.1 | Village No.2 |
|---|---|---|
| Total number of household | 305 | 296 |
| Total number of population (*person*) | 1,214 | 1,396 |
| Total size of farmland (*ha)* | 160 | 173 |
| Principal agricultural products | eggplant, wheat, maize | eggplant, jujube, wheat, maize |
| Foundation year of FPC | December 2008 | March 2009 |
| Total number of FPC participants | 125 | 105 |
| Registered capital of FPC (*million yuan*) | 3.20 | 3.15 |
| Number of full-time workers of FPC (*person*) | 4 | 5 |

*Source*: Author's Village and FPC survey and field interview conducted on May 2012.

The basic characteristics of surveyed villages and FPCs are shown in Table 1. The total numbers of households and areas of farmland are almost the same for the two villages, and the principal products and cropping patterns are also similar. The FPCs of the two sample villages were established with strong support from the village committees at almost the same time: December 2008 for village No.1 and March 2009 for village No.2. FPC members in 2010 were 125 and 105 households, respectively, constituting 37.9% and 34.4% of all households in each village. Most participants, 88.6 %, joined the FPC around 2008–09. The remaining participants had entered a former farmer's cooperative for wheat, which was established in July 2006 but not registered at the Industry and Commerce Bureau as a formal FPC, and continued as a member of the new FPCs. Participation in the FPCs is voluntary and withdrawal is unrestricted.

We have randomly chosen nearly 100 households from each village according to the probability proportional to the population share, using the lists of FPC members for participants and resident registration data for non-participants. Table 2 presents the

distribution of sample farmers. As shown in the table, 72 households are formal members of FPCs cultivating vegetables (hereafter, "participants") whereas 60 households are non-participants of FPCs but cultivate vegetables (hereafter, "non-participants"). Among vegetable-cultivating farmers, 126 farmers cultivate eggplant as a principal product, constituting 95% of participants, and the remaining farmers cultivate other vegetables, such as peppers and green peppers. As the cropping pattern of vegetable production tends to be affected by seasonality and market conditions, it is difficult to completely control for the variety of vegetables. In addition to vegetable-producing households, we also randomly selected 69 households who cultivate only traditional crops, such as maize, wheat, and cotton, (hereafter, "grain farmers") to evaluate the ability of vegetable cultivation to enhance agricultural income.

Table 2 Numbers of Sampled Households

| | Vegetable farmers | | Grain farmers | Total |
|---|---|---|---|---|
| | participants | non-participants | | |
| Number of households | 72 | 60 | 69 | 201 |
| Percentage | 36 | 30 | 34 | 100 |

*Source*: Farm survey in Xinjiang County.

The preconditions for obtaining membership in FPCs are the same in each village, namely to build by themselves standard greenhouses to grow vegetables, and the guidelines for greenhouses were specified by the county government. A standard greenhouse, called "winter-warm style" (*dongnuan shi*) covers nearly 3 *mu* (15 *mu* equals 1 hectare), and the total cost one of building is approximately 40,000–50,000 yuan per greenhouse[6]. However, the construction of the greenhouse itself appears not to be a major factor preventing vegetable farmers from participating in FPCs, because 93% of non-participants possess

[6] Simple greenhouses made from bamboo and plastic were widespread in Xinjiang County until the end of the 1990s. These greenhouses cost approximately 10,000 yuan, and the required lot size was 0.7 to 0.8 *mu* per greenhouse. Since the early 2000s, the construction of a new type of greenhouse, named the "winter-warm style", has become widespread in this area. Constructing a "winter-warm style" greenhouse required the surface of the earth to be dug to a depth of nearly 70 to 80 centimeters to maintain temperatures in the winter. Thereafter, thick clay walls along the northern side are built along with bamboo frames supported by cement props to allow the greenhouse to be covered with plastic sheets.

several greenhouses used to cultivate vegetables. On the other hand, limited number (nearly 17%) of grain farmers possess a greenhouse, thus investment in a greenhouse appears to be a key factor for initiating vegetable cultivation in this area.

### 2.3. Services provided by FPCs

Both FPCs in the surveyed villages offer a wide range of service to vegetable farmers.[7] First, the FPCs supply superior eggplant seedlings grown in FPC-owned and operated greenhouses. One FPC exchanges agency contracts with a major nursery business in Holland to cultivate eggplant seedlings. This FPC raised nearly 580,000 seedlings in 2009, of which 380,000 were sold to FPC participants, and the rest were distributed to eggplant farmers within the county[8]. While the other FPC began to cultivate eggplant seedlings in 2011, it raises only a relatively limited number, only circulated among vegetable farmers within the village.

Second, the FPCs make blanket orders of agricultural input materials, such as fertilizer, pesticides, and plastic sheets, providing them to farmers at a discount of nearly 10%. The FPCs directly place blanket orders with the material makers and farmers visit stores in the village to pick them up.

Third, the FPCs offer free instruction in vegetable cultivation techniques through on-site training and lecture classes. The FPCs and village committees employ an agricultural technique instructor from Shouguang city (a county-level city) in Shandong province, which is one of the most advanced vegetable-producing areas in China. The term of the instructors' contract is normally one year, and they are required to reside in the village and make rounds through the village to offer technical advice on vegetable cultivation at the request of farmers. Moreover, the instructors are also engaged in raising the eggplant seedlings that are distributed throughout the county. FPCs and village committees pay these instructors a salary of approximately 50,000 yuan per year.

Fourth, the FPCs mainly undertake marketing activities to bargain with vegetable traders who come to the wholesale market located adjacent to the FPC's offices. The

[7] Agro technical extension centers, which are responsible for giving technical advice to farmers, also exist at the township level in Xinjiang, while their extension service tends to specialize in traditional crops, such as wheat, maize, and cotton, and their staff appears to lack knowledge of vegetable cultivation. According to interviews conducted with agro technical extension center staff, the total number of staff at the township level is restricted to a few people, thus it is difficult for the center to offer detailed services to vegetable-cultivating farmers.

[8] The interview with FPC representatives shows that the sale price of eggplant seedlings is the same for both participants and non-participants.

wholesale markets were constructed by village committees at nearly the same time as the establishment of the FPCs. In these markets, FPC staff offer a grading service for the agricultural products that farmers bring, and directly negotiate with the traders on behalf of farmers without any charges[9].

With respect to the FPCs' services, it is noteworthy that these services' beneficiaries are not necessarily restricted to FPC participants: non-participants can also enjoy these services without any extra charges. Non-participants are able to sell their products through FPCs, and can also purchase agricultural input materials at discounted prices. These externalities of FPCs' services are closely related to the fact that both FPCs were founded by powerful supporters of village committees. Thus, it appears difficult for FPCs to exclude non-participant farmers from their services as they belong to the same villages[10].

The non-excludability of non-participants can be confirmed by the choice of marketing channels. Table 3 shows average selling prices and shares of amounts sold for each marketing channel for eggplants. While the participants sell nearly all eggplants via consignment sales to FPCs, consignment sales are an important channel for non-participants as well. Specifically, the latter's share of amounts sold is 56%, nearly 14 percent points higher than that sold through the wholesale market. This result indicates that consignment sales to FPCs are not restricted to participants, and a t-test yields no significant difference for sale prices between participants and non-participants. In addition, average sales prices through FPC consignment sales and in the wholesale market do not differ significantly for non-participants. In reality, eggplants produced by participants and non-participants are treated as the same brand and sold to merchants who visit the local wholesale market, suggesting that the FPCs have not succeeded in differentiating their products from those of non-participants[11].

Meanwhile, FPC participants are required to invest a specific amount of money to obtain stock in the FPCs, with most participants paying 500 yuan to the FPCs, which equals the price of one share of FPC stock. The FPC's profits are supposed to be redistributed according to investment or sales amounts, but this was not actually implemented until 2011. After this initial investment, participants do not have to pay an annual membership fee.

[9] In addition, the FPCs sometimes mediate between farmers and financial institutions (Rural Credit Cooperative, Agricultural Bank of China) to facilitate farmers' applications for agricultural loans.

[10] In fact, according to the interview with FPC leaders, they mentioned that excluding non-members from the FPCs' services was difficult because non-participants were also villagers.

[11] Although the distribution of eggplant selling price for non-participants is more concentrated around the average price (2.0 yuan/kg), no significant difference of selling price is observed between participants and non-participants using a t-test.

Table 3 Marketing Channels for Eggplant

| | Participants | | Non-participants | |
|---|---|---|---|---|
| | average selling price (yuan/kg) | share of amount sold (%) | average selling price (yuan/kg) | share of amount sold (%) |
| Consignment sales to FPC | 2.01 | 97 | 2.02 | 56 |
| Consignment sales to full-time farmers | 1.85 | 2 | | 0 |
| Wholesale market | 2.00 | 2 | 2.04 | 42 |
| Sell by themselves | | 0 | 2.10 | 2 |

The study questionnaire asked respondents to choose (single choice) their main reason for participating in the FPCs. The share of respondents choosing “to ensure a marketing channel” was highest, constituting 36% of all participants, which indicates that the FPC’s marketing activities is the most important factor influencing whether to participate in the FPCs. Following this, the answers “to accept financial support” and “to stabilize sales price” were chosen by 18% and 14% of participants, respectively. According to the interviews with FPC representatives and participants, the participants (and some non-participants) are able to use credit to purchase fertilizers and pesticides offered by the FPCs, and repay the costs at the end of the cultivation season without interest. With regard to sale prices, vegetables are sold at market spot prices and the FPCs do not propose price stabilization to the participants. According to our survey, approximately 70% of vegetable farmers participated in the FPCs at the same time as initiating greenhouse vegetable cultivation. These results indicate that FPC participation offers a type of psychological effect for farmers seeking to secure marketing channels for their vegetables.

## 3. Estimation Strategy and Descriptive Statistics

### 3.1. Parametric Method

I introduce evaluation problems in a regression framework, and assume that the dependent variable is the net income from vegetable cultivation or agricultural production to estimate the impacts of FPC participation. As suggested by Key and Runsten (1998) and the World Bank (2006), the impacts of contract farming and FPCs are multidimensional, such as offering credit and insurance for participants to cope with market imperfections, and reducing transaction costs associated with searches, screening, and the transfers of goods. However, one of the most important purposes of FPCs is to increase farmers’

economic well-being, and this impact appears to be summarized in farm household income. Thus, I focus on net income from crop or vegetable cultivation, deducting input costs (seeds, fertilizer, pesticide, and land rental fees, etc.), and an estimated income function ($Y$) is defined as follows:

$$Y_i = \boldsymbol{\beta}'\mathbf{X_i} + \gamma D_i + \varepsilon_i = \begin{cases} Y_{i0} = \boldsymbol{\beta}'\mathbf{X_i} + \varepsilon_{i0} & if \quad D_i = 0 \\ Y_{i1} = \boldsymbol{\beta}'\mathbf{X_i} + \gamma + \varepsilon_{i1} & if \quad D_i = 1 \end{cases} \qquad (1)$$

where $\mathbf{X}$ and $\boldsymbol{\beta}$ are, respectively, vectors of exogenous variables and parameters (including a constant term). The "Treatment" of participation in an FPC is denoted by a dummy variable $D_i$ which equals 1 if the farmer participates in an FPC and 0 otherwise. If participation in the FPC is conducted randomly, namely $D$ and $\varepsilon$ are uncorrelated, ordinary least squares leads to unbiased estimate of the impact of FPC participation. However, according to the provisions of FPC law and my interviews with the FPC, FPC participation appears to be determined endogenously. Specifically, more motivated and competent farmers are willing to join the FPC. Therefore, I assume a selection function by latent regression as follows:

$$D_i^* = \boldsymbol{\beta}_{\mathbf{Z}}'\mathbf{Z_i} + u_i \qquad D_i = 1 \ if \ D_i^* > 0, \quad D_i = 0 \ otherwise \qquad (2)$$

where the vectors $\mathbf{Z}$ and $\boldsymbol{\beta}_{\mathbf{Z}}$ denote, respectively, exogenous variables and parameters, and the variables of $\mathbf{Z}$ are required to overlap with $\mathbf{X}$ but include at least one independent source of variation in $D$ that satisfies the conditions of the instrumental variables (Bratberg et al. 2002, and Cameron and Trivedi 2005). In addition, it is assumed that $u_i$ and $\varepsilon_i$ are bivariate normally distributed as follows:

$$\begin{pmatrix} \varepsilon_i \\ u_i \end{pmatrix} = N\left( \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma^2 & \rho\sigma \\ \rho\sigma & 1 \end{pmatrix} \right) \qquad (3)$$

A reduced form agricultural income function to adjust for selection bias as well as to control household characteristics is estimated. The income function is then specified as follows:

$$\ln Y_i = \alpha + \beta_1 L_i + \beta_2 T_i + \beta_3 K_i + \gamma D_i + \mathbf{c}'\mathbf{H_i} + \phi_j V_j + \varepsilon_i \qquad (4)$$

where $L$ denotes the total amount of labor, $T$ denotes the total area of contracted farmland, $K$ denotes the total amount of capital for greenhouses, agricultural machines, and farm implements, $\mathbf{H}$ denotes a vector of household characteristics affecting agricultural productivity, and $V_j$ is the village dummy. Parameters to be estimated are $\alpha, \beta_1, \beta_2, \beta_3, \gamma, \phi_j$ and $\mathbf{c}$. In estimating the income function, to enhance asymptotic efficiency (Bolwig et al. 2009), I adopt the full information maximum likelihood (FIML) method, which estimates equations (1) and (2) simultaneously, rather than the Heckman two-step method[12].

With regard to the instrumental variables to control endogeneity of FPC participation, I adopt two variables. One variable evaluates a villager's willingness to attend villagers' meetings (3 point scale; 1 = less willing, 2 = ordinal, 3 = very willing), and the other is a dummy variable for whether the household head is a CCP (Chinese communist party) member. Recent literature shows that the introduction of village democracy through direct election of village cadres facilitates the supply of public services, such as the construction of irrigation, roads, and educational facilities, and improves the income distribution among village households (Luo et al. 2007, 2010, Martinez-Bravo et al. 2012, Shen and Yao 2008, Wang and Yao 2007). Following these studies, the variable of willingness to attend villagers' meetings is assumed to represent the level of recognition of village democracy and public services, thus the higher the degree, more inclined people will be to participate in FPCs[13]. In addition, according to previous studies (Miyata et al. 2009 and Kong et al. 2012), CCP members and village cadres tend to take the initiative in joining FPCs to facilitate villagers' participation. As it does not directly relate to the level of vegetable cultivation technique, CCP status seems to be a good instrument to control endogeneity.

### 3.2. Non-parametric Methods

In addition to this parametric method, I examine the impacts of FPC participation as

[12] Since the restriction of error terms seems to be too strong, I conducted Pagan-Hallt, White and Breusch-Pagan tests to check the homoscedasticity of error terms. The estimated results show that the null hypotheses are not rejected at the 10% level for most cases. Thus, the GMM procedure is not adopted in this article.

[13] It might be possible that the political participation by farmers is motivated by their self-interest, but as the services FPCs provide to farmers are relatively standardized, little scope exists to obtain extra benefits from the FPC by political bargaining. Thus, I can assume that willingness to attend villagers' meetings is a suitable instrumental variable to control the endogeneity of participating in an FPC.

well as vegetable cultivation by estimating the average treatment effect on the treated (ATT) as follows:

$$\begin{aligned} ATT &= E[Y_{i1}|D_i=1]-E[Y_{i0}|D_i=1] \\ &= E[Y_{i1}|D_i=1]-E[Y_{i0}|D_i=0]+E[Y_{i0}|D_i=0]-E[Y_{i0}|D_i=1] \end{aligned} \quad (5)$$

where $E(\cdot)$ denotes the expectation operator, $Y_{i1}$ denotes the outcome of interest (vegetable or agricultural net income) for household $i$ participating in an FPC, and $Y_{i0}$ denotes the outcome for the same household not participating in an FPC, and $D$ is a binary indicator that equals 1 if a farmer participates in an FPC and 0 otherwise.

In estimating ATT, I could not observe $[Y_{i1}|D_i=1]$ and $[Y_{i0}|D_i=1]$ simultaneously for the same household, and a simple comparison between treatment and control groups involves a selection bias, whose magnitude is shown in $E[Y_{i0}|D_i=0]-E[Y_{i0}|D_i=1]$ if FPC participation is practiced non-randomly such that participation is implemented on a farmer's own initiative. Thus, I introduce the program evaluation method of PSM proposed by Rosenbaum and Rubin (1983) to estimate ATT. The method assumes that outcome is independent of program participation conditional on a set of observable characteristics ($\mathbf{W}$), implying that $Y_{i0} \perp D_i | p(\mathbf{W})$, where $\perp$ denotes independence and $p(\mathbf{W})$ denotes a score representing the propensity to participate in an FPC with a set of covariates $\mathbf{W}$. PSM can eliminate selection bias caused by observable household characteristics.[14]

In order to minimize the likelihood and magnitude of bias due to selection-on-unobservables, such as farmers' entrepreneurship, skill for cultivation risk preference and commitment to cultivation, I conducted a detailed questionnaire survey among farmers, addressing questions about attitudes toward risk and village politics, willingness to adopt new techniques and impressions of People's Communes for inclusion in $\mathbf{W}$ [15]. I gauge the willingness of famers to acquire new agricultural techniques by farmers' self-evaluation on an ordinal scale of 1–3, and the higher the number, the more willing they are. The variable of attitude toward risk is evaluated on a 1–3 scale (the more risk-loving they are, the larger the value), and the variable of sensitiveness to market information is

[14] As shown in Heckman et al. (1997), one of the most important preconditions for implementing PSM is that both treated and comparison groups are drawn from the same market. The villages chosen in this study are geographically adjacent, and their products comprise the same brand of eggplant in wholesale markets. Statistical comparisons of the market price of eggplants between the villages using a t-test are not significant at the 10 % level for all cases.

[15] Ito et al. (2012) insist that image of the People's Commune and distinction of old (People's Commune) and new cooperative is one of the major key factors preventing farmers from joining an agricultural cooperative for fear of losing land utilization rights and farm management control.

also measured on a 1–3 scale. Furthermore, the impression of the People's Commune is a dummy variable which is 1 if the farmers were influenced by its image to make the decision about participation or non-participation in the cooperative, and 0 otherwise. [16]

The propensity score on program participation tends to be calculated using a parametric method, and I will adopt a Probit model for the estimations. The literature has developed several types of matching estimators, and a trade-off between bias and variance tends to arise among matching algorithms when the sample size is small (Caliendo and Kopeinig 2008). Thus, to check the consistency of the estimations, I will adopt the matching algorithms of nearest-neighbor matching, radius matching with $\|P_i - P_j\| < 0.05$ and kernel matching.

Furthermore, the framework of the impact evaluation can be extended to vegetable cultivation if the definitions of $D_i$ and $Y_i$ are adjusted properly. Namely, if $D_i$ denotes a binary variable which equals 1 if the farmer engages in vegetable cultivation and 0 otherwise, and $Y_i$ denotes net income from crop cultivation and total income per capita, then the impact of vegetable cultivation is estimated by ATT. In this estimation, it should be noticed that grain farmers are more willing to engage in off-farm occupations by their own choice to compensate for relatively low agricultural income. Therefore, the comparison of total income as well as agricultural income for vegetable and grain farmers is required to estimate the treatment effect.

### 3.3. Descriptive Statistics

Table 4 presents descriptive statistics of household characteristics for (1a) participants, (1b) non-participants, and (2) grain farmers. The variables that determine FPC participation as well as affect agricultural production are included in this table.

No significant differences are observed between (a) and (b) for agricultural net income, labor days, area of farm land cultivated for vegetables, and agricultural capital, while some variables, such as total income, vegetable net income and total cultivated areas, for participants are significantly larger than those for non-participants. In addition, compared with non-participants, the size of contract farmland for participants is significantly larger,

[16] Since a substantial lump sum investment is required to build a greenhouse, most farmers could not use their own savings or obtain a loan from banks and credit cooperatives. We prepared detailed questions on their financial status, and found that 88% of vegetable farmers obtained agricultural loans from financial institutions whereas 17% of grain farmers did. However, among non-borrowers of grain farmers, only 6 grain farmers replied that their loan applications were rejected or they did not submit an application due to fear of being rejected. Therefore, the possibility that grain farmers tend to be caught in credit constraint appears to be very low. In addition, since the variable of credit constraint is perfectly predicted for vegetable cultivation, I could not employ it as an independent variable for Probit analysis.

and the health index of household head and willingness to attend village meetings are also significantly higher, while the percentage of the old age dummy is significantly lower.

Table 4 Descriptive Statistics by Farm Type

| | (1) Vegetable Farmers | | (a) Participants | | (b) Non-participanmts | | (2) Grain Famers | | *t* -Value (a) vs. (b) | *t* -Value (1) vs. (2) |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | | |
| Total income per capita (*yuan* ) | 8,175 | 7,203 | 9,466 | 8,418 | 6,652 | 5,092 | 5,098 | 3,691 | 2.280 ** | 3.369 *** |
| Total income (*yuan* ) | 30,324 | 18,552 | 33,356 | 17,876 | 26,746 | 18,841 | 21,993 | 20,847 | 2.073 ** | 2.937 *** |
| Agricultural net income (*yuan* ) | 21,558 | 15,524 | 23,401 | 13,676 | 19,414 | 17,300 | 6,986 | 11,361 | 1.478 | 7.004 *** |
| Vegetable net income (*yuan* ) | 18,000 | 13,499 | 20,047 | 13,639 | 15,460 | 12,995 | 3,739 | 9,696 | 1.947 * | 7.859 *** |
| Income from off-farm ocupations (*yuan* ) | 5,568 | 8,215 | 6,171 | 9,086 | 4,856 | 7,057 | 9,140 | 11,119 | 0.919 | -2.616 *** |
| Total labor days (*days* ) | 659 | 242 | 704 | 259 | 607 | 210 | 500 | 199 | 2.348 ** | 4.765 *** |
| Labor day for agricultural work (*days* ) | 556 | 199 | 576 | 204 | 532 | 191 | 326 | 171 | 1.299 | 8.280 *** |
| Labor day for vegetable cultivations (*days* ) | 457 | 194 | 480 | 188 | 430 | 198 | 148 | 124 | 1.494 | |
| Labor day for non-farm work (*days* ) | 103 | 156 | 127 | 175 | 75 | 126 | 174 | 207 | 1.949 * | -2.762 *** |
| Total cultivated farmland (*mu* ) | 11.95 | 5.27 | 12.76 | 5.35 | 11.01 | 5.07 | 12.88 | 5.37 | 1.917 * | -1.191 |
| Cultivated farm land for vegetable (*mu* ) | 4.61 | 1.95 | 4.53 | 1.88 | 4.70 | 2.03 | | | -0.498 | |
| Dispersion of farm land (*Simpson index* ) | 0.638 | 0.158 | 0.641 | 0.161 | 0.635 | 0.156 | 0.652 | 0.182 | 0.232 | -0.572 |
| Self-evaluation on period of contrancted farmland (1: less than 30 years; 0: others) | 0.083 | | 0.056 | | 0.115 | | 0.250 | | -1.233 | -3.354 *** |
| Age of Household Head (HH) (*years* ) | 46.2 | 8.8 | 46.4 | 8.9 | 46.1 | 8.8 | 52.8 | 11.2 | 0.160 | -4.635 *** |
| Education of HH (*years of education* ) | 8.80 | 2.00 | 8.92 | 1.88 | 8.66 | 2.13 | 8.50 | 2.44 | 0.750 | 0.916 |
| Health index of HH (1: bad; 2: relatively bad; 3: normal; 4: relatively good; 5: good) | 3.98 | 0.94 | 4.15 | 0.85 | 3.79 | 1.00 | 3.57 | 1.05 | 2.279 ** | 2.908 *** |
| Attitude toward risk (1: risk averse; 2: risk neutral; 3: risk loving) | 2.66 | 0.67 | 2.65 | 0.67 | 2.67 | 0.68 | 1.89 | 0.97 | -0.165 | 6.667 *** |
| Willingness to acquire new agricultural techniques (1: less willing; 2: ordinary; 3: very willing) | 2.77 | 0.47 | 2.83 | 0.41 | 2.70 | 0.53 | 2.56 | 0.65 | 1.577 | 2.664 *** |
| Self-evaluation of understanding of market trends (1: less understanding; 2: ordinary; 3: more understanding) | 1.79 | 0.74 | 1.82 | 0.78 | 1.75 | 0.70 | 1.72 | 0.68 | 0.507 | 0.641 |
| Contracted farmland | 7.98 | 2.63 | 8.44 | 2.66 | 7.45 | 2.50 | 7.98 | 3.22 | 2.187 ** | -0.002 |
| Household size | 2.53 | 0.93 | 2.60 | 0.97 | 2.44 | 0.87 | 2.39 | 0.88 | 0.504 | 0.191 |
| Agricultural capital | 58,695 | 30,576 | 62,139 | 27,880 | 54,629 | 33,256 | 15,674 | 26,558 | 1.417 | 10.058 *** |
| Child dummy (1 if member under 5 years old within household; 0 otherwise) | 0.241 | | 0.236 | | 0.246 | | 0.250 | | -0.131 | -0.149 |
| Old age dummy (1 if member over 70 years old within household; 0 otherwise) | 0.150 | | 0.097 | | 0.213 | | 0.264 | | -1.874 | -1.986 ** |
| Impressions of the People's Commune (1: influenced; 0: not influenced to join FPC) | 0.098 | | 0.111 | | 0.082 | | 0.085 | | 0.560 | 0.308 |
| Willingness to attend villagers' meetings (1: less willing; 2: ordinary; 3: more willing) | 2.571 | 0.655 | 2.667 | 0.557 | 2.459 | 0.743 | 2.648 | 0.588 | 1.839 * | -0.823 |
| Cadre dummy | 0.113 | | 0.097 | | 0.131 | | 0.181 | | -0.613 | -1.348 |
| CCP dummy | 0.060 | | 0.083 | | 0.033 | | 0.083 | | 1.219 | -0.626 |
| Willingness to help in the farming season (1: less willing; 2: ordinary; 3: more willing) | 1.872 | 0.830 | 1.903 | 0.825 | 1.836 | 0.840 | 1.915 | 0.841 | 0.461 | -0.354 |

Notes: *** significant at the 1% level, ** at the 5% level, and * at the 10% level.

In contrast, differences between (1) vegetable farmers and (2) grain farmers are much clearer. The final column of Table 4 indicates that the total and agricultural net incomes of group (1) are significantly higher than those of group (2). In addition, striking differences

between vegetable and grain farmers are observed not only for agricultural inputs such as labor days and agricultural capital but also for attitudes toward risk and new agricultural techniques. Regarding the variable of attitude toward risk, the results of the t-test indicate that vegetable farmers are more likely to be risk lovers. The same trend is observed for the variable of willingness to acquire new agricultural techniques: vegetable farmers are significantly more willing to adopt new techniques. Furthermore, the differences between groups (1) and (2) for the variables of age and health condition of the household head are significant, indicating that relatively younger and healthier household heads appear to become vegetable farmers.

Summarizing the results, the differences in major variables between participants and non-participants are less striking than those between vegetable and grain farmers, indicating that the implementation of vegetable cultivation tends to be highly related to household characteristics as well as attitudes toward agricultural production.

## 4. Estimating Results on Production Function and PSM

### 4.1. Income Function

Table 5 presents the results of crop cultivation and vegetable income functions from OLS and FIML. In estimating the income function, variables that represent household characteristics (age and educational level of household head), willingness to engage in agricultural production (attitude toward risk, adoption of agricultural new techniques, and self-evaluation of understanding of market trends), and village dummy are included as explanatory variables. The estimated results are mostly consistent between estimation procedures. Regarding the first stage of FIML estimation, the coefficient of willingness to attend village meetings is significantly positive for vegetable income but not for agricultural income. These results indicate that the more willing they are to attend village meetings, the more they would like to participate in FPCs concerning vegetable income.

On the other hand, coefficients of the CCP dummy for crop cultivation and vegetable incomes are positive but not significant. In addition, the log-likelihood ratio test (LR test) for $\rho = 0$ ($\rho$ denotes a coefficient of correlation between $u_i$ and $\varepsilon_i$) is not statistically significant at the 10% level. These results suggest that the estimation procedure of OLS is statistically supported, and that the selection of whether farmers participate in FPCs appears to be performed according to observable characteristics of households.

Table 5 Estimated Results of Income Functions

| | Agricultiral net income | | | | Vegetable net income | | | |
|---|---|---|---|---|---|---|---|---|
| | OLS | | FIML | | OLS | | FIML | |
| | coefficient | z-Value | coefficient | z-Value | coefficient | z-Value | coefficient | z-Value |
| Simpson index | 0.380 | 0.709 | 0.377 | 0.896 | -0.166 | -0.446 | -0.186 | -0.444 |
| Health | 0.072 | 1.013 | 0.072 | 0.955 | 0.079 | 1.001 | 0.076 | 1.040 |
| Age | 0.053 | 0.941 | 0.053 | 0.886 | 0.101 | 1.748 * | 0.098 | 1.736 * |
| Age*Age | -0.001 | -1.132 | -0.001 | -1.028 | -0.001 | -1.973 * | -0.001 | -2.007 ** |
| Education | -0.107 | -1.106 | -0.107 | -0.808 | -0.179 | -1.220 | -0.177 | -1.378 |
| Education*Education | 0.008 | 1.408 | 0.008 | 1.035 | 0.010 | 1.178 | 0.010 | 1.266 |
| Attitude toward risk | 0.160 | 1.598 | 0.160 | 1.717 * | 0.086 | 1.069 | 0.084 | 0.929 |
| Willingness to acquire new agricultural techniques | 0.061 | 0.473 | 0.060 | 0.455 | 0.107 | 0.814 | 0.103 | 0.805 |
| Self-evaluation on understandings market trend | 0.154 | 1.992 ** | 0.153 | 1.838 * | 0.078 | 0.883 | 0.073 | 0.893 |
| FPC dummy | 0.187 | 1.252 | 0.247 | 0.646 | 0.212 | 1.637 | 0.474 | 1.066 |
| Contracted farmland | 0.036 | 1.553 | 0.036 | 1.392 | 0.045 | 1.902 * | 0.045 | 1.796 * |
| Total worker | -0.024 | -0.387 | -0.025 | -0.365 | 0.044 | 0.654 | 0.040 | 0.619 |
| Agricultural capital | 8.02E-06 | 3.472 *** | 8.05E-06 | 3.779 *** | 9.36E-06 | 3.519 *** | 9.47E-06 | 4.807 *** |
| Village dummy | 0.102 | 0.619 | 0.103 | 0.701 | 0.173 | 1.045 | 0.178 | 1.247 |
| Constant | 6.823 | 4.728 *** | 6.816 | 4.187 *** | 6.333 | 3.982 *** | 6.297 | 3.991 *** |
| First Stage | | | | | | | | |
| Willingness to attend villagers' meetings | | | 0.254 | 1.456 | | | 0.290 * | 1.682 |
| CCP dummy | | | 0.975 | 1.630 | | | 0.959 | 1.632 |
| ath(ρ) | | | -0.060 | -0.166 | | | -0.271 | -0.611 |
| Number of observations | 127 | | 127 | | 126 | | 126 | |
| F-Value | 5.96*** | | | | 4.97*** | | | |
| Wald $\chi^2$ | | | 48.59*** | | | | 55.49*** | |
| R-squared | 0.297 | | | | 0.333 | | | |
| Root MSE | 0.686 | | | | 0.668 | | | |
| LR test for ρ=0 | | | 0.876 | | | | 0.566 | |

*Source*: Author's Estimation from farm household survey.

*Notes*: 1) *** significant at the 1% level, ** at the 5% level, and * at the 10% level.

2) Standard error of the coefficients are adjusted by Huber–White method.

All coefficients of the FPC dummy are positive but not statistically significant, indicating that participation in FPCs does not enhance income from agricultural production. As examined in the previous section, this probably reflects the fact that the services provided by the FPCs in terms of marketing, unified purchasing, and instruction in vegetable cultivation techniques are not necessarily restricted to participants, so non-participants can also benefit from FPCs. Regarding other independent variables, the coefficient of agricultural capital is significantly positive both for crop cultivation and

vegetable incomes, whereas coefficients of self-evaluation of understanding market trends and contracted farmland are significantly positive for crop cultivation and vegetable incomes, respectively. Coefficients of ages have significant inverse-U shape relationship for vegetable income.

### 4.2. Probit Model for Matching

Next, I will calculate the propensity score with three types of Probit model to confirm the effects of income enhancement through FPC participation as well as implementation of vegetable cultivation. As shown above, since unobservable characteristics of households do not necessarily affect the decision to participate in FPCs, it appears that the adoption of PSM procedures that assumes selection is performed on observables can be justified. Concerning the participation in FPCs, I will estimate the Probit model for whether a farmer participates in the FPC, and the observations will be restricted to the vegetable-producing farmers [Case (A)]. Whereas, an estimation of the Probit model for whether a famer engages in vegetable cultivation will be also performed for all observations including grain farmers [Case (B)]. A wide range of explanatory variables, which represent farmers' attributes as well as attitudes toward agricultural production and public works, are included in the Probit model to deduce more reliable estimators.

Table 6 reports the estimated results of the Probit models. Compared with the results of Case (A), the frequencies of significant variables for Case (B) are higher, and according to the value of Pseudo $R^2$, the fitness of the Probit model for Case (B) appears to be superior. These results imply that the distinction between vegetable and grain farmers is more apparent than that between participants and non-participants. The coefficients of health index and old age dummy are significantly positive and negative, respectively, for both cases. Namely, healthier households are inclined to participate in FPCs or initiate vegetable cultivation, whereas households who have aged members are less likely.

The result of Case (A), that famers in the village cadre are less likely to participate in the FPCs, is unexpected as the FPCs in the surveyed areas were established through strong support from the village committees. This result might be related to free-rider behavior by village cadres, as they are familiar with the non-exclusivity of FPCs' services. Also, the cadres of village committees tend to have little time to engage in vegetable cultivation because they are required to deal with the daily work of the village committee and the FPCs.

Table 6 Estimated Results of the Probit Models

| | Case (A) | | Case (B) | |
|---|---|---|---|---|
| | coefficient | z-Value | coefficient | z-Value |
| Age | -0.049 | -0.385 | 0.379 | 3.089 *** |
| Age*Age | 0.001 | 0.471 | -0.004 | -3.164 *** |
| Education | 0.154 | 0.536 | 0.122 | 0.521 |
| Education*Education | -0.006 | -0.373 | -0.006 | -0.404 |
| Cadre dummy | -0.900 | -1.835 * | -0.025 | -0.057 |
| CCP dummy | 1.042 | 1.538 | -0.253 | -0.458 |
| Health index | 0.302 | 2.045 ** | 0.267 | 1.733 * |
| Contracted Land | -0.002 | -0.006 | 0.226 | 1.177 |
| Contracted land*Contracted land | 0.007 | 0.416 | -0.012 | -1.109 |
| Number of household member | -0.037 | -0.300 | 0.172 | 1.604 |
| Attitude toward risk | 0.016 | 0.084 | 0.268 | 1.909 * |
| Self-evaluation on period of contracted farmland | -0.420 | -0.913 | -0.670 | -1.990 ** |
| Willingness to help at the farming season | 0.102 | 0.657 | -0.081 | -0.551 |
| Willingness to acquire new agricultural techniques | 0.335 | 1.239 | 0.730 | 2.947 *** |
| Self-evaluation on understandings market trend | -0.043 | -0.235 | -0.075 | -0.404 |
| Child dummy | 0.184 | 0.543 | -0.309 | -1.009 |
| Old age dummy | -0.694 | -1.780 * | -0.804 | -2.191 ** |
| Impressions to the People's Commune | 0.345 | 0.822 | 0.521 | 1.012 |
| Willingness to attend villagers' meetings | 0.208 | 1.052 | -0.124 | -0.609 |
| Village dummy | -0.203 | -0.646 | 1.471 | 4.908 *** |
| Constant | -2.805 | -0.794 | -13.457 | -3.874 *** |
| Number of observations | 131 | | 194 | |
| Log Likelihood | -77.39 | | -75.02 | |
| LR $\chi^2(19)$ | 26.2 | | 94.55*** | |
| Pseudo $R^2$ | 0.145 | | 0.387 | |

*Source*: Author's Estimation from farm household survey.

Notes: 1) *** significant at the 1% level, ** at the 5% level, and * at the 10% level.

2) Case (A) consists of (a) participants and (b) non-participants, and a dependent variable is whether a farmer is a FPC participant.

Case (B) consists of vegetable farmers and grain farmers, and a dependent variable is whether a farmer is a vegetable cultivator.

As for Case (B), the coefficients of age have a significant inverse-U shaped relationship with the introduction of vegetable cultivation and FPC participation. While, the coefficient of the time on contracted farmland is significantly negative, suggesting that household heads who perceive their farmland contract as being relatively insecure are less willing to implement vegetable cultivation. This result is consistent with previous studies that show insecure land transfer rights discouraged farmers from investing in agriculture

(Carter and Yao 1999, Li, et al. 1998 and Jacoby et al. 2002). Furthermore, the coefficients of attitude toward risk as well as willingness to acquire new agricultural techniques are significantly positive, indicating that more risk-loving and motivated farmers tend to engage in vegetable cultivation.

### 4.3. Estimating PSM Results

Based on the propensity score calculated from the Probit models, PSMs are conducted over the region of common support where the distributions of propensity scores overlap between treatment and untreated groups. Table 7 summarizes the results for the treatment effect in each case. The treatment effect in Case (A) is evaluated in terms of income per capita as well as agricultural and vegetable net incomes, whereas those in Case (B) are measured by income per capita and agricultural net income. In addition, the treatment effects are measured in terms of labor income and unit area of cultivated land because the ATT with PSM cannot control for differences in inputs among farmers except for the propensity score[17,18].

As shown for Case (A) in Table 7, while significant differences between participants and non-participants are observed in several cases before matching, few significant treatment effects are observed after matching. More specifically, no significant treatment effects are observed with regard to total income and agricultural net income regardless of matching methods, and almost the same results are observed for vegetable net income. These results are consistent with the estimations of the income function, indicating that participation in an FPC has no significant impact on increasing agricultural income for vegetable farmers. However, it should be noticed that the direct impact of participation on vegetable net income are slightly more positive, but not necessarily significant, when using kernel and radius matching.

In contrast, the estimated results of Case (B), which compares the treatment effects between vegetable and grain farmers, are more obvious. Specifically, the treatment effects on income per capita and agricultural net income are significantly positive, except for agricultural net income when using nearest-neighbor matching. As shown in Table 4, the

[17] The estimated results of the balance test on variables utilized for Probit model show that the average amounts of all variables do not differ significantly between treated and untreated groups at the 10% level in each case.

[18] I also estimated ATT of agricultural net income per agricultural capital. Since the standard deviation of agricultural capital and agricultural net income for grain farmers are considerably large (see Table 4), the estimated results of agricultural capital appear to be caught in low statistical power. Therefore, those outcomes are not included in Table 7.

average income of grain farmers from off-farm occupations is significantly higher than that of vegetable farmers; however, the agricultural income of vegetable farmers thoroughly compensates for the gap, giving a significantly higher income for vegetable farmers. The treatment effects on total and agricultural incomes when using kernel matching are 2801 and 2001 yuan/person, respectively, which are 53.1% and 58.0% higher than those of grain farmers. In addition, treatment effects on agricultural income per unit area of cultivated land are more than double those for grain farmers, while those for income per unit labor input are positive but not significant for all cases. These results suggest that vegetable cultivation enhances land productivity but requires more labor input, thus resulting in relatively low labor productivity.

Table 7 Estimated Results of Treatment Effect in Each Case

| | Before Matching | | | | After Matching | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Kernel matching | | | | Nearest-neighbor matching | | | | Radius matching | | | |
| | Treated | Untreated | Gap | *t*-value | Treated | Untreated | Gap | *t*-value | Treated | Untreated | Gap | *t*-value | Treated | Untreated | Gap | *t*-value |
| Case (A): participants vs. vegetable cultivating non-participants | | | | | | | | | | | | | | | | |
| Income per capita | 9,133 | 6,652 | 2,481 | 2.09 ** | 8,616 | 7,178 | 1,437 | 1.10 | 8,616 | 6,897 | 1,719 | 1.22 | 8,616 | 7,356 | 1,260 | 0.96 |
| Agricultural net income | | | | | | | | | | | | | | | | |
| per capita | 6,371 | 4,937 | 1,434 | 1.51 | 6,003 | 5,184 | 819 | 0.74 | 6,003 | 5,224 | 779 | 0.67 | 6,003 | 5,267 | 736 | 0.67 |
| per cultivated land (*mu*) | 5,665 | 4,235 | 1,430 | 2.20 ** | 5,566 | 4,557 | 1,009 | 1.30 | 5,566 | 4,896 | 670 | 0.78 | 5,566 | 4,528 | 1,038 | 1.34 |
| per labor input | 72.14 | 61.89 | 10.24 | 0.41 | 72.19 | 63.07 | 9.12 | 0.34 | 72.19 | 51.88 | 20.31 | 0.85 | 72.19 | 65.48 | 6.71 | 0.25 |
| Vegetable net income | | | | | | | | | | | | | | | | |
| per capita | 5,365 | 3,992 | 1,373 | 1.73 * | 5,284 | 3,751 | 1,533 | 1.53 | 5,284 | 3,549 | 1,735 | 1.88 * | 5,284 | 3,790 | 1,494 | 1.50 |
| per cultivated land | 1,781 | 1,739 | 42 | 0.14 | 1,820 | 1,494 | 326 | 0.76 | 1,820 | 1,440 | 380 | 0.76 | 1,820 | 1,510 | 310 | 0.73 |
| per labor input | 37.40 | 32.31 | 5.08 | 0.95 | 36.19 | 27.85 | 8.33 | 1.11 | 36.19 | 26.45 | 9.74 | 1.80 * | 36.19 | 28.34 | 7.85 | 1.06 |
| Case (B): vegetable cultivating farmers vs. grain farmers | | | | | | | | | | | | | | | | |
| Income per capita | 7,987 | 5,064 | 2,922 | 3.16 *** | 8,073 | 5,272 | 2,801 | 2.33 ** | 8,073 | 5,398 | 2,675 | 2.16 *** | 8,156 | 5,305 | 2,851 | 2.34 ** |
| Agricultural net income | | | | | | | | | | | | | | | | |
| per capita | 5,703 | 2,093 | 3,610 | 4.76 *** | 5,451 | 3,450 | 2,001 | 1.92 * | 5,451 | 3,963 | 1,487 | 1.24 | 5,451 | 3,614 | 1,837 | 1.74 * |
| per cultivated land (*mu*) | 4,999 | 1,492 | 3,507 | 6.82 *** | 5,038 | 2,155 | 2,884 | 4.54 *** | 5,038 | 2,376 | 2,663 | 3.63 *** | 5,038 | 2,120 | 2,918 | 4.54 *** |
| per labor input | 67.45 | 57.59 | 9.86 | 0.50 | 76.19 | 72.01 | 4.18 | 0.15 | 76.19 | 74.70 | 1.49 | 0.05 | 76.19 | 71.40 | 4.79 | 0.17 |

Notes: 1) *** significant at the 1% level, ** at the 5% level, and * at the 10% level.
2) Case (A) consists of (a) participants and (b) non-participants, and a dependent variable is whether a farmer is a FPC participant.
Case (B) consists of vegetable farmers and grain farmers, and a dependent variable is whether a farmer is a vegetable cultivator.

Combined with the results of the parametric estimations, I can summarize that FPC participation does not necessarily improve agricultural and vegetable net incomes for vegetable farmers regardless of controlling observable and unobservable factors. On the other hand, the estimation of the treatment effect reveals that the implementation of vegetable cultivation significantly increases total and agricultural incomes by the adoption of more labor-intensive and land productivity enhancing varieties. Therefore, rather than the decision to participate in FPCs, the decision to commence to engage in more specialized

vegetable cultivation is more important to enhance farmers' agricultural as well as total incomes.

## 5. Conclusion

This study investigated the effect on agricultural income of FPC participation as well as the adoption of vegetable cultivation. While policy support from central and local governments to establish FPCs has been intensified to improve rural peoples' welfare, the existing literature on FPCs does not focus on the endogeneity of farmers participation in FPCs and the effects of switching from traditional varieties (or traditional cultivating techniques) to relatively new ones. Therefore, a simple comparison between the participants and non-participants appears to misevaluate the functions of FPCs, and the comparison between adopters and non-adopters of new varieties is required to identify adoption effects. In this study, I selected two vegetable-producing villages of Xinjiang in Shanxi province to estimate the treatment effects through parametric and nonparametric approaches.

The estimated results of treatment effects can be summarized as follows. First, no significant difference between participants and non-participants regarding agricultural and vegetable incomes can be observed in either parametric or nonparametric estimations. This outcome is closely related to the features of management adopted by the FPCs. Specifically, the FPCs were established with great support from village committees, thus the services provided by the FPCs are not restricted to participants, meaning non-participants can also enjoy the services provided by the FPCs at no cost. This externality of FPCs' services enables non-participants to realize a higher vegetable income approximately that is equivalent to that of participants.

Second, a comparison between vegetable and grain farmers regarding total and agricultural incomes reveals that the treatment effects of vegetable cultivation on total income are significantly positive regardless of matching procedures, although no significant difference is observed for agricultural labor productivity. These results indicate that the implementation of vegetable cultivation itself requires more labor-intensive efforts but contributes to the enhanced total economic welfare of its adopters. Furthermore, land tenure insecurity and attitudes toward vegetable cultivation risk appear to be major impediments to the introduction of relatively uncertain but more lucrative products.

These findings suggest that profound examinations of the services provided by FPCs and the externalities to non-participants are crucial to accurately evaluate the impact of FPC

participations. On the other hand, policy support for potential vegetable farmers, such as the provision of agricultural loans and technical training, seems a promising measure to facilitate vegetable cultivation. In addition, this technical training for grain farmers appears to be effective to let them become agricultural laborers to be employed by other vegetable farmers, enhancing their agricultural wage income as well as strengthening the divisions of labor in the village as a whole. Furthermore, the intensification of farmland tenure security by central and local governments would contribute to grain farmers being more inclined to undertake riskier agricultural investment, such as constructing greenhouses, as well as to facilitate farmland transaction among farmers.

In early stages of agro-industrialization, the easy access to FPC membership and the non-excludability of non-participants from the FPC's services depicted in this study appear to contribute to vegetable-producing agglomeration in less-developed areas. However, with the advancement of vegetable cultivation and the intensification of competition among vegetable-producing areas, the formalization of FPC management and the imposition of strict qualifications to participate in FPCs will be required to produce high-quality products as well as to achieve sustainable agricultural development.

**References**

Abebe, Gumataw K., Jos Bijman, Ron Kemp, Onno Omta, and Admasu Tsegaye (2013), "Contract Farming Configuration: Smallholder's Preference for Contract Design Attributes," *Food Policy*, Vol. 40, pp. 14–24.

Barrett, Christopher, Maren Bachke, Marc Bellemare, Hope Michelson, Sudha Narayann, and Thomas Walker (2012), "Smallholder Participation in Contract Farming: Comparative Evidence from Five Village," *World Development*, Vol. 40, No. 4, pp. 715–730.

Bolwig, Simon, Peter Gibbon, and Sam Jones (2009), "The Economics of Smallholder Organic Contract Farming in Tropical Africa," *World Development*, Vol. 37, No. 6, pp. 1094–1104.

Bratberg, Espen, Astrid Grasdal, and Alf Erling Risa (2002), "Evaluating Social Policy by Experimental and Nonexperimental Methods," *Scandinavian Journal of Economics*, Vol. 104, No. 1, pp. 147–171.

Caliendo, Marco, and Sabine Kopeinig (2008), " Some Practical Guidance for the Implementation of Propensity Score Matching," *Journal of Economic Surveys*, Vol.

22, No. 1, pp.31–72.

Cameron, Colin, and Pravin Trivedi (2005), *Microeconometrics: Methods and Applications*, New York: Cambridge University Press.

Carter, Michael R. and Yang Yao (1999), "Specialization without Regret: Transfer Rights, Agricultural Productivity and Investment in an Industrializing Economy," *World Bank Policy Working Paper* 2202.

Deng, Hengshan, Jikun Huang, Zhigang Xu, and Scott Rozelle (2010), "Policy Support and Emerging Farmer Professional Cooperatives in Rural China," *China Economic Review*, Vol. 21, No.4, pp. 495–507.

Fischer Elisabeth and Matin Qaim (2012), "Linking Smallholders to Markets: Determinants and Impacts of Farmer Collective Action in Kenya," *World Development*, Vol. 40, No. 6, pp. 1255-1268.

Guo, Hongdong and Robert W. Jolly (2008), "Contractual Arrangements and Enforcement in Transition Agriculture: Theory and Evidence from China," *Food Policy*, Vol. 33, Issue 6, pp. 570–575.

Heckman, James J., Hidehiko Ichimura, and Petra E. Todd (1997), "Matching as an Econometric Evaluation Estimators: Evidence from Evaluating a Job Training Programme," *Review of Economic Studies*, Vol. 64, No. 4, pp. 605–654.

Hu, Ruifa, Yaqing Cai, Kevin Z. Chen, and Jikun Huang (2012), "Effects of Inclusive Public Agricultural Extension Service: Results from a Policy Experiment in Western China," *China Economic Review*, Vol. 23, Issue 4, pp. 962–974.

Hu, Ruifa, and Jikun Huang (2001), "Situation and Effect of Agricultural Extension Service Investment in China," *Management World*, No. 3, pp. 25–31 (In Chinese).

Huang, Jikun, Ruifa Hu, and Huayong Zhi (2009), "Agricultural Technology Extension System at Grass-roots Level: Development and Reform during Thirty Years," *Journal of Agricultural Economics*, No. 1, pp. 4–10 (In Chinese).

Ito, Junichi, Zongshun Bao, and Qun Su (2012), "Distributional Effects of Agricultural Cooperatives in China: Exclusion of Smallholders and Potential Gains on Participation," *Food Policy*, Vol. 37, Issue 6, pp. 700–709.

Jacoby, Hanan, Guo Li and Scott Rozelle（2002）, "Hazards of Expropriation: Tenure Insecurity and Investment in Rural China," *American Economic Review*, Vol. 92, No. 5, pp. 1420-1447.

Jia, Xianping, and Jikun Huang (2011), "Contractual Arrangements between Farmer Cooperatives and Buyers in China," *Food Policy*, Vol. 36, Issue 5, pp. 656–666.

Jia, Xianping, Jikun Huang and Zhigang Xu (2012), "Marketing of Farmer Professional

Cooperatives in the Wave of Transformed Agrofood Market in China," *China Economic Review*, Vol. 23, Issue 3, pp. 665–674.

Key, Nigel, and David Runsten (1999), "Contract Farming, Smallholders, and Rural Development in Latin America: The Organization of Agroprocessing Firms and the Scale of Outgrower Production," *World Development*, Vol. 27, No. 2, pp. 381–401.

Kong, Shangzhi, Bingqing Shi and Zhen Zhong (2012), *Study on Management Structure and Social Effect of Farmers' Professional Cooperative in China: Survey on 100 Cooperatives and 1000 Farm Households*, Beijing: China Agriculture Press (In Chinese).

Li, Guo, Scott Rozelle and Loren Brandt（1998）, "Tenure, Land Rights, and Farmer Investment Incentives in China", *Agricultural Economics*, Vol. 19, No. 1-2, pp. 63-71.

Lingohr-Wolf, Susanne (2011), *Industrialization and Rural Livehoods in China: Agricultural Processing in Sichuan*, London: Routledge.

Lingohr, Susanne (2007), "Rural Households, Dragon Heads and Associations: A Case Study of Sweet Potato Processing in Sichuan Province," *The China Quarterly*, Vol. 192, pp. 898–914.

Luo, Renfu, Linxiu Zhang, Jikun Huang, and Scott Rozelle (2007), "Election, Fiscal Reform and Public Goods Provision in Rural China," *Journal Comparative Economics*, Vol. 35, No. 3, pp. 583–611.

Martinez-Bravo, Monica, Gerard Padró i Miquel, Nancy Qian, and Yang Yao (2012) "The Effects of Democratization on Public Goods and Redistribution: Evidence from China," NBER Working Paper, No. 18101, pp. 1–53.

Miyata, Sachiko, Nicholas Minot, and Dinghuan Hu (2009), "Impact of Contract Farming on Income: Linking Small Farmers, Packers, and Supermarket in China," *World Development*, Vol. 37, No. 11, pp. 1781–1790.

MoA (Ministry of Agriculture) ed. *China Agricultural Development Report*, Beijing: China Agriculture Press (various issues) (in Chinese).

MoA (Office for Agricultural Industrialization and Research Center for Rural Economy in Ministry of Agriculture) ed. (2008), *Development Report on Chinese Agricultural Industrialization*, Beijing, China Agriculture Press (in Chinese).

MoA (Department of Rural Economic System and Management, Central Station of Administration on Rural Cooperative Economy, and Agribusiness Management Institute) eds. (2011), *Development Report on Farmer's Professional Cooperatives in China*, Beijing: China Agriculture Press (in Chinese).

Reardon, Thomas, Christopher B. Barrett, Julio A. Berdegue, and Johan F. M. Swinnen (2009), "Agrifood Industry Transformation and Small Farmers in Developing Countries," *World Development*, Vol. 37, No. 11, pp. 1717–1727.

Rosenbaum, Paul R. and Donald B. Rubin (1983), "The Central Role of the Propensity Score in Observational Studies for Causal Effects," *Biometrika*, Vol. 70, No. 1, pp. 41–55.

Shen, Minggao, Scott Rozelle, Linxiu Zhang, and Jikun Huang (2007) "Farmer's Professional Associations in Rural China: State Dominated or New State-Society Partnerships?" FSI Working Paper, Stanford University.

Shen, Yan, and Yang Yao (2008), "Does Grassroots Democracy Reduce Income Inequality in China?" *Journal of Public Economics*, Vol. 92, Issue 10–11, pp. 2182–2198.

Singh, Sukhpal (2002), "Contracting out Solution: Political Economy of Contract Farming in the Indian Punjab," *World Development*, Vol. 30, No. 9, pp. 1621–1638.

Takahashi, Kazushi, and Christopher Barrett (2014), "The System of Rice Intensification and its Impact on Household Income and Child Schooling: Evidence from Rural Indonesia," *American Journal of Agricultural Economics*, Vol. 96, No.1, pp. 1–21.

Wang, Shuna and Yang Yao (2007), "Grassroots Democracy and Local Governance: Evidence from Rural China," *World Development*, Vol. 35, No. 10, pp. 1635–49.

World Bank (2006), *China - Farmers Professional Associations: Review and Policy Recommendations*, Washington D. C.: World Bank.

# ～Previous IDE Discussion Papers ～

| No. | Author(s) | Title | |
|---|---|---|---|
| 578 | Hisatoshi HOKEN | Participation in Farmer's Cooperatives and Its Effects on Agricultural Incomes: Evidence from Vegetable-producing Areas in China | 2016 |
| 577 | Michikazu KOJIMA and Mariko WATANABE | Effectiveness of Promoting Energy Efficiency in Thailand: the Case of Air Conditioners | 2016 |
| 576 | Bo MENG, Jianguo WANG, Robbie ANDREW, Hao XIAO, Glen PETERS, Jinjun XUE | Spatial Spillover Effects in Determining China's Regional CO2 Emissions Growth: 2007-2010 | 2016 |
| 575 | Kumiko MAKINO | The Framing Discourses of 'Honorary White' in the Anti-Apartheid Movement in Japan | 2016 |
| 574 | Souknilanh KEOLA | Measuring Population Mobility Speed from Space | 2016 |
| 573 | Lei LEI | The Environment Dimension of Food Supply Chain Analysis | 2016 |
| 572 | Humayun KABIR | From School to Work: Muslim Youths' Education and Employment Strategies in a Community in Uttar Pradesh, India | 2016 |
| 571 | Lei LEI | Tea Supply Chain in East Asia | 2016 |
| 570 | Kaoru NABESHIMA and Etsuyo MICHIDA | Japanese Import Survey: Descriptive Statistics | 2016 |
| 569 | Aya Suzuki and Vu Hoang Nam | Food Quality Awareness: Cases from Shrimp Producers in Thailand and Vegetable Consumers in Vietnam | 2016 |
| 568 | Ching-mu CHEN and Satoru KUMAGAI | Economic Impacts of the Kra Canal: An Application of the Automatic Calculation of Sea Distances by a GIS | 2016 |
| 567 | Ikumo ISONO, Satoru KUMAGAI, Kazunobu HAYAKAWA, Souknilanh KEOLA, Kenmei TSUBOTA and Toshitaka GOKAN | Comparing the Economic Impacts of Asian Integration by Computational Simulation Analysis | 2016 |
| 566 | Kazunobu HAYAKAWA, Nuttawut LAKSANAPANYAKUL, Taiyo YOSHIMI | Effect of Import Time on Export Patterns | 2016 |
| 565 | Kazunobu HAYAKAWA | Domestic and International Border Effects | 2016 |
| 564 | Bo MENG, Norihiko YAMANO, Satoshi INOMATA, Hao XIAO, Jianguo WANG, Jiabai YE | Compilation and Applications of Extended OECD Inter-country Input-Output Tables: Considering a Target Country's Domestic-regional Heterogeneity | 2016 |
| 563 | Asao ANDO and Bo MENG | A Unified Framework of Trade in Value Added: Physical, Monetary, Exchange Rates, and GHG Emissions | 2016 |
| 562 | Satoru SHIMOKAWA | Dietary Patterns and Nutritional Impacts of Rising Food Prices in Asian Countries | 2016 |
| 561 | Noriyuki OSADA | Housing the Rangoon Poor: Indians, Burmese, and Town Planning in Colonial Burma | 2016 |
| 560 | Tadashi ITO, Toshiyuki MATSUURA and Chih-Hai YANG | Stability of Complementarity between Japanese FDI and Import of Intermediate Goods: Agglomeration Effects and Parent-Firm Heterogeneity | 2016 |
| 559 | Ikumo ISONO and Hikari ISHIDO | Service liberalization in Lao PDR | 2016 |
| 558 | Kaoru NABESHIMA, Byeongwoo KANG, and Mila KASHCHEEVA | Descriptive Analysis of the Knowledge Network Formation in East Asia | 2016 |

| No. | Author(s) | Title | |
|---|---|---|---|
| 557 | Yoko ASUYAMA and Hideaki GOTO | Negative Skill Sorting across Production Chains | 2016 |
| 556 | Yuya KUDO | Malaria Infection and Fetal Growth during the War: Evidence from Liberia | 2016 |
| 555 | Satoshi INOMATA | Adjustment Methods of National Input–Output Tables for Harmonized and Consistent Multi-Regional Input–Output Databases | 2016 |
| 554 | Kiyoyasu TANAKA | Do International Flights Promote Foreign Direct Investment? The Role of Face-to-Face Communication | 2016 |
| 553 | Yasushi HAZAMA | Influence of Economic Performance and Corruption on Voting Behavior in a Predominant Party System | 2016 |
| 552 | Satoshi NAKANO, Kazuhiko NISHIMURA and Jiyoung KIM | Structural Propagation of Productivity Shocks: The Case of Korea | 2016 |
| 551 | Ashwini DESHPANDE, Alain DESROCHERS, Christopher KSOLL and Abu S. SHONCHOY | The Impact of a Computer Based Adult Literacy Program on Literacy and Numeracy: Evidence from India | 2016 |
| 550 | Masahiko GEMMA | Time Preference of Rice Producing Households in the Mekong Delta, Vietnam | 2016 |
| 549 | Lorenzo ROTUNNO, Pierre-Louis VEZINA, and Tadashi ITO | Heckscher-Ohlin: Evidence from virtual trade in value added | 2016 |
| 548 | Toshitaka GOKAN | On the sustainability of a monocentric city: Lower transport costs from new transport facilities | 2016 |
| 547 | Hisaya ODA and Yuko TSUJITA | Rural Electrification Revisited: The Case of Bihar, India | 2015 |
| 545 | Yoko ASUYAMA | Skill Sorting and Production Chains: Evidence from India | 2015 |
| 544 | Yoshihiro HASHIGUCHI | Allocation Efficiency in China: An Extension of the Dynamic Olley-Pakes Productivity Decomposition | 2015 |
| 543 | Satoru SHIMOKAWA | Is Prohibiting Land Reallocation Enough to Promote the Development of Farmland Rental Markets in China? | 2015 |
| 542 | Kazunobu HAYAKAWA, Tadashi ITO, and Toshihiro OKUBO | On the stability of intra-industry trade | 2015 |
| 541 | Kazunobu HAYAKAWA, Nuttawut LAKSANAPANYAKUL, and Shujiro URATA | Measuring the Costs of FTA Utilization: Evidence from Transaction-Level Import Data of Thailand | 2015 |
| 540 | Kazunobu HAYAKAWA, Toshiyuki MATSUURA, and Sadayuki TAKII | Does Trade Liberalization Boost Quality Upgrading?: Evidence from Indonesian Plant-Product-Level Data | 2015 |
| 539 | Hisatoshi HOKEN and Qun SU | Measuring the Effect of Agricultural Cooperatives on Household Income Using PSM-DID | 2015 |
| 538 | Byeongwoo KANG | What best transfers knowledge? Capital, goods, and innovative labor in East Asia | 2015 |
| 537 | Momoe MAKINO | Better than Nothing? Dowry in the Absence of the Legal Protection of Women's Inheritance Rights | 2015 |
| 536 | Takeshi KAWANAKA | The Stakes of Politics and Electoral Administration: A Comparative Study of Southeast Asian Democracies | 2015 |
| 535 | Tadashi ITO and Pierre-Louis VEZINA | Production fragmentation, Upstreamness, and Value-added: Evidence from Factory Asia 1990-2005 | 2015 |
| 534 | Momoe MAKINO | Marriage, Dowry, and Women's Status in Rural Punjab, Pakistan | 2015 |