Rice Contract Farming in Lao PDR: Moving from Subsistence to Commercial Agriculture

Sununtar Setboonsarng

PingSun Leung

Adam Stefan

February 2008

ADB Institute Discussion Paper No. 90

Sununtar Setboonsarng is a senior research fellow at the Asian Development Bank Institute. Ping Sun Leung was an off-site visiting fellow at the Asian Development Bank Institute from December 2005 to August 2006. He is also a professor of molecular biosciences and bioengineering at the University of Hawaii at Manoa, Honolulu, USA. Adam Stefan is a research associate at the Asian Development Bank Institute.

ADBI's discussion papers reflect initial ideas on a topic, and are posted online for discussion. ADBI encourages readers to post their comments on the main page for each discussion paper (given in the citation below). Some discussion papers may develop into research papers or other forms of publication.

This discussion paper is part of an ADBI research project on contract farming and market facilitation for the rural poor. The project will produce a book, tentatively titled *Making Globalization Work for the Poor and the Environment: Contract Farming and Organics*.

Suggested citation:

Setboonsarng, Sununtar, PingSun Leung, and Adam Stefan. 2008. Rice Contract Farming in Lao PDR: Moving from Subsistence to Commercial Agriculture. ADBI Discussion Paper 90. Tokyo: Asian Development Bank Institute. Available: http://www.adbi.org/discussion-paper/2008/02/25/2492.rice.contract.farming.in.lao.pdr/

Asian Development Bank Institute
Kasumigaseki Building 8F
3-2-5 Kasumigaseki, Chiyoda-ku
Tokyo 100-6008, Japan

Tel: +81-3-3593-5500
Fax: +81-3-3593-5571
URL: www.adbi.org
E-mail: info@adbi.org

Abstract

Poverty is prevalent among small farms in transition economies such as the Lao PDR, where market failures prevail and subsistence production is the norm. Contract farming is emerging as a promising tool to facilitate market linkages and provide the necessary supports that enable small farms to transition to commercial production. Using data from a household survey of 332 contract farmers and 253 non-contract farmers, this study attempts to empirically assess the potential of contract farming as a development tool to increase small farm incomes and reduce rural poverty.

Using propensity score matching methodology and an endogenous switching regression model to assess the profitability of contract and non-contract rice farms in the Lao PDR, we found that contract farmers earn significantly higher profits than non-contract farmers. The results also show that contract farming tends to provide the greatest increase in income to farmers with below-average performance. These findings suggest that contract farming can be an effective private-sector-led mechanism to facilitate the transition to commercial agriculture. In addition to bringing foreign direct investment (FDI) into the rural sector, contract farming can be an effective tool to improve the profitability and raise the incomes of small farmers, thereby reducing poverty in rural areas with limited market development.

JEL Classification: Q12, Q13, O31

Contents

I. INTRODUCTION

As globalization and market liberalization profoundly change global agricultural production, small farms in developing countries are at risk of being excluded from the opportunities for higher-value production arising from the opening of regional and international markets. Small farms typically lack the resources, knowledge, and information to compete in increasingly integrated markets. They are hampered by imperfect market information, poor infrastructure, and have few links with buyers in the marketing chain. These disadvantages contribute significantly to the low incomes and poverty found in developing countries where small farms dominate the agricultural sector.

In the Lao PDR, agriculture accounts for nearly half of the country's gross domestic product (GDP) and employs 77% of the national workforce according to the United Nations Development Programme/National Statistics Centre (UNDP/NSC, 2006). Rice cultivation is the single most important economic activity, accounting for half of all agricultural output and one-fifth of total GDP. Almost all of the country's agricultural output is produced on small family farms. Despite the importance of agriculture to the national economy, poverty in the Lao PDR is most prevalent among small farming households. An estimated 87% of the country's poor live in households headed by farmers (NSC, 1999).

Although the enactment of the New Economic Mechanism (NEM) in 1986 opened the country to international markets, low market integration remains the prevailing condition. The vast majority of farmers practice subsistence rice farming and lack access to the supports necessary to improve their productivity and income. Market access is limited due to poor infrastructure, insufficient market information, and a regionally confined marketing system dominated by a limited number of traders (MPDF, 2004).

To facilitate the transition from subsistence to a market-oriented economy, the government has encouraged foreign direct investment (FDI) by the private sector in rural areas. In areas where transport infrastructure has been put in place, FDI has flowed in to take advantage of the country's relatively abundant, fertile land and low cost of labor.

One example of private sector investment that has proliferated in recent years is contract farming, an institutional arrangement that links farmers to consumers in foreign or domestic markets and links farmers to vital inputs. Under a typical contract agreement, the contracting firm (usually an agro-processing or marketing firm) agrees to purchase a specific commodity at an agreed-upon price and time, while the farmer agrees to supply the contracted quantities at the specified quality standards. The contracting firm also agrees to provide the farmer with production inputs and in-kind credit, to be reimbursed by the farmer at the time of sale.

While contract farming appears to facilitate market linkages and provide opportunities for farmers to increase their income, the rapid and widespread expansion of contract farming has prompted us to take a closer look at its benefits and costs to smallholders.

Using the case of Lao Arrowny Corporation, a Lao-Japanese joint venture that has contracted more than 2,000 farmers since 2002 to produce Japanese rice for export, this study provides a comprehensive comparison of contract rice farming households and non-contract rice farming households under similar agro-ecological and social conditions. It employs propensity score matching comparison and endogenous switching regression models to determine if contract farms are more profitable than non-contract farms, and whether contract farming is biased towards more competitive farms.

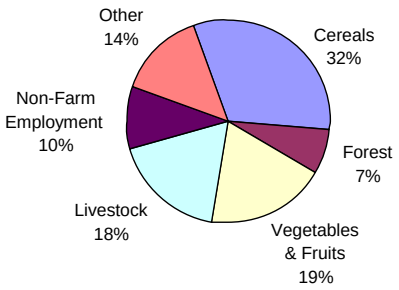
The first section of the paper examines the agricultural production and marketing system and provides an overview of contract farming in the Lao PDR. The second section describes the

survey data and summarizes the household characteristics of the sampled farms. The third section briefly discusses the methodology used in this study and presents the results of the profitability comparisons. A concluding section summarizes the main findings.

II. PRODUCTION AND MARKETING IN THE LAO PDR

Crop production systems in the Lao PDR remain primarily subsistence oriented, with minimal use of improved varieties, fertilizers, and pesticides. Although the use of modern inputs is increasing, their adoption has largely been confined to production in the Mekong river corridor (Schiller et al., 2006). Farmers are generally excluded from the growing markets for high-value crops due to the lack of extension mechanisms and credit provision systems. Adoption of new technologies by risk-averse subsistence farmers is also constrained by the absence of risk-sharing strategies.

Figure 1: Average Sources of Rural Household Income in the Lao PDR



Source: UNODC, Laos Opium Survey, 2004

In 2004, average annual productivity (agricultural GDP/agricultural population) was $235 per worker, compared with $148 in Cambodia, $159 in Viet Nam, and $413 in Thailand (FAO, 2006). At the province level, however, there is significant variation in agricultural productivity. While national average productivity (measured in terms of gross revenue from agriculture) is $0.14 per hour worked, the provincial averages range from $0.09 per hour worked in Saravane to $0.26 in Xayabury and Bokeo (NSC, 2005). The comparatively high productivity in Xayabury and Bokeo can be attributed to the prevalence of contract farming and cross-border exports in those provinces, suggesting the potential of market-oriented production to increase productivity and income. Overall, the border districts of the Lao PDR show stronger economic activity and have lower poverty headcounts than non-border districts (World Bank, 2006).

The lack of a functional marketing system is a major barrier to improving the productivity of Lao agriculture. Agricultural marketing is generally on a small scale with short marketing channels. Only 5% of the country's total rice production (approximately 110,000 tons) is commercially marketed (MPDF, 2004). The commercial trade in rice is dominated by a state-owned enterprise, the State Enterprise and Food Crop Promotion (SEFCP), which controls 70% of the market. The SEFCP has historically constrained the growth of trade and output growth by fixing the prices of food commodities (often below production costs) and restricting private sector trade between provinces (ADB, 2006).

Small farms typically sell paddy to traders who visit rural areas or deliver paddy to mills located along the main road or near larger towns for consumption or direct sale in the village. Due to the predominance of spot markets, prices are set by traders based on the previous

season's price or production costs, and price fixing among traders is common. As a result, there is the widespread perception that traders are exploiting farmers (Oraboune and Nanthavongdouangsy, 2006).

III. CONTRACT FARMING IN THE LAO PDR

Contract farming has spread rapidly in the Lao PDR in recent years. Growth in domestic demand for agricultural produce has been driven by urban expansion, providing new market opportunities for small farms, especially those located near urban centers. There is also increasing regional demand from Thailand, Viet Nam, and China for specialty crops including hemp, mulberry paper, castor bean, Job's tears, and palm nut, all of which are produced in Laos.

Thailand, in particular, has actively pursued contract farming as an area for economic cooperation in the Mekong region. Under an initiative of the Association of the Southeast Asian Nations (ASEAN) Free Trade Area (AFTA), for example, Thailand agreed to provide assistance to develop border areas in Laos for contract farming to meet the demand of its growing food industry (MPDF, 2004). Thailand has also announced that it would allow tariff-free importation of all approved agricultural products produced under contract farming in ACMECS[1] member countries.

There is also significant export potential for niche products and organic products. Although small and medium enterprises are marginalized by the advancing consolidation of multinational agribusinesses, certain niche markets remain competitive for small farms (UNDP/NSC, 2006). Diversification of agricultural activities into these high-value markets can improve small farms' incomes.

Contracts can take a wide variety of forms, ranging from a simple verbal agreement between farmer and trader to a written contract that explicitly details the obligations of each party. However, the majority of contract farming ventures in the Lao PDR are informal arrangements between farmers and small traders that operate outside legal boundaries. Firms have reported losses due to farmers violating the contract to sell their crops on the market, while farmers have reported losses because the contracting firm did not share the cost of a failed crop or did not collect the produce after harvest. In such cases, there is no legal avenue for farmers or firms to recover losses (ADB, 2007).

Nonetheless, a number of local and foreign private investors have established medium- to large-scale contract farming agreements with smallholder farmers:

Tea, Phongsaly Province

Tea contract farming in Phongsaly involves 520 households and covers a production area of approximately 400 hectare (ha). The contracts are signed between Chinese traders and the Provincial Government, which organizes farmers to grow the tea for a predetermined price. The Chinese investors provide seed and technical assistance on production and processing methods, and they purchase all of the tea from the farmers to sell in the PRC market.

Maize, Bokeo Province

Maize is produced under verbal contract with a Thai import firm by approximately 600 households with a total cultivation area of 1,136 ha. The firm supplies contracted farmers

[1] 2nd ACMECS Summit, held 3 November 2005 in Bangkok, Thailand. The Ayeyawady-Chao Phraya Mekong Economic Cooperation Strategy (ACMECS) is a cooperation agreement among Thailand, Myanmar, Cambodia, the Lao PDR, and Viet Nam, which aims to promote balanced development in the Mekong region.

with inputs including seed, fertilizer, and credit. The maize is grown in accordance with government regulations.

Soybeans, Udomsay Province

Soybean production is organized by an American-Lao joint venture feed mill firm in several districts. The firm provides seed and technical assistance for production technology yet offers a price slightly below market price. In 2004, many contracts were breached and the supply chain broken when Chinese traders offered more competitive prices and purchased soybeans from the contracted farmers.

Maize, Luang Nam Tha Province

An American non-governmental organization (NGO) registered as a trading firm operates contract farming of maize in three districts without a formal contract. The NGO provides farmers with in-kind credit in the form of seed and purchases their produce at the end of the season. During its first two years of operation, the NGO did not encounter any breaches of contract; however, in 2003, Chinese traders purchased all farmer output. The NGO did not possess the means to enforce the verbal contracts and lost the seed.

Sugar Cane, Phongsaly Province

Lao farmers produce sugar cane for a Chinese sugar mill across the border. The buyers provide some seeds and fertilizer but do not offer a guaranteed price. At harvest, the dried sugar cane is weighed and the cost of inputs is subtracted from the sale price. Although the transaction is one-sided, additional farmers have shifted to sugar cane cultivation—without input supports—to participate in the sales (UNDP/NSC, 2006).

Sweet Corn, Vientiane Province

Lao Agro Industry Co. (LAI) is a Thai–Lao joint venture affiliated with Lampang Food Products, a Thai food processor and exporter. LAI has been operating in the Lao PDR since 1994, processing bamboo shoot, baby corn, mango, and sugar palm seed. LAI contracts households from the sweet corn farmer production and marketing group (FPMG) to supply sweet corn to its cannery. The company provides credit for seed and fertilizer, while the local government provides credit for land preparation. Although only 11 households on 3.5 ha were contracted in the 2006/07 dry season, LAI is targeting a planting area of approximately 160 ha to produce 2,000 tons of sweet corn.

Horticulture, Bokeo Province

Thai processing firms organize contract farming of horticulture crops such as mustard cabbage in Bokeo Province. Information is not available on the number of participating households or land area under cultivation. Green bean production has largely been discontinued as farmers experienced negative health consequences due to high pesticide use; one farmer interviewed during a field visit reported a death in his family due to pesticide poisoning.

Rubber, Northern provinces

Para-rubber cultivation was introduced in Luang Namtha province in the mid-1990s with assistance from China. The rubber cultivation area in the Northern provinces has since expanded steadily due to growing demand from China. Although large-scale concession areas currently account for the majority of rubber production, the government is promoting

smallholder rubber production as a way of stabilizing shifting cultivation and increasing upland farmer income (Manivong and Cramb, 2007).

IV. CASE STUDY: CONTRACT RICE FARMING IN VIENTIANE PROVINCE

Established in 2002, the Lao Arrowny Corporation is a joint venture between a Lao and a Japanese investor to produce organic Japanese rice for export to Japanese expatriates in Southeast Asia. The company received approval from the Ministry of Agriculture and Forestry (MAF) to recruit small farms from an area covering 18,500 ha countrywide. As of 2004, the company had approximately 2,000 households with a total land area of 800 ha under contract.

The selection criteria for contract farms include: 1) owning their own rice field; 2) acceptance by fellow farmers as hard working in order to become members of the farmers' association; and 3) agreeing to not use chemical fertilizers in the growing process. While the company markets the rice as "bio-organic rice," it is not sold as certified organic rice. In fact, the company allows farmers to use a small amount of chemical fertilizers, up to 30 kilo/ha.

Contract farmers receive the premium price specified in the contract for growing organic rice, less the amount of credit used for inputs. The company supplies raw materials in the form of in-kind credit for seed and organic fertilizer (bat manure) and provides technical assistance. The team leader of the extension staff was a former government extension agent who received training in Japan under official development assistance (ODA).

Lao Arrowny, however, faces several challenges that reflect the early stage of private sector development in the Lao PDR. The supply of rice from farmers presently exceeds the company's working capital for procurement and processing. The company lacks in-house processing capacity and incurs high transport costs to have the paddy processed in Thailand prior to third-country export. As a result, Lao Arrowny failed to meet the market demand in 2004, exporting only 540 tons of rice against potential demand for up to 10,000 tons.

Using a standard questionnaire, a farm survey was conducted in September 2004 with 585 farmers in Vientiane Province. The surveyed households include 332 contract farmers and 253 non-contract farmers in the same agro-eco and socioeconomic settings. The surveyed villages are fertile, low-land rice growing villages located in Vientiane Municipality, immediately outside of the capital city of Vientiane. These areas have relatively good road access, public health service centers, and agriculture extension centers, including the Agriculture Promotion Bank (APB).

Rice is primarily grown under rain-fed production, although in some areas supplementary irrigation is available. These areas represent a farming system in transition from subsistence to commercial orientation, as traditional agriculture adapts to the emergence of new economic opportunities from increasing demand for crops and livestock from the Vientiane urban center. Farmers generally have more than one plot of rice land, growing certain varieties for home consumption (typically sticky rice) and other varieties for sale.

The following sections describe the socioeconomic characteristics and rice production systems of contract farming households and non-contract farming households.

V. HOUSEHOLD CHARACTERISTICS

Family size and land size

On average, contract farmers have larger families and own more land. The average family size for contract farmers is 5.88 persons (4.52 adults) per household, greater than non-contract farmers' average of 5.61 persons (4.03 adults) per household. On average, a contract farming household owns 2.48 ha, compared with 1.72 ha for non-contract farmers (Table 1).

Table 1: Household Characteristics

Variables	Contract	Non-Contract	p-value*
No. of family members	5.88	5.61	0.0853
No. of family members older than 16	4.52	4.03	0.0011
Percentage of females in family	49	49	0.8628
Total land (ha)	2.48	1.72	0.0002
No. of TVs	0.96	0.86	0.0038
No. of radios	0.23	0.19	0.3316
No. of hand tractors	0.61	0.46	0.0004
No. of plows	0.006	0.011	0.4683
No. of bikes	1.02	1.02	0.9798
No. of motorbikes	0.81	0.65	0.0155
Value of livestock (millions of kip)	6.22	4.83	0.0533
Monthly consumption expenditure per person (1,000 kip)	144	147	0.8592
Percentage of home-grown in consumption expenditure	36	38	0.3695
Credit total (1,000 kip)	446	191	0.0196
Income per adult from non-rice sources (1,000 kip)	2,401	2,334	0.7546
Income per adult from other crops (1,000 kip)	298	163	0.0848
Income per adult from animal sales (1,000 kip)	417	262	0.0039
Income per adult from off-farm activities (1,000 kip)	1,686	1,909	0.2428
Ratio of off-farm income in non-rice income (%)	67	77	0.0012
Ratio of handicrafts in off-farm income (%)	9	12	0.1767
Ratio of wage in off-farm income (%)	45	44	0.7825
Ratio of remittance in off-farm income (%)	6	8	0.2503
Ratio of other activities in off-farm income (%)	40	36	0.2887
Distance to farm-to-market road (km)	20.23	22.20	0.2224
Distance to highway (km)	7.54	8.61	0.1020

* p-value is the smallest level of significance for which we can reject the respective hypothesis test of difference in means between contract and non-contract farmers using the appropriate t-test.

Household economic conditions

On average, contract and non-contract farmers have similar household economic conditions. Although contract farmers own more fixed assets than non-contract farmers, including televisions, tractors, motorbikes, and livestock, contract and non-contract households have similar monthly consumption expenditures (147 thousand kip/person and 144 thousand

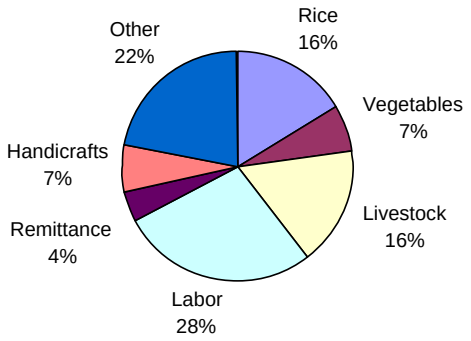
kip/person, respectively)[2] and rely on homegrown products to a similar extent (36% and 38%, respectively). The average monthly consumption expenditure for both contract and non-contract households is slightly higher than average for Vientiane Province (NSC, 2004).

Income profile

The incomes of the surveyed households are not limited to agriculture but derived from diverse sources, as shown in Figure 2. On average, contract and non-contract farmers have similar incomes from non-rice sources (2.4 million and 2.3 million kip/adult, respectively). However, non-contract farmers derive a significantly higher percentage of non-rice income from off-farm activities (77%) than contract households (67%). The composition of off-farm income is similar for both groups, with wage labor comprising nearly half of off-farm income. For wage income, household members typically travel to Vientiane city for employment opportunities.

Contract farmers on average have higher incomes from the sale of crops and livestock, suggesting that they are more oriented toward commercial production than their non-contract counterparts. As they are located slightly, although not significantly, closer to the highway and market than non-contract households, contract farmers may have better access to market information and be able to take advantage of market demand for their produce.

Figure 2: Average Sources of Income of Surveyed Households



Credit

Overall, 16% of the surveyed households had loans from the APB, including 20% of contract farmers and 10% of non-contract farmers. Since Lao Arrowny operates in areas immediately outside of the capital city, the surveyed households have better access to formal credit than most small farms in the Lao PDR. In 2003, less than 3% of rural households in the Lao PDR borrowed from the formal sector (Coleman and Wynne-Williams, 2006). As the APB generally lends to farmer groups rather than to individual small farms, these results suggest that the contract arrangement can facilitate improved access to credit.

Among farmers borrowing from the APB, there is no significant difference in the amount of credit received. The average loan size from the APB for contract farmers was 2.24 million kip compared with 1.85 million for non-contract farmers. As all loans were financed by the APB, the interest rates and repayment terms were largely the same.

[2] US$1 = 9,478.80 kip at the time of this writing (27 November 2007).

VI. FARMING CHARACTERISTICS

Commercial rice field

Relatively few non-contract households engage in commercial production of rice (29% compared with 89% of contract farms). It is interesting to note that the average commercial plot of non-contract households producing rice for sale is 1.43 ha, significantly larger than the average 1.11 ha of contract farmers (Table 2). This may imply that the few commercial farmers not under contract are more specialized in commercial production, while contract farmers are farmers in transition to commercial farming.

The majority of surveyed households plant multiple varieties of rice in their commercial plots. In addition to primarily producing organic Japanese rice for Lao Arrowny, some contract farmers also produce CR203 rice under contract with the Beer Lao Brewery Company. This suggests that once farmers become familiar with contract farming through one firm, they are more likely to enter into contract farming with another firm. Both types of farmers typically also plant small amounts of traditional varieties to sell to traders or in the local market.

Table 2: Commercial Production: Revenue, Cost, and Profit

Variables	Contract	Non-Contract	p-value*
No. of households	296	72	--
Size of commercial area planted (ha)	1.11	1.43	0.0327
Percentage of planted area harvested	98	99	0.6068
Revenue (1,000 kip/ha)	5,237	3,527	0.0008
Rice price (kip/kg)	1,587	1,344	0.0000
Yield (kg/ha)	3,272	2,603	0.0420
Cash Cost (1,000 kip/ha)	2,251	1,778	0.1102
Cash Cost (kip per kg of rice production)	1,290	936	0.0830
Ratio of hired labor cost in total cash cost (%)	32	45	0.0001
Profit per area of land (1,000 kip/ha)	2,924	1,751	0.0307

* See footnote in Table 1.

Rice price

Contract farmers received significantly higher prices than non-contract farmers. Under the contract, farmers received an average price of 1,911 kip per kg for organic Japanese rice. For other varieties of rice, there is no significant difference in the prices received by contract and non-contract farmers, as rice sold outside of the contract is sold at market prices. Due to the premium price for Japanese rice, the average rice price for all varieties was 1,587 kip/kg for contract farmers and 1,344 kip/kg for non-contract farmers.

The higher-than-market price offered by Lao Arrowny was ranked by 62% of contract farmers as the most important factor influencing their decision to join the contract.

Yield

In addition to receiving higher prices, farmers under contract also had significantly higher yields than non-contract farmers. Contract farmers' average yield for all varieties of rice is 3,272 kg/ha, compared with 2,603 kg/ha for non-contract farmers. The yield difference

between contract and non-contract farmers likely reflects the higher intensity and efficiency of production under contract. As stated previously, farmers under contract have better access to inputs and technology, as the contracting firm provides technical assistance and supplies in-kind credit for high-yield seed and fertilizer.

Costs

On average, farmers under contract have higher cash costs than non-contract farmers, spending 1,290 kip to produce one kilo of rice compared with 936 kip/kg. Contract farmers also have higher total cash costs per hectare of rice field (2.2 million kip to 1.8 million kip); however, this difference is not statistically significant.

Material costs

Contract farmers have significantly higher (cash) material costs than non-contract farmers, averaging 1,474 thousand kip/ha of rice field compared with 920,000 kip/ha. The difference was also significant for material costs per kilogram of rice production (852 kip/kg compared with 462 kip/kg). For both contract and non-contract farmers, fertilizer is the largest material expense. Contract farmers, however, have significantly higher fertilizer costs, spending on average 814,000 kip/ha, compared with 528,000 kip/ha for non-contract farmers.

Similarly, contract farmers also have significantly higher seed costs than non-contract farmers, both per hectare (283,000 kip/ha compared with 81,000 kip/ha) and per kilo of rice production (192 kip/kg compared with 41 kip/kg).

On average, contract and non-contract farmers do not differ significantly in the use of compost, pesticides, irrigation, or machine rental cost (Table 3).

Table 3: Material Cost Structure for Commercial Operation

Variables	Contract	Non-Contract	p-value*
Total material cost (1,000 kip/ha)	1,474	920	0.0044
Total material cost (kip/kg)	852	462	0.0127
Seed cost (1,000 kip/ha)	283	81	0.0009
Seed cost (kip per kg of rice production)	192	41	0.0144
Seed price (kip/kg)	2,842	1,913	0.0000
Fertilizer cost (1,000 kip/ha)	814	528	0.0567
Fertilizer cost (kip per kg of rice production)	429	272	0.1239
Fertilizer price (kip/kg)	3,347	3,231	0.2223
Pesticide cost (1,000 kip/ha)	0.31	0.33	0.9256
Pesticide cost (kip per kg of rice production)	2.78	1.67	0.4733
Irrigation cost (1,000 kip/ha)	180	137	0.2203
Irrigation cost (kip per kg of rice production)	107	74	0.1885
Rental machine cost (1,000 kip/ha)	136	166	0.4686
Rental machine cost (kip per kg of rice production)	82	71	0.6249

* See footnote in Table 1.

Labor structure

Commercial production under contract is significantly more labor intensive than production outside of the contract, requiring an average of 147 days of labor per hectare compared with 88 days per hectare for non-contract farms (Table 5). In terms of labor composition, family labor accounts for 80% of contract farms' total labor and 67% of non-contract farms' total labor. The amount and cost of hired labor does not differ significantly between contract and non-contract farmers. On average, the cost of hired labor for contract farms was 783,000 kip/ha, compared with 792,000 kip/ha for non-contract farms. Contract farms used slightly more female hired labor than non-contract farms, although the difference is not significant.

Table 4: Labor Cost Structure for Commercial Operation

Variables	Contract	Non-Contract	p-value*
Hired labor (days/ha)	26.0	24.1	0.7985
Hired labor cost (1,000 kip/ha)	783	792	0.9563
Hired labor cost (kip/kg)	431	442	0.9010
Ratio of females in hired labor (%)	59	52	0.1593
Family labor (days/ha)	118.4	58.8	0.0000
Family labor (kg/day)	55.7	60.7	0.5378
Total labor (days/ha)	146.4	87.8	0.0006
Ratio of family labor in total labor (%)	80	67	0.0015
Ratio of hired labor in total labor (%)	20	33	0.0015

* See footnote in Table 1.

Profitability

Although they have higher costs than non-contract farmers, contract farmers are compensated by higher yields and price premiums. As a result, contract farmers are significantly more profitable than farmers outside the contract, earning an average of 2,924,000 kip/ha of rice field, compared with the 1,751,000 kip/ha earned by non-contract farmers.

VII. PROPENSITY SCORE AND MATCHING ANALYSIS

In an impact assessment study, one of the most difficult issues is the possibility of selection biases. This problem occurs because we would like to know the effect of a treatment on the participants' outcome but cannot observe the outcomes with and without treatment on the same individual at the same time. Simply comparing mean outcomes may not reveal the actual treatment effect, as participants and non-participants typically differ even in the absence of treatment (Caliendo and Kopeining, 2005). For example, contract farmers may differ systematically from non-contract farmers and the above simple mean comparisons may reflect differences in their characteristics rather than the impacts of contract farming. In other words, failure to account for treatment selection biases may lead to biased estimation of the true treatment effect.

The propensity scoring matching (PSM) method (Becker and Ichino, 2002) provides a more refined method of comparing the performance of contract and non-contract farmers by accounting for their inherent differences. The basic concept is to compare contract farmers to non-contract farmers who are similar to contract farmers in all relevant characteristics

except the contract. The differences in the outcomes of contract farmers and the selected non-contract farmers can then be attributed to the contract.

The first step of the PSM approach is to estimate farmers' propensity scores based on their basic characteristics (i.e., characteristics that are not affected by the choice of contract). The propensity score of each farmer measures his tendency to join the contract. The magnitude of a propensity score ranges between 0 and 1; the larger the score, the more likely the farmer is to join the contract.

After farmers' propensity scores are estimated, the second step is to divide farmers into groups of similar propensity scores. In addition, each group should be balanced, containing farmers who do not have significantly different characteristics.

After the balanced groups are formed, we can compare the performance of contract and non-contract farmers in each group. As such comparisons are based on stratification control for the differences of farmers' characteristics, the performance differences between contract and non-contract farmers would be more likely caused by contract farming rather than farmers' intrinsic characteristics.

Finally, the performance difference between contract and non-contract farmers can be measured by the weighted average of the contract and non-contract differences in each group, with the number of observations in each group as the weights.

The propensity score approach is used here to compare contract farmers' and non-contract farmers' performance in their commercial operation. The following variables are used in the propensity score estimation: 1) farm size; 2) number of adult family members; 3) ratio of females in the family; 4) value of production assets; 5) value of consumption assets; 6) value of transportation assets; 7) farm distance to highway; and 8) farm distance to market.

Table 5 presents the differences in the performance of contract and non-contract farms, using simple mean and propensity score matching comparisons. The findings of the PSM comparisons are consistent with the results of the simple mean comparisons. They indicate that contract farms have higher revenue, rice price, yield, cash costs, and profit than non-contract farms, and that the results are statistically significant.

Table 5: Propensity Score Matching Comparison of Contract and Non-Contract Farms

Variables	Difference (Contract minus Non-Contract)	
	Simple Mean	PSM Comparison
Revenue (1000 kip/ha)	1,710	1,949
p-value	0.0008	0.0000
Rice Price (kip/kg)	243	266
p-value	0.0000	0.0000
Yield (kg/ha)	669	794
p-value	0.0420	0.0058
Cash Cost (1,000 kip/ha)	473	564
p-value	0.1102	0.0542
Cash Cost (kip/kg)	354	343
p-value	0.0830	0.0360
Cash Profit (1,000 kip/ha)	1,173	1,296
p-value	0.0307	0.0013

The use of PSM to minimize selectivity bias thus suggests that these differences are the result of contract farming rather than the intrinsic characteristics of the sampled households. However, like the simple mean comparison, PSM may misinterpret the treatment effect, because it only controls for observed variables, and hidden self-selectivity bias may remain. As the decision to join the contract is voluntary and is based on individual self-selection, it is possible that contract farmers have systematically different *unobserved* characteristics from non-contract farmers. For example, farmers' motivation may be an unobserved covariate affecting both their performance and their decision to join the contract. To address these unobservable selection biases, we employ an endogenous switching regression model as described below.

VIII. SWITCHING REGRESSION

Consider the following selection model that describes farmers' choices of joining the contract and their performance with and without the contract:

If $\gamma Z_i + u_i > 0$, farmer *i* chooses to join the contract, which is described by $I_i = 1$;

If $\gamma Z_i + u_i \leq 0$, farmer *i* chooses not to join the contract, which is described by $I_i = 0$;

Farmer *i*'s profitability with the contract ($I_i = 1$) is $y_{1i} = \beta_1 X_{1i} + \varepsilon_{1i}$;

Farmer *i*'s profitability without the contract ($I_i = 0$) is $y_{0i} = \beta_0 X_{0i} + \varepsilon_{0i}$;

In the model, Z_i is a vector of farm characteristics that affect farmers' decision to join the contract; X_{1i} and X_{0i} are two vectors of farm characteristics that affect farmers' performance under the contract and without the contract; and y_{1i} and y_{0i} are dependent variables measuring farmers' profitability. γ, β_1 and β_0 are vectors of parameters to be estimated. u_i, ε_{1i}, and ε_{0i} are three random error terms that follow a trivariate normal distribution.

After the parameters are estimated, we can calculate:

$$xb_{1i} = E(y_{1i} | x_{1i}) = x_{1i}\beta_1 \quad (1)$$

$$xb_{0i} = E(y_{0i} | x_{0i}) = x_{0i}\beta_0 \quad (2)$$

$$yc_{1\_1i} = E(y_{1i} | I_i = 1,\ x_{1i}) = x_{1i}\beta_1 + \sigma_1\rho_1 f(\gamma Z_i)/F(\gamma Z_i) \quad (3)$$

$$yc_{0\_1i} = E(y_{0i} | I_i = 1,\ x_{1i}) = x_{1i}\beta_0 + \sigma_0\rho_0 f(\gamma Z_i)/F(\gamma Z_i) \quad (4)$$

$$yc_{0\_0i} = E(y_{0i} | I_i = 0,\ x_{0i}) = x_{0i}\beta_0 - \sigma_0\rho_0 f(\gamma Z_i)/[1 - F(\gamma Z_i)] \quad (5)$$

$$yc_{1\_0i} = E(y_{1i} | I_i = 0,\ x_{0i}) = x_{0i}\beta_1 - \sigma_1\rho_1 f(\gamma Z_i)/[1 - F(\gamma Z_i)] \quad (6)$$

xb_{1i} represents the unconditional expectation of farmers' performance under the contract; xb_{0i} represents the unconditional expectation of farmers' performance without the contract; yc_{1_1i} represents the conditional expectation of contract farmers' performance under the contract; yc_{0_1i} represents the conditional expectation of contract farmers' performance without the contract; yc_{0_0i} represents the conditional expectation of non-contract farmers' performance without the contract; and yc_{1_0i} represents the conditional expectation of non-contract farmers' performance under the contract. σ_1 and σ_0 are the standard errors of ε_{1i}, and ε_{0i}; ρ_1 is the correlation coefficient between ε_{1i} and u_i; ρ_0 is the correlation coefficient between ε_{0i} and μ_i; *f(.)* is the normal density function; and *F[.]* is the cumulative normal distribution.

Indicators for premiums of joining the contract

yc_{1_1i} and yc_{0_1i} represent, respectively, the average of contract farmers' actual performance under the contract and the average of their counterfactual performance without the contract. The difference $\Pi_1 = yc_{1\_1i} - yc_{0\_1i}$ provides a measure of the impact of contract farming on the performance of farmers who actually chose to join the contract. $\Pi_1 > 0$ (or $\Pi_1 < 0$) would indicate a positive (or negative) impact of contract farming. Similarly, $\Pi_0 = yc_{1\_0i} - yc_{0\_0i}$ provides a measure of the impact of contract farming on the performance of farmers who actually chose not to join the contract.

Indicators for selection bias

The estimated correlation coefficients, ρ_0 and ρ_1, provide interesting insights of the sampled farms in choosing the contractual arrangement. For example, $\rho_1 > 0$ would indicate that farms that actually chose to enter the contractual arrangement have above-

average performance under the contract. The average performance in this case is defined as $x_i\beta_1$, assuming all farms in the sample were subjected to the contractual arrangement. In other words, a positive ρ_1 implies "positive selection" into choosing the contract.

Furthermore, if non-contract farms had in fact chosen to join the contract, their performance would be worse than those farms that actually chose to enter the contract. On the other hand, $\rho_1 < 0$ implies "negative selection" into choosing the contract, or farms that actually chose to enter the contractual arrangement have below-average performance under the contract. In this case, if the non-contract farms had in fact chosen to join the contract, their performance would have been above that of the contracted farms.

Conversely, $\rho_0 > 0$ implies "negative selection" into not choosing the contract for the non-contract farms. In other words, non-contract farms have below-average performance, and if the contract farms had in fact chosen not to join the contract, their performance would have been better than that of the non-contract farms.

If $\rho_0 < 0$, there is "positive selection" into not choosing the contract for the non-contract farms, or farms that actually chose not to enter the contract have above average performance without the contract. In this case, if the contract farms had in fact chosen to not join the contract, their performance would have been worse than that of the non-contract farms.

Following Maddala (1983) and Hamilton and Nickerson (2003) but using the correlation coefficients instead of the covariances, four interesting cases can be discerned from the two correlation coefficients.

Case 1: $\rho_0 < 0$ *and* $\rho_1 > 0$

In this case, farms that chose to enter the contractual agreement have above average performance under the contract, while farms that chose to stay outside the contract have above average performance without the contract.[3] In other words, both contract and non-contract farms chose the correct or appropriate tactics by which they have relative advantage. This case may be characterized as a situation where both contract and non-contract farms are in fact capturing their "comparative advantage."

Case 2: $\rho_0 > 0$ *and* $\rho_1 > 0$

In this case, farms that actually chose to enter the contract (i.e., the contract farms) would have above-average performance whether they are under the contract or without the contract. In other words, contract farms have an "absolute advantage" in the sense that they have above-average performance with or without the contract. Conversely, non-contract farms in general have below-average performance whether they are under the contract or without the contract.

Case 3: $\rho_0 < 0$ *and* $\rho_1 < 0$

[3] The "average performance under the contract" in this report means the average of the performance of all farmers (irrespective of their actual contract choices) if they are under the contract. The "average performance without the contract" in this report means the average of the performance of all farmers (irrespective of their actual contract choices) if they are without the contract.

In contrast to case 2, non-contract farms in this case have an "absolute advantage" in the sense that they tend to have below-average performance both under the contract and without the contract, while contract farms have below-average performance both under the contract and without the contract.

Case 4: $\rho_0 > 0$ *and* $\rho_1 < 0$

In this case, contract farms would in general have below-average performance under the contract but above-average performance without the contract, while non-contract farms would have above-average performance under the contract but below-average performance without the contract. In this sense, farms chose the tactics that provide them "comparative disadvantage." This would not happen most of the time except when there are factors that may force farms to adopt less-desirable tactics.

Comparison of contract farmers' and non-contract farmers' profitability in commercial rice farming

Based on the above switching regression model, we use "movestay" module (Lokshin and Sajaia, 2004) in the STATA program to evaluate factors that affect farmers' decisions to join the contract and their performance with or without the contract. We measure farmers' performance by their profits per hectare in their commercial operations.

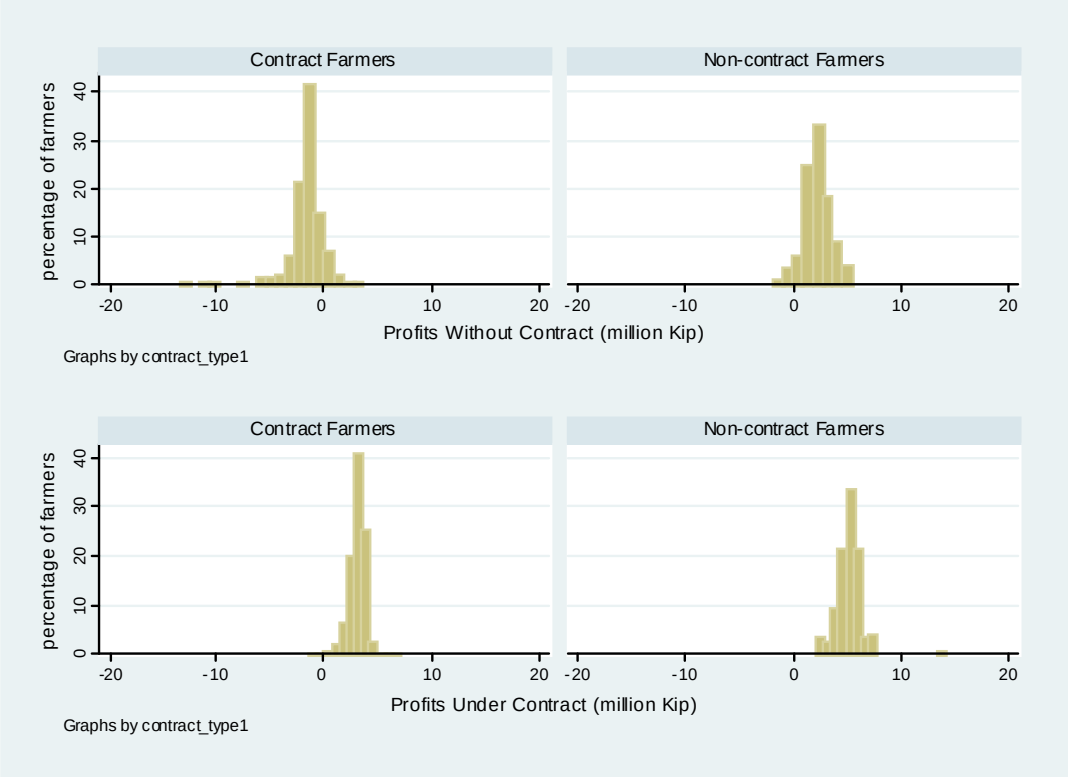
The selection model includes the following variables: household characteristics, including family size and ratio of females in the household; and farm characteristics, including farm size, value of production assets, value of consumption assets, value of transportation assets, the distance of the farm to the market and the distance of the farm to the highway. The profit functions[4] include farm size, family size, and the value of consumption assets. The estimated results of the selection model and profit functions are presented in Appendix Tables A.1 and A.2, respectively. The overall model is significant at the 10% level as indicated by Wald's χ^2.

Using the indicators described above, the premiums from joining the contract and their selection bias indicators are calculated. Figure 2 depicts the distribution of contract and non-contract farmers' profits under contract and without the contract.

The counterfactual analysis indicates that both contract and non-contract farmers tend to increase their profitability by joining the contract. The contract farmers' profits under contract (bottom left graph) are on average higher than their counterfactual profits without the contract (top left graph). Joining the contract is estimated to have increased the profits of contract farmers by 4.63 million kip. In the case of non-contract farmers, the counterfactual profits under contract (bottom right graph) are on average higher than the actual profits outside the contract (top right graph). In other words, the profits of non-contract farmers would have increased by 3.21 million kip had they joined the contract.

[4] Due to the unavailability of data to formulate a traditional profit function, we resort to a more "ad hoc" specification in this case.

Figure 3: Profitability Comparison of Contract and Non-Contract Farmers



As shown in Appendix Table A.1, the estimated ρ_0 and ρ_1 are both negative, although ρ_1 is not statistically significant. This pattern is described above as case 3, indicating that contract farmers have below-average performance both under contract and without the contract. In other words, contract farmers are less profitable than non-contract farmers, both under contract and without the contract. This suggests that the observed higher profitability of contract farming is not due to contract farming attracting more profitable farms; rather, contract farming tends to be more attractive and more beneficial to farmers with relatively low performance.

IX. CONCLUSION

The rapid expansion of contract farming in the Lao PDR necessitates the empirical verification of its impacts on farmers. As we cannot compare the same farmer both under contract and outside the contract, we must estimate the average impact of contract farming by comparing groups of contract and non-contract farmers. As contract farmers may be different, however, from non-contract farmers in many ways and the decision to join the contract is voluntary, these unobservable factors may lead to selection and self-selection biases. Controlling for these biases is generally the most difficult part of an impact assessment study.

To account for the possible occurrence of selection bias and disentangle the effects of contract farming, this study employed propensity score matching comparison methodology. The findings of the PSM comparison confirm the results of the initial assessment and verify that the higher revenue and profitability of contract farms are the result of joining contract farming, rather than systematic differences between contract and non-contract farms.

To control for potential hidden self-selection biases affecting their decisions to join the contract, farmers' performance with and without the contract was evaluated using an endogenous switching regression model. The results of the switching regression provide evidence that contract farming tends to be more profitable than non-contract farming, and suggests that the higher profitability of contract farms is not the result of farms with higher profit potential joining the contract. In fact, the counterfactual simulations indicate that contract farmers would have lower profits than non-contract farms if they operated outside of the contract. In other words, contract farming is particularly attractive to farmers with relatively poor performance. This finding has strong development implications as it implies that better-off farmers may have better access to information on production and markets and therefore choose to produce independently rather than taking on the burden of fulfilling the requirements of a contract. In this context, the contract farming arrangement is an attractive development tool as it effectively targets relatively poor-performing farmers, who require the most support.

The results of the empirical analysis support the claim that contract farming is an effective tool to increase the incomes of smallholder farmers in rural areas where market failure is prevalent. The findings show that the sampled contract rice farmers cultivated higher-yielding, improved rice varieties and earned higher incomes than non-contract rice farmers under similar agro-ecosystem and socioeconomic conditions. The sampled contract farmers have better access to inputs and credit and an assured market for their produce, which enables them to earn higher profits. The evidence also suggests that contract farmers are more likely to diversify production into other commercial crops or livestock, leading to increased incomes and more secure livelihoods. The contract arrangement thus appears to be effective in facilitating the transition of small farmers from subsistence to commercial production.

The role of extending new technology to improve the productivity of the agricultural sector is traditionally performed by the public sector. Moving the vast number of subsistence farmers toward commercial production, however, requires enormous public sector resources that are generally unavailable in transition economies such as the Lao PDR. This study shows that promoting contract farming arrangements to draw FDI into the rural sector has been a policy in the right direction.

Through contract farming, the private sector effectively extends new production technology and facilitates access to modern inputs and remote markets offering higher prices. This translates into improved incomes and an effective transformation from subsistence to commercial production with no financial burden to the public sector. Contract farming appears to be particularly appropriate for rural areas where transport infrastructure has recently been established and in transition economies where institutions to facilitate market exchange are in an early stage of development.

References

ADB. 2006. *Lao PDR: Governance Issues in Agriculture and Natural Resources*. Manila.

ADB. 2007. *Smallholder Development Project Midterm Report, October 2007*. Vientiane. Prepared by Lao Consulting Group.

Becker, S., and A. Ichino. 2002. Estimation of Average Treatment Effects Based on Propensity Scores. *Stata Journal* 2 (4): 358-377.

Caliendo, Marco, and Sabine Kopeinig. 2005. *Some Practical Guidance for the Implementation of Propensity Score Matching*. Berlin: German Institute for Economic Research.

Coleman, Brett E., and Jon Wynne-Williams. 2006. *Rural Finance in the Lao People's Democratic Republic*. Manila: ADB.

Da Silva, Carlos Arthur B. 2005. *The Growing Role of Contract Farming in Agri-Food Systems Development: Drivers, Theory and Practice*. Rome: FAO.

Eaton, Charles, and Andrew W. Sheperd. 2001. Contract Farming: Partnerships for Growth. *FAO Agricultural Services Bulletin* 145. Rome: FAO.

FAO. 2006. *FAO Statistical Yearbook 2005/06*. Vol. 2. Rome.

Hamilton, B.H. and J.A. Nickerson. 2003. Correcting for endogeneity in strategic management research. *Strategic Organization* 1 (1): 51-78.

ITC (International Trade Centre UNCTAD/WTO). 2005. Sectoral Strategy: Organic Products. *Working Draft of National Export Strategy for Lao PDR 2006-2008*. Vientiane: ITC.

Lokshin, M. and Z. Sajaia. 2004. Maximum likelihood estimation of endogenous switching regression models. *Stata Journal* 4 (3): 282-289.

Maddala, G. S. 1983. *Limited-Dependent and Qualitative Variables in Economics*. Cambridge University Press.

Manivong, V., and R.M. Cramb. 2007. Economics of Smallholder Rubber Production in Northern Laos. Contributed paper to 51st Annual Conference of Australian Agricultural and Resource Economics Society, Queenstown, New Zealand, 13-16 February 2007. Available: http://www.nafri.org.la/documents/Special_report/ Manivong%20and%20Cramb_REVISED.pdf

MPDF (Mekong Private Sector Development Facility). 2004. *Lao PDR SME Agribusiness Study for the Vientiane Plain*. Prepared by Lao Consulting Group.

NSC. 1999. *The Household of Lao PDR: Social and Economic Indicators, Lao Expenditure and Consumption Survey 1997/98, LECS 2*. Vientiane: NSC.

NSC. 2004. *The Household of Lao PDR: Social and Economic Indicators, Lao Expenditure and Consumption Survey 2002/03, LECS 3.* Vientiane: NSC.

Oraboune, Syviengxay, and Kongthong Nanthavongdouangsy. 2006. Agricultural Commercialization – A Strategic Direction for Farm Families to Overcome Poverty in Lao PDR. Country Team Paper for ITC Executive Forum on National Export Strategy, Berlin, 27-30 September. Available: http://www.intracen.org/wedf/ef2006/Global-Debate/ Country-Team-Papers/LaoPDR_Paper.pdf

Schiller, J.M., M.B. Chanphengxay, B. Linquist, and S. Appa Rao. 2006. *Rice in Laos*. Los Baños: International Rice Research Institute.

Second ACMECS Summit Declaration. Bangkok, 3 November 2005. Available: http:// www.acmecs.org/fileadmin/Meeting_Doc/ 2nd_ACMECS_Summit_Declaration.pdf

Setboonsarng, Sununtar, P.S. Leung, and J. Cai. 2006. Contract Farming and Poverty Reduction: The Case of Organic Rice Contract Farming in Thailand. In *Poverty Strategies in Asia*. Chapter 10, edited by Edward Elgar Publishing.

UNDP. 2001. *National Human Development Report, Lao PDR 2001: Advancing Rural Development*. Vientiane: UNDP.

UNDP/NSC. 2006. *National Human Development Report, Lao PDR 2006: International Trade and Human Development*. Vientiane: UNDP/NSC.

World Bank. 2006. *Lao PDR: Rural and Agriculture Sector Issues Paper*. Washington.

APPENDIX

Table A.1 Endogenous Switching Regression Estimation Results (The Lao PDR Conventional Rice Farming)

Number of observations: 295 (241 contract conventional farmers; 54 non-contract conventional farmers)
Wald chi2(10) = 10.73
Prob > chi2 = 0.0971
Log likelihood = 531.89

Selection Model	Coefficient	Std. Err.	z	P>z
Land (farm size)	-0.7840	0.3993	-1.9600	0.0500
Labor (family size)	0.2806	0.3543	0.7900	0.4280
Capital (production assets)	0.0189	0.0389	0.4900	0.6270
Capital X Labor	-0.0260	0.0266	-0.9800	0.3290
Capital X Land	-0.0125	0.0160	-0.7800	0.4350
Land X Labor	0.5750	0.2832	2.0300	0.0420
Ratio of females in household	-0.7022	0.5208	-1.3500	0.1780
Transportation assets	0.0056	0.0181	0.3100	0.7560
Consumption assets	0.0208	0.0198	1.0500	0.2930
Distance to highway	0.1529	0.1166	1.3100	0.1890
Distance to market	0.2175	0.0761	2.8600	0.0040
Constant	0.0350	0.6253	0.0600	0.9550
σ_0	0.0153	0.0027		
σ_1	0.0307	0.0015		
ρ_0	-0.7218	0.1504		
ρ_1	-0.2038	0.2069		

Table A.2 Profit Functions

Profit Functions	Coefficient	Std. Err.	z	P>z
Profit without contract				
Land (farm size)	0.0154	0.0114	1.3500	0.1780
Labor (family size)	-0.0024	0.0081	-0.3000	0.7640
Capital (production assets)	-0.0006	0.0010	-0.6700	0.5040
Capital X Labor	0.0008	0.0007	1.1400	0.2550
Capital X Land	-0.0007	0.0004	-1.8200	0.0680
Land X Labor	-0.0092	0.0078	-1.1800	0.2380
Constant	18.9919	0.0128	1,485.7300	0.0000
Profit under contract				
Land (farm size)	-0.0131	0.0083	-1.5700	0.1150
Labor (family size)	0.0014	0.0071	0.1900	0.8480
Capital (production assets)	0.0002	0.0007	0.2700	0.7860
Capital X Labor	0.0001	0.0005	0.1200	0.9030
Capital X Land	0.0000	0.0003	0.0800	0.9390
Land X Labor	0.0065	0.0058	1.1100	0.2670
Constant	19.0099	0.0102	1,859.1200	0.0000