Is Contract Farming More Profitable and Efficient Than Non-Contract Farming－ A Survey Study of Rice Farms In Taiwan

by

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Abstract

Trade liberalization and globalization has modernized the food retail sector in Taiwan, affecting consumers, producers and trade patterns. These changes have placed significant pressures on farmers and processors including more stringent quality control and product varieties. The government has launched a rice production-marketing contract program in 2005 to assist rice farmers and the agro-business sector to work together as partners. The minimum scale for each contract is 50 hectares of adjacent rice paddies with 50 participants including rice farmers, seedling providers, millers and marketing agents. In order to evaluate the outcome of this program, a survey is conducted in the summer of 2005 after the first (spring) crop is harvested. Information of price and value of output and major variable and fixed inputs are collected along with characteristics of the farmers and farms. The survey results show that the average revenue of a contract farm is about 11 percent higher than an average non-contract farm. The per hectare cost of production in a contract farm is about 13 percent lower and as a result the average profit margin under contract is more than 50 percent above those without contract. A swtiching regression profit frontier model is adopted to further investigate their efficiency performance. The result indicates that an average contract farms is 20 percent more efficient than an average non-contract farm in a comparable operating environment. The results also suggests that although contract farming has potential to improve the profit of smallholders, it is not a sufficient condition for such improvement.

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A Survey Study of Rice Farms In Taiwan

I. Introduction

Contract farming has been proposed as an avenue for private sector to take over the roles previously served by the government in the provision of information, inputs or credit for small-scale farmers in the developing countries (World Bank, 2001). Increasing attention has been given to whether contract farming can provide small farmers with improved income or sufficient protection from incurring losses due to price fluctuations. Rice production in Taiwan is largely based on small family holdings with an average size of one hectare per farm for more than 30 years. Farmers learn to gain production and scale efficiencies by organizing custom farming teams to work for those who do not own machineries (Fujiki, 1999). Most rice farmers are independent producers, who sell their products individually and have little bargaining power with input suppliers and produce markets.

Over the years, the government guaranteed procurement at a support price 20 percent above the average production costs has increased rice production and created imbalances in the supply and demand in the rice market. The government procurement scheme has also served as a major vehicle to stabilize rice price which is three times the world level as well as farmers´ income. Importation of rice is banned to provide extra protection for the domestic high-cost producers. However, after formally joining the WTO in January 2002, Taiwan began to open up its market to imports of rice. A total of 144,000 metric tons of rice are imported annually under the quota system, which is equivalent to about 8 percent of annual consumption.

Both rice farmers and marketing chain have been brought to the crossroad and must undertake fundamental changes. However, the present rice marketing system has failed to provide a conducive environment due to the insufficient forward and backward linkages after a long history of government protection. Farmers suffer income losses from price fluctuations because any slight increase(decrease) in rice production leads to a price crash(boom). On the other side of the market, trade liberalization and globalization has also modernized the food retail sector in Taiwan, affecting consumers, producers and trade patterns. Consumers have been willing to pay for more variety and higher quality foods and increased value-added services. These changes have placed additional pressures on farmers and processors including more stringent quality control and product varietiy.

To overcome such bottleneck, the government has launched a rice production-marketing contract program in 2005 to assist rice farmers and the agro-business sector to work together as partners toward prosperity. The minimum scale for each contract is 50 hectares of adjacent rice paddies with 50 participants including rice farmers, seedling providers, millers and marketing agents. Locally-adapted improved seedling and low-input technologies are provided to the rice farmers and millers under the contract program supervised by the local extension services and food agencies. The participating farmers have to adopt the production traceability and book-keeping system and agree not to sell their product to other buyers including the government. Contract farming can be particularly beneficial for rice farmers to acquire new technical and managerial know-how and for agro-industry to meet consumers´ demand for quality and safe products.

In order to evaluate the outcome of this program, a survey is conducted in the summer of 2005 after the first (spring) crop is harvested. Information of price and value

of output and major variable and fixed inputs are collected along with characteristics of the farmers and farms. The survey covers 80 contract farmers in 7 provinces producing different varieties of rice throughout the major production districts. For comparison purposes, 246 non-contract farmers are also interviewed in the same or nearby villages within the same province and other adjacent provinces. The distribution of farm size is quite similar with an average of 2.09 and 2.00 hectares for the contact and non-contract farms respectively. The survey results show that the average revenue is NT$145,000 per hectare on a contract farm, which is about 11 percent higher than an average non-contract farm. The per hectare cost of production in a contract farm is about 13 percent lower than the con-contract farm. As a result, the average profit margin under contract is more than 50 percent above those without contract. A stochastic profit frontier model will be adopted to further investigate the efficiency performance and its determinants for both contract and non-contract farms. The result will also be used to test the hypothesis that contract farms are more efficient than non-contract farms in a comparable operational and technological environment. Policy recommendations on whether contract farming can indeed be a new and an effective institutional reform mechanism to increase profitability for small-scale family farms will be drawn.

The remainder of this study is organized as follows. The next section describes the survey design followed by a brief description of the sample data and empirical model. Section four presents the empirical results and the final section concludes.

II. Survey Design and Sample Characteristics

This section illustrates the survey design and the characteristics of the sample. Both contract and non-contract farms are interviewed. The choice of survey sites

was based on the official record of the contracts. Geographical dispersions are also taken into consideration because the rice variety is affected by the climate and local production environment. For example, Taigon No 9 and Tainon No 71 are widely adopted varieties in the northern and central regions, while Taigon No. 2 and Kaoshung No 139 are more popular in the southern and eastern regions. To enhance the sample's representative, a stratified sampling procedure is adopted. First, the sample size in each township is determined in proportion to the hectares under contract. Then, the sample farm is randomly drawn from the contract listing provided by the rice millers who offer the contract. The non-contract farms from the sample province or nearby provinces are selected in proportion to the planting hectares from the list provided by the extension specialists of the township Farmer's Associations. Table 1 lists the sample distribution by province and township. The numbers of contract and non-contract farms interviewed are 80 and 246, respectively. Ten farms were interviewed for the questionnaire pretest purposes followed by a formal on-site survey conducted in July 2005.

Questions regarding previous planting experiences, rice variety, contract prices, production costs, and demographic factors are addressed in the questionnaire. Demographic factors included socio-economic data, household size and off-farm income. Table 2 illustrates the socio-economic characteristics of the household heads of the sample farms. For the contract farms, most of the household heads are 50 years old males, had a elementary-level education and have no off-farm jobs. The non-contract farm household heads have similar characteristics except a much higher off-farm job participation rate. Overall speaking, household heads for contract farms are younger and more specialized in rice farming than non-contract farms.

Table 3 compares the average revenue and production cost of contract and non-contract farms in each region on per hectare basis. First, the average revenues of contract farms are higher than those of non-contract farms in most regions except the southern region. The output per hectare is about the same. Therefore, the major reason of higher revenue is due to higher rice quality. Most of the contract farms receive higher prices except those in the southern region. A flooding event in 2005 damaged the first crops in many agricultural provinces in the southern region. However, these contract farms still outperform the non-contract farms by higher yields per hectare. So despite the flooding damage, the total revenues are still better than the non-contract ones.

Next, the contract farms spend more on their seeds due to variety differences. However, due to strict restriction on fertilizer and chemical usages, these contract farms spend much less on the chemical expenditures. Therefore, on average the total expenditure n of contract farms is 20 percent lower than those of non-contract farms. The gross and net revenues of contract farms are higher than the non-contract farms for all regions. The profit margins on the gross basis range from NT$6,000 in the north up to NT$60,000 in the east. On the net basis, the profit margin of entering the contract arrangement is about NT$40,000 in the central region and NT$60,000 for those located the southern and eastern regions. The net revenues of the farms in the northern region have the smallest margin or no benefit at all from the contract.

III. Empirical Model

A rice farmer's decision on whether to sign up a production-marketing contract is a self-selection problem and such a problem can be described by a switching regression model and a criterion function (Lee, 1978; Huang et al., 2002). Suppose the i^{th} rice

farmer has two choices, joining or not joining a contract, and this decision is determined by the following profit functions, π_C and π_N, for contract and non-contract farmers respectively:

$$\pi_{Ci} = X_{Ci}\beta_C + \varepsilon_{Ci}, \quad (1)$$

$$\pi_{Ni} = X_{Ni}\beta_N + \varepsilon_{Ni}, \quad (2)$$

where X_{Ci} and X_{Ni} are the vectors of profit determinants of contract options while ε_{Ci} and ε_{Ni} are stochastic error terms with zero means and the variances σ_C^2 and σ_N^2, respectively. The farmers' decision on joining or not this contract depends on the profit differential between contract and non-contract and other non-profit considerations and can be described by a criterion function as follows:

$$\mathrm{I}_\mathrm{i}^* = Z_i\alpha + \gamma(\pi_{Ci} - \pi_{Ni}) + \varepsilon_i \quad (3)$$

where Z_i is a vector of non-profit variables while the random variable ε_i represents the unobservable factors that affect the selection of joining a contract. The criterion function in equation (3) indicates that a rice farmer may join the contract if the profit from joining the contract is higher than the profit without the contract. Since the farmer can only choose either to sign a contract or to stay independent, only one of the two profits (X_{Ci} or X_{Ni}) can be observed. Therefore, the dependent variable $I_i^* > 0$ if the profit of joining contract is observed or $I_i^* \le 0$ when the profit of non-joining contract is found.

Equations (1) to (3) cannot be estimated directly because the decision to contract may be determined by unobserved variables (e.g., farmers' characteristics, management ability) that may also affect performance. Therefore, the error terms in (1)~(3) will be correlated.

A standard two-stage procedure of Lee (1978) and Willis and Rosen (1979) is adopted to allow unbiased estimation. Suppose two inverse Mills ratios W_{Ci} and W_{Ni} derived from equation (3) are applied into equations (1) and (2) as follows:

$$\pi_{Ci} = X_{Ci}\beta_C + \delta_C W_{Ci} + \varepsilon_{Ci} \qquad \text{for } I_i = 1, \text{ and} \qquad (4)$$

$$\pi_{Ni} = X_{Ni}\beta_N + \delta_N W_{Ni} + \varepsilon_{Ni} \qquad \text{for } I_i = 0 \qquad (5)$$

In the empirical procedure, the two inverse Mills ratios are estimated from equation (3) using probit choice models. Later, these two estimated inverse Mills ratios, $\hat{W}_{Ci}$ and $\hat{W}_{Ni}$, are incorporated into equations (4) and (5) to correct the sample selection bias and to obtain the unbiased estimators for ($\hat{\beta}_C, \hat{\beta}_N, \hat{\delta}_C, \hat{\delta}_N$) using least square methods.

To estimate the inefficiency for non-contract rice farmers, the first step is to calculate the residual from equation (5) where the residual is calculated as:

$$e_{Ni} = \pi_{Ni} - X_{Ni}\hat{\beta}_N - \hat{\delta}_N \hat{W}_N = v_{Ni} + u_{Ni} - E(\varepsilon_{Ni}) \qquad (6)$$

Following the study by Huang et al. (2002) on the definition of efficiency, the $\pi_{Ni}^{\max}$ is denoted as the maximized profit of non-contract rice farmers. So the deviation of profit π_{Ni} from the frontier, $\pi_{Ni}^{\max} - \pi_{Ni}$, is a composite error ($\varepsilon_{Ni}$) that consists of a symmetric, two-sided error, v_{Ni}, and a one-sided component, u_{Ni}. Suppose v_{Ni} is a normally distributed function with mean 0 and variance σ_v^2 while u_{Ni} is normally truncated at a distribution function with mean 0 and variance σ_u^2. The estimated variances of σ_v^2 and σ_u^2 can be obtained, respectively, by the method of moments (Olson et al., 1980) as follows:

$$\hat{\sigma}_u^2 = [\frac{m_3}{\sqrt{2/\pi}(4/\pi - 1)}]^{2/3}, \text{ and} \quad (7)$$

$$\hat{\sigma}_v^2 = m_2 - [1 - \frac{2}{\pi}]\hat{\sigma}_u^2 ,$$

where m_2 and m_3 are the second and third moments of the residual e_{Ni}.

The profit inefficiency for a non-contract farmer can be estimated following Battese and Coelli (1988) accordingly:

$$E(\exp(-u_{Ni}) \mid \varepsilon_{Ni}) = \frac{\Phi(\mu_{Ni}^* / \sigma_* - \sigma_*)}{\Phi(\mu_{Ni}^* / \sigma_*)} \exp(-\mu_{Ni}^* + \frac{1}{2}\sigma_*^2), \quad (8)$$

where $\mu_{Ni}^* = \hat{\varepsilon}_{Ni} \frac{\hat{\sigma}_u^2}{\hat{\sigma}_v^2}$, $\sigma_*^2 = \frac{\hat{\sigma}_u^2 \hat{\sigma}_v^2}{\hat{\sigma}^2}$, $\hat{\sigma}^2 = \hat{\sigma}_u^2 + \hat{\sigma}_v^2$, $\hat{\varepsilon}_{Ni} = e_{Ni} + \sqrt{2/\pi}\,\hat{\sigma}_u$.

IV. Estimation Results

The data in this study were taken from the survey described in Section 2 during a period of July to September in 2005. After deleting the samples with missing observations, the empirical estimation is based on 201 non-contract sample farms and 80 contract sample farms. Table 4 summarizes the sample statistics for both contract and non-contract farms. The average planting acreage of the contract farm is 2.21 hectare, which is slightly higher than the average of non-contract farms 1.73 hectare.

The average age of contract farms' household heads is only 43 years old. This is much younger than the 60 years old of the non-contract household heads. The percentage of full time contract farm household heads is 70%, which is higher than the 52 % of the non-contract farms. The percentage of farmers receiving high school or above education is also higher than those of non-contract farms. This suggests that contact farmers

tend to have more years of education than the non-contract farmers.

As for production costs, Table 4 shows that chemical and machine costs for rice contract farmers are less than non-contract farmers while there is no significant difference in seed cost. The profit of contract is on average 27% higher than without joining contract.

The empirical model for estimating the decision to join the contract versus to product independently is specified as follow:

$$I_i = \gamma_0 + \gamma_1(AGE)_i + \gamma_2(EDU)_i + \gamma_3(FULL)_i + \gamma_4(REVENUE)_i + \gamma_5(REG)_i + \varepsilon_i, \qquad (9)$$

where $I_i = 1$ if a latent profit margin from joining the contract is positive while it is 0 otherwise.

The estimation results for equation (9) are shown in Table 5. Table 5 shows that having a primary occupation on-farm raises the likelihood of contracting. This is consistent with our expectations. However, increases in years of age and education lower the probability that farmer will join the contract. Older rice farmers would less likely to join the contract probably because of the habit formation effect. They are reluctant to change unless necessary. More educated farmers may also have a higher income and thus a higher reservation wage to be induced into contract production. Table 5 also suggests that farmers in the eastern region are more likely to accept a contract because these farmers could earn more than could farmers in other regions.

The empirical model for estimating the impact of contract production on farm's profit performance taking into account the selection process are denoted as follows:

$$
\begin{aligned}
\ln(\pi)_i = {} & \beta_0 + \beta_1 \ln(SEED)_i + \beta_2 \ln(CHEM)_i + \beta_3 \ln(LABOR)_i + \beta_4 \ln(ACRE)_i \\
& + \beta_5 \ln(SEED * CHEM)_i + \beta_6 \ln(SEED * LABOR)_i \\
& + \beta_7 \ln(CHEM * LABOR)_i + \beta_8 \ln(CHEM * ACRE)_i \\
& + \beta_9 \ln(LABOR * ACRE)_i + \beta_{10} \ln(AGE)_i + \beta_{11} \ln(EDU)_i \\
& + \beta_{12} \ln(FULL)_i + \beta_{13} \ln(REG)_i + \delta_{1i} W_i + \delta_{2i} W_i * \ln(ACRE) + \varepsilon_i,
\end{aligned}
\tag{10}
$$

where subscript $i = c$ for contract farms and $i = nc$ for con-contract farms.

The estimation results for equations (10) are shown in Table 6 with the selectivity bias adjusted. First, the farm size (*ACRE*) has positive and significant impact on the profit of contract farms, but all other inputs like seed, chemical and labor have no significant impact except when they are interacted with the farm size. This result suggests that the profit of contract farming is highly correlated with the acreage devoted to the contract. This is expected because the contract usually requires farmers to comply with certain input allocation restrictions. Thus farmers lose control over their management decisions and the linkage of profit and input usage no longer exists. The other implication is that larger farms benefit more than the smaller ones once they join the contract. The results for non-contract farms are quite different in that inputs other than acreage are the major determinants of the profit. Thus the autonomy of input allocations is preserved by the non-contract farmers.

As for the non-profit determinants, both location and employment status play a significant role in the profit. Farms located in the eastern region has higher profits than those located in other regions, however it is only statistically significant for those under the contract arrangement. Part-time contract farmers earn higher profits than their full-time peers. Thus, although full-time farmers have larger probability to participate contract farming, they may not be better off than those par-time contract farmers. This may reflect a trade-

off between profit gain and loss of autonomy by the contract. However, the case for non-contract farms is opposite. Full-time farmers enjoy higher profits than their part-time peers because there is no loss of managerial control when farmers produce independently.

Because the scale of production has a strong positive correlation with the likelihood of contracting, we also add an interaction term of sample selection and scale (i.e., W_i*$ACRE$) when the two mill's ratios (W_i) are added into the model. The coefficients of the selectivity bias adjustment (W_i) are both significant but have the opposite signs with $\delta_{1c} = -0.84$ and $\delta_{1nc} = 0.48$. This result implies that those who choose to join the contract are worse than the average contract farmers in terms of profit earnings. Those who choose to produce independently are better than the average independent farmers. The positive and significant $\delta_{2c} = 0.28$ implies that larger farm size is associated with an increasing profit for contract farms.

Finally, Table 7 shows the estimates of profit margins of non-contact farms over contract farms and the measurement of profit in-efficiency of the non-contract farms for the entire sample and for subgroups by farm size, by full-time versus part-time, and by location. As sown in Table 7, for the sample as a whole there is about 20 percent profit efficiency in contract rice farming. There is no significant variation in inefficiency by farm scale, by full-time versus part-time, or by location. Older farmers tend to be more in-efficient when they produce independently. Joining the contract may help them gain efficiency in profit earnings.

V. Concluding Remark

Contract farming has become an attractive policy instrument for many developing countries to assist small farmers to gain access to markets, information, credits, and

necessary services to manage their risk. On the other hand, contract farming may have subtle impacts on both farmers' income and managerial control. Therefore, the success or effectiveness of this policy instrument depends on whether these contracts are attractive enough for the farmers by increase their profits while loss of autonomy can be minimized. In this paper, we conduct an on-farm survey on more than 300 rice farmers in Taiwan. The per hectare cost of production in a contract farm is about 13 percent lower and as a result the average profit margin under contract is more than 50 percent above those without contract.

Next, a switching regression model is adopted to analyze farmers' decision on contract participation and profit performance. The estimation result indicates that an average contract farms is 20 percent more efficient than an average non-contract farm in a comparable operating environment. These results imply that contract arrangement can indeed be an effective institutional reform mechanism to increase profitability and competitiveness for small-scale family farms. We also find that the contract decision is determined not only by a profit comparison between contract and independent production but also by other demographic determinants like age, education level, employment status and geographical locations.

Finally, we find that none of the inputs except land size is significant factor determining the profit. Larger farms tend to benefit more from the contract. Therefore, although contract farming has potential to improve the profit of smallholders, it is not a sufficient condition for such improvement. Small farmers can be excluded from contracts partly because they cannot take advantages in profit earnings and partly because they can be adversely affected by the loss of autonomy in input allocation by the contract.

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Table 1. Sample Size and Geographical Distribution

Region	Province	Township	Contract farm	Non-contract farms
North	Taoyuan	Shinwu		13(5.3%)
	Miaoli	Yuanli	6(7.5%)	9(3.7%)
		Sub-total	6(7.5%)	22(8.9%)
Central	Taichung	Taichia		19(7.7%)
		Wufeng	5(6.3%)	12(4.9%)
	Chunghwa	Fushing		16(6.5%)
		Pitou	12(15%)	15(6.1%)
		Erlin	9(11.3%)	
		Hermei		15(6.1%)
		Sub-total	26(32.5%)	77(31.3%)
South	Yunlin	Tsutung	3((3.8%)	14(5.7%)
	Chiayi	Taibao		13(5.3%)
		Shinkung		13(5.3%)
		Minshung		12(4.9%)
	Tainan	Hobin		15(6.1%)
		Shenghua		16(6.5%)
		Shiayin	6(7.5%)	
		Baihe	5(6.3%)	
	Kaoshung	Daliao		12(4.9%)
	Pintung	Wondan		13(5.3%)
		Sub-total	14(17.5%)	108(43.9%)
East	Yilang	Jiaoshi		13(5.3%)
	Hualian	Fuli	6(7.5%)	16(6.5%)
	Taitung	Kuanshan	11(13.8%)	7(2.8%)
		Tsushung	17(21.3%)	3(1.2%)
		Sub-total	34(42.5%)	39(15.9%)
TOTAL			**80(100%)**	**246(100%)**

Table 2. Socio-Economic Characteristics of the Sample

	Number of Sample		Percentage in Total (%)	
	Contract	Non-contract	Contract	Non-contract
Gender				
Male	76	236	95.00	98.74
Female	4	3	5.00	1.26
Age				
Below 30	1	0	1.25	0.00
31~40	5	10	6.25	4.25
41~50	11	37	13.75	15.75
51~64	34	106	42.5	45.11
65 and above	29	82	36.25	34.89
Education				
None	9	8	11.25	4.19
Elementary	39	87	48.75	45.55
Middle school	13	46	16.25	24.08
High school	15	41	18.75	17.15
Vocational college	3	8	3.75	3.34
College and above	1	1	1.25	0.41
No. in farming				
1	31	69	38.75	28.87
2	37	131	46.25	54.81
3	8	28	10.00	11.72
4 and more	4	11	5.00	4.60
Type				
Full-time	56	136	70.00	55.28
Part-time	24	110	30.00	44.72

Table 3. Revenues and Production Cost of Sample Farm by Region

Unit: Kg/Hectare; NT$/Hectare

	North		Central		South		East		Total	
	Con-tract	Non-contract	Con-tract	Non-contract	Con-tract	Non-contract	Con-tract	Non-contract	Con-tract	Non-contract
Revenue	116,492	109,732	141,697	114,648	121,996	115,646	148,153	85,735	145,289	105,183
Production	7,789	7,625	7,393	7,729	9,550	7,706	6,379	5,887	7,074	7,143
Price	15.0	14.4	19.2	14.8	12.8	15.0	23.2	14.6	20.5	14.7
Total Cost	97,791	91,152	107,337	109,452	84,520	142,934	90,089	96,077	94,062	112,460
Direct	59,608	59,006	66,884	71,864	62,960	107,599	54,598	50,288	60,692	72,909
Seed	8,516	7,909	8,364	7,941	8,652	8,213	7,224	5,578	7,932	7,192
Pesticide	871	6,010	6,787	9,796	9,413	12,220	6,247	4,666	6,794	8,505
Fertilizer	12,514	13,902	11,971	9,683	9,627	11,678	9,287	8,281	10,347	9,863
Material	0	0	2,060	3,459	0	12,419	0	3,451	1,539	6,372
Custom	31,343	29,483	29,777	29,443	25,634	37,539	25,805	16,833	27,323	26,325
Hire labor	3,966	0	5,286	8,446	3,727	14,943	3,385	11,479	3,562	10,340
Energy	2,398	1,701	2,639	3,095	5,907	10,587	2,651	2,812	3,196	4,312
Indirect	38,183	32,146	40,453	37,588	21,560	35,334	35,491	45,789	33,370	39,551
Self-wage	16,696	16,696	21,376	20,987	11,800	14,734	21,484	18,848	18,892	19,298
Land rent	21,487	15,450	19,077	16,601	9,760	20,600	14,007	26,941	14,478	20,253
Gross Profit	56,884	50,726	74,813	42,785	59,036	8,047	93,556	35,447	84,596	32,274
Net Profit	18,701	18,580	34,360	5,196	37,476	-27,287	58,065	-10,342	51,227	-7,277

Table 4. Sample Statistics: Means and Standard Deviation

Variables	Non-Contract Farms	Contract Farms
Acreage (hectare)	1.73	2.21
	(1.51)	(1.82)
Age	60.27	43.31
	(9.95)	(4.66)
Education (%)	19.90%	23.75%
Full Time (%)	52.06%	70.00%
Seed Cost ($NT)	779.05	777.08
	(1290.4)	(96.69)
Chemical Cost ($NT)	995.96	626.05
	(1802.0)	(386.50)
Fertilizer Cost ($NT)	605.92	922.19
	(1068.8)	(473.87)
Labor Cost ($NT)	3110.5	1812.5
	(3006.5)	(1208.9)
Profit ($NT 1000)	221.35	280.94
	(209.33)	(248.01)

Note: The numbers in the parenthesis represent the standard deviations ㎜.
Education is the percentage of sample with education higher than high school level.
Full time is the percentage of full-time farmers in the sample.

Table 5. Probit Estimation of the Sample Selection Model

Variables	Coefficients and Standard Errors
Constant	10.526**
	(2.106)
Age	-0.192**
	(0.039)
Education	-0.695**
	(0.218)
Full Time	0.696*
	(0.440)
Revenue	0.27*E-06
	(0.11E-05)
Region Dummy	1.586**
	(0.686)
McFadden R-Square	0.7313
LR Statistic	120.48

Note: Region Dummy variable is defined as 1 if the region is located East Taiwan while it is zero for other regions.
The numbers in the parenthesis are standard errors.
** means significant at 5% significant level while * is significant at 10% significant level.

Table 6. Estimation Profit Functions for Contract and Non-Contract Rice Farmers

Variables	Contract	Non-Contract
Constant	24.18	-101.39*
	(40.07)	(61.14)
SEED	-3.13	4.95
	(5.44)	(7.51)
CHEM	-0.46	12.68**
	(3.19)	(4.53)
LABOR	-2.35	14.34**
	(3.74)	(7.30)
ACRE	4.57**	-0.74
	(1.82)	(2.56)
SEED*CHEM	0.19	-0.15
	(0.39)	(0.51)
SEED*LABOR	0.56	-0.71
	(0.52)	(0.89)
CHEM*LABOR	-0.19	-1.43**
	(0.12)	(0.35)
SEED*ACRE	-0.67**	0.84**
	(0.28)	(0.33)
CHEM*ACRE	0.17**	-0.20*
	(0.08)	(0.12)
LABOR*ACRE	-0.04	-0.31
	(0.05)	(0.13)
AGE	-0.01	-0.01
	(0.07)	(0.08)
EDUCATION	0.002	-0.03
	(0.02)	(0.04)
FULL	-0.11*	0.19**
	(0.058)	(0.08)
REGION	0.16**	0.18
	(0.08)	(0.19)
W (Inverse Mills ratio)	-0.84**	0.48*
	(0.40)	(0.26)
*W**ACRE	0.28**	-0.06
	(0.12)	(0.07)
Adjusted R-Square	0.974	0.942

Note: The profit function is a translog function which means we take logarithm on both the dependent and independent variables except for AGE, EDUCATION, FULL, and REGION variables.

Table 7. Profit in-efficiency of Non-contract Farms

	Non-Contract
All Farmers	0.8110
Full-Time Farmers	0.8117
Part-Time Farmers	0.8104
Large Scale	0.8118
Small Scale	0.8107
Older Farmers	0.8060
Young Farmers	0.8178
East Region	0.8117
Non-East Region	0.8100