EVALUATION OF A HYBRID SEED CONTRACT BETWEEN SMALLHOLDERS AND AN MNC IN EAST JAVA, INDONESIA

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abstract

Three hundred smallholders near Malang in East Java were surveyed of whom 150 were participating in a hybrid seed contract with Pioneer Hybrid International Inc, an American MNC that has been contracting in the area since 1986. The objectives of the study were to determine whether the contract improved the welfare of those who participated and, if participation did improve welfare, to evaluate why this contract, in contrast to many other farm contracts in developing countries, is successful. A transaction cost framework was used to specify a framework for probit analysis of contract participation and regression analysis used to measure the contribution made by contract participation to gross margins. The empirical results suggest (i) contract selection was by Pioneer and not through self-selection, (ii) the contract is likely to favour larger farmers and (iii) the Pioneer contract improved returns to farm capital and hence was likely to be welfare improving for contractors. The success of the contract over many years was attributed to the nature of the contracting process which was between Pioneer and grower groups and not at the individual smallholder level.

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1. Introduction

Market liberalisation, combined with the influences of changing dietary habits and technical change, is increasing production and trade in High Value Food (HVF) products such as seed, horticultural products, spices and certain vegetables (Friedland, 1994). Watts and Goodman (1997) describe this as the emergence of 'New Agricultural Countries', NACs, where exports of traditional crops such as cereals, sugar and tropical beverages are declining while exports such as Brazilian citrus, Mexican 'non-traditionals', exotics such as Kenyan off-season vegetables and Chinese shrimp from Argentina are becoming an increasing proportion of both total and export agricultural income. Much of this market development has been underpinned by contracts between agribusiness firms and smallholders in developing countries (Jaffee, 1994).

The net effect of contract farming on the welfare of smallholders has been controversial. A number of authors express concern that contractors favour larger growers and hence poorer growers may be left out of the development process (CDC, 1989; Runsten, 1992; and Little and Watts, 1994). Other hazards of contract farming are potential for 'capture' of smallholders within contracts, negative social effects of the 'cash economy', narrowing of local markets as contracted production squeezes out local food production, deteriorating contract terms as contracts mature and general concerns about how multi-national corporations behave in developing countries (Clapp, 1988; Wilson, 1990; Little and Watts, 1994; Torres, 1997; Singh, 2000). Positive evaluations of contract farming generally indicate farmers either benefit from contracts in terms of enhanced profits or get out of them. Benefits from contract participation result from improved access to markets, credit and technology, better management of risk, improved family employment and, indirectly, empowerment of women and development of a successful commercial culture (Glover and Kusterer, 1990; Runsten, 1992; Key and Runsten, 1999; Eaton and Shepherd, 2001).

In this study, we surveyed 300 smallholders near Malang in East Java. Of these, 150 were participating in a hybrid seed contract with Pioneer Hybrid International Inc[3], an American MNC that has been contracting in the area since 1986. Our objectives included finding out whether farmers who participated in the contract were better off than those who did not participate and understanding the reasons why this particular contract seemed so successful when there have been so many failed contract farming schemes in the past. The study uses a

[3] www.pioneer.com

transaction cost framework, described in the next section of the paper, which is followed by sections describing the contract and survey and statistical results and then a section with discussion and conclusions.

2. Theoretical Background

2.1 Transaction Cost Framework

Contract farming between multinationals (or other large corporations) and smallholders in developing countries may appear to be a peculiar relationship given the dramatic differences in asset position and organisational capacity of the two actors. To evaluate contract farming, it is important to consider why such a relationship would emerge, particularly as opposed to other types of market structures. In this section, we consider a transaction cost framework in order to understand this relationship.

Williamson (1979) developed a cost-based framework for understanding firms' decisions about transacting. He argued that the structure to emerge in a market would be that which minimised transaction costs to participants. In his framework, transaction costs are functions of three specific elements in a market: *bounded rationality*, *opportunism* and *asset specificity*, without which markets would be simple exchange systems with no vertical or horizontal integration of productive activities. Dietrich (1994) and Dorward (2001) provide formal introductions to transaction cost problems in agriculture, however, some examples are sufficient here to convey the flavour of the approach.

Bounded rationality describes differences in information between would-be buyers and sellers. For example, an agribusiness firm may have an excellent knowledge of markets while smallholders may have little knowledge of them, hence, there may be benefits from a contract that informs smallholders about opportunities. *Opportunism* may occur when there are opportunities for taking advantage of situations to the detriment of the other party in an agreement. For example, smallholders may be concerned the firm could, by virtue of its market domination, offer a very low price in the spot market or, alternatively, the firm may be concerned that sellers could collude to drive up prices. Writing contracts clearly spelling out obligations may reduce these types of concerns. *Asset specificity* reflects risks associated with protecting 'sunk costs' in processing plants, logistical systems or market development or, for smallholders, costs of protecting investments in specialised machinery and knowledge. Both firm and smallholders may seek to protect these investments through contracting.

An agribusiness firm wishing to source new HVF products has a number of options. One option is to make purchases in the spot market. However, such markets, particularly in developing countries, may be missing or have high transaction costs related to uncertainties about supply, prices and or quality. Uncertain supplies and volatile prices result from thinness in new markets. Tight quality requirements reflect difficulties with preserving, packaging, freezing and providing transport while meeting requirements of fussy developed country consumers (Goodman and Watts, 1997). Smallholders wishing to supply products to new HVF spot markets may also face high transaction costs. There may be only one or a few big buyers for a new commodity, technical requirements may be difficult to understand and production and market information scarce.

The outcome of these high transaction costs in emerging spot markets for HVF products is that agribusiness firms and smallholders look for alternative ways to transact through partial or complete vertical integration. Two options are plantations (complete vertical integration) and contract farming (partial vertical integration) where the choice between the two would be based on relative transaction costs. With plantations, transaction costs that would not be encountered in contracted production include land acquisition costs, skilled management, high levels of supervision to counteract agency problems and political problems (Stiglitz, 1974; Coulter et al., 1999). Against these disadvantages, plantations may confer more predictable supply and lower unit costs resulting from scale economies. Hayamai and Otsuka (1993) argue HVF crops are technically more sophisticated and require more worker initiative and hence need greater supervision, all factors working against plantations in favour of contracting.

Contract farming is not without significant transaction costs. Dietrich (1994) identifies four broad classes of transaction costs likely to be incurred by an agribusiness firm setting up a contractual arrangement with smallholders: (i) costs of drafting, negotiating and enforcing contracts, (ii) maladaption costs when contract specifications are not met, (iii) set-up and running costs associated with governance and (iv) bonding costs of effecting secure commitments. A firm deciding to enter into a contractual arrangement with smallholders has come to the conclusion that transaction costs associated with this arrangement are less than either trying to work through the spot market or vertically integrating through plantation production. In seeking smallholders to contract with, firms must consider transaction costs as well as production costs.

Applying the same framework to smallholders, specific benefits from contracting may include reduced costs of: (i) accessing product markets, (ii) getting credit (iii) providing employment for family members (iv) managing risk and (v) obtaining market and agronomic information. Thus, contracting should be attractive to small scale farmers who are constrained in credit and labour markets and who cannot achieve economies to scale in gathering information or accessing markets. Such farmers may be attractive to firms due to their low costs of production, particularly in HVF crops that are labour intensive.

2.2 Empirical Framework

Two issues that arise in analysing contract farming concern whether contracts improve returns on smallholder capital and what types of smallholders might benefit from contracts. If, as hypothesized, contract farming allows smallholders to reduce transaction costs, then this should result in an improved capital return where capital includes human capital, land and machinery and, where labour markets are constrained, family labour. To capture this effect using econometric techniques, a gross margin equation is specified in Section 5. Farm gross margin is defined as the contribution made to farm income by each component of capital and the econometric equation is specified with variables for different types of capital, constraints on use of capital arising from transaction costs and a zero-one variable indicating contract participation. The coefficient on the zero-one variable is then interpreted as measuring the monetary impact of the contract on farm returns.

Since participation in contract farming could be endogenous (jointly determined with gross margins) we test for endogeneity and report results of a two stage estimation procedure along with the normal linear regression. Given contract participation is a zero-one variable, a two stage estimation procedure is adopted from Angrist (2000). In the first stage, a linear probability model of likelihood of selection for the contract, a participation equation, is specified as a function of smallholder attributes and then, in the second stage, the gross margin equation is estimated using the forecast of likelihood from stage one as an explanatory variable.

As well as ensuring unbiased estimates, the estimation of the contract participation equation provides insight into whether participation is based on self-selection or selection by Pioneer. For example, if contractors are better educated is this because Pioneer prefers better educated contractors? Similarly, does Pioneer select smallholders with more land or are ‘larger’ smallholders selecting themselves for the contract? In this context, the participation equation is interesting for more than just resolving methodological issues about simultaneity bias. It

provides insight into the characteristics of smallholders who contract. That is, whether contracting households are different from other households – do they own more land, are they better educated, what types of smallholders are likely to be found participating in contracts, what are the constraints on participation? Answers to these questions provide understanding of the constraints faced by smallholders wishing to participate in contracts and of how farm-level policy might be formulated to support contract farming. The standard econometric for examining a zero-one variable such as participation is through the use of probit regression. For the analysis of participation we therefore include both the results of the probit estimation and the linear probability estimation which we use in the two-stage procedure.

3. Seed Corn Contract

Pioneer is a multi-national corporation (MNC) growing a range of high value agricultural products in many countries including Australia. In Indonesia, Pioneer grows only hybrid seed corn which is produced only in East Java. Thirty to forty per cent of this seed is exported mainly to the Philippines with small amounts to Thailand and Japan with the remaining 60-70 per cent sold domestically. It first offered contracts for the production of hybrid seed corn to East Javanese smallholders in 1986. At present there are between 40 and 50 grower groups participating in the contract each year with a total of about 10,000 contracted growers in East Java. Average plantings are around 0.2 ha and total plantings by Pioneer contractors last year were around 2000 ha. Production was around 7000 tonnes which was cleaned, screened, sized, tested and packaged in the plant in Malang for sale in small packs (1, 5 and 40 kg) and jumbo packs of 1000 kg.

There is only one quality standard although different varieties are grown. Only 40-50 per cent of delivered seed meets the standard and seed not reaching this standard is sold as consumption corn. All seed delivered to the plant is accepted regardless of quality with quality issues dealt with through exclusion of poor performers from future contracts and by spotting problems in the field prior to harvest. Pioneer says ‘if growers follow guidelines then quality problems are ‘bad luck’ and costs will be borne by the company’. The cost of this risk is probably spread over all growers through offer prices.

The price paid to growers is 130 per cent over the prevailing spot price for consumption corn. Currently spot price for consumption corn is around Rp. 500 per kg[4] compared to a contract price of around Rp. 1150 per kg. (Yield from contracted corn is around 6 tonnes per ha compared to consumption corn yield of 12 tonnes per ha.) Inputs provided by Pioneer include foundation seed, money for land preparation, physical inputs (chemicals) and extension services. Costs of these inputs (except extension services) are deducted from the post-harvest payment for the crop with Pioneer organising funding through a commercial bank.

Negotiation, for single season contracts only, occurs at grower group level between Pioneer and the *ketua kelompok tani* (Head of the Grower Group, HGG) who represents the interests of growers in his group. Negotiations also involve the *kepala desa*, (village mayor), local politicians and government extension officers. These parties do not actively negotiate, rather, they perform two other roles. First, their presence legitimises the outcome of the negotiations. Second, if a dispute arises they act as intermediaries or 'referees'. There is a written agreement at group level signed by the HGG, politicians and extension officers with verbal agreements between growers and the HGG. Thus, the contract selection problem for Pioneer is primarily at grower group level with the selection decision taking into account distance from plant, irrigation, previous corn experience and disease and rodent problems.

Pioneer provides one extension officer for every one or two villages. They provide advice to growers on husbandry, monitor the crop and provide feedback to Pioneer. The staff member is likely to have an undergraduate degree in agriculture and come from a farming background. These are company people who move around geographically during their careers and have performance assessed on the basis of contract success.

Cross-pollination with other corn crops can contaminate hybrid corn seed and render it unregisterable as certified seed. Thus, Pioneer insists that all corn grown by a smallholder group (a specified geographical area) must be Pioneer hybrid seed corn. Since a neighbouring village or farmer group is a potential source of contamination, Pioneer may need to also capture their production, hence, clusters of contracting groups occur. Individuals not participating in the contract may receive a payment from the company for not growing corn if they have a previous history of growing corn. In this situation, the grower surrenders use of

[4] Consumption corn refers to grain while corn is delivered to the Malang plant is 'on the cob' with husk and usually the stem intact. As a rule of thumb, from Birchall, (2002), approximately one half of the mass weight of such corn is grain hence the 'grain equivalent' price paid to contractors is Rp. 2300 per kg, considerably higher than the consumption price.

the land for the growing season and a hybrid corn crop is planted by another grower. The compensation, called 'rent', is set at the gross margin for consumption corn. Usually at most only three or four growers in the group are affected by this arrangement.

Pioneer employs around 30 full time staff at Head Office in Malang in management and administrative positions in the office and processing facility. There are an additional 300 people employed in the processing facility on a part-time basis of whom around half are female. In addition, hybrid seed corn husbandry is labour intensive. For example, it takes 60 people one day to de-tassle one hectare and many day labourers are employed casually at specific points in the growing cycle.

Finally, Pioneer faces competition for smallholders to produce seed corn from Monsanto and PC, both MNCs. These firms are more diversified than Pioneer. Competition is for groups and villages though it is not clear how fierce this competition is.

4. Survey Results

4.1 Background

The survey was undertaken in April, 2002 by *Balai Pengkajian Teknologi Pertanian*, East Java (the East Javanese branch of the national agricultural research agency, BPTP) and the authors assisted in training enumerators, testing the survey and supervision of the field survey. Ten *dusun* (hamlets) were chosen from seven *desa* (villages) within the two *kecamatan* (districts) of Tajinan and Sumber Pucung in East Java.

A community level survey was conducted at *dusun* level with local officials. The *dusun* averaged 539 households with the smallest having 102 and largest 1316 with households predominantly employed in agriculture (96 per cent). In terms of development indicators, the survey showed 90 per cent of households had mains electricity, 86 per cent mains water and 4 per cent had a telephone in the household. The major agricultural activities are horticulture and crops, mainly rice, and livestock production was minimal with an average of 37 cattle per *dusun*. However, with one *dusun* reporting 236 cattle, the latter distribution was highly skewed.

Smallholders in all ten *dusun* had contracts with Pioneer and 150 contracting households were randomly selected from these. A further 150 households not involved with Pioneer were randomly selected from across the ten *dusun* giving a total sample 300 households. A final

sample of 289 smallholder survey forms were used, 144 non-contractors and 145 contractors. In all, 11 forms were not usable due to the inability to contact and survey selected smallholders, gaps in the data due to bad enumeration and, because of the late discovery of these problems, difficulties 'getting back' to the household for clarification. We have no reason to believe these problems will create bias in the sample.

Of the 145 contractors only six had been contracting since the inception of the contract in 1986, 90 per cent had less than seven years experience and around half had at most three years of experience contracting to Pioneer. Thirty per cent had not participated in at least one season of the contract since their first contractual year. These figures indicate significant levels of entry to and exit from the contract over time.

4.2 Key Measures

Table 1 provides comparisons of average values for key variables for participants and non-participants in the seed corn contract. Heads of households (HOHs) were mainly males with only three females (widows) in the sample. The average age of HOHs was 51 years and HOHs had an average of 6.7 years of formal schooling. Average household size was 4.1 with a household 'member' defined as any person residing full-time in the house for at least six of the previous 12 months. On average, 23 per cent of household members were aged less than 14 years or greater than 65 years and defined for purposes of the study as dependents. There was a significant difference in the average length of time that land had been managed by the two groups with non-contractors having managed their land longer than contractors. This may reflect that non-contractors tended to be older. In contrast, there were no differences in household size or education levels.

Land is the most valuable asset for these households in terms of both contribution to income and to prestige. Smallholders own on average 0.47 ha and rent in 0.18 ha with most of this being irrigated land (0.48 ha). Land owned and under management was significantly lower for the non-contract group and contractors have significantly higher levels of rented in land. Contractors also have significantly more irrigated land. On average, households own agricultural assets worth Rp. 284,000 including rotary hoes, water pumps, thrashers and small planting, weeding and harvesting equipment. There is a much larger investment in non-agricultural assets such as cars, motorbikes and televisions with an average of Rp 4.5 million worth of non-agricultural assets per household. The approximate value per household for all livestock is Rp. 2.24 million with the latter assets likely to be playing an important role as a

source of savings and production. In general, contractors are more likely to have higher levels of asset ownership, have taken out more loans in the previous two years and have more savings.

Sixty three per cent of total household labour was used on farm with 53 per cent of total household income generated through on-farm activities. Clearly, households are still predominantly farming households however significant levels of income are generated off-farm. Non-contracting households used 20 per cent more household labour in off-farm activities reflecting the likelihood that contract farming creates on-farm employment opportunities. On average, non-contractors obtained 60 per cent of their income from off-farm sources compared to 39 per cent for contractors.

Membership of community groups and participation in community activities provides an indication of links between households and the community and were used as a proxy for social capital in the study. HOHs belonged to an average of 2.1 community groups with an average membership duration of 8.1 years and 24 per cent of HOHs had or were group leaders. The level of 'giving' for community activities such as village festivals and building funds may also provide evidence of social capital and seemed relatively high across the sample at Rp. 900,000 for the previous 12 months.

Contractors are more likely to be a member of a community group however this reflects compulsory membership of contractors in the Pioneer group. If Pioneer group membership is not included then the reverse result holds true; non-contractors are more likely to be members of community groups. Participation in contract farming may crowd out other community activities.

4.3 Gross Margins

A gross margin (GM) analysis was undertaken to provide an overview of the smallholder farming systems and initial comparisons between contractor and non-contractor sources of income. In Table 2 total farm GM is disaggregated by farm inputs to provide comparisons of input use between contractors and non-contractors and, in Table 3, average GMs and areas for individual crops are reported.

Cropping activities are the most important sources of on-farm income in the study area. There are three major crops grown by smallholders: rice, corn and sugar cane. Rice is the dominant crop with contractors and non-contractors planting 30 and 25 per cent of their land

respectively to rice. Non-contractors tend to plant greater areas to consumption corn (12 per cent compared to 8 per cent) and sugar cane (17 per cent as compared to 13 per cent). Contractors, however, grow seed corn which more than compensates for these differences. Contractors plant, on average, 22 per cent of their available land to seed corn.

Seed corn provides the highest GM of the major crops with a return nearly 20 per cent higher than rice and sugar cane grown by contract farmers. Seed corn also has the highest input costs and returns per hectare. It uses significantly higher fertiliser, pesticide and non-family labour. It may be that, unlike with other crops, extra labour is paid in cash rather as a portion of yield (*bawon*). In general, contract farmers produce crops that have higher GMs/ha than crops grown by non-contractors. Sixty per cent of contract farmers obtain above-median GMs/ha for rice compared to only 40 per cent of non-contractors. The reasons for this may be either that better farmers are selected for the contract or the experience of growing a crop with the support of a large multinational company supplying regular innovative advice have made these farmers better than those who, with similar resource bases, have not had the benefit of this relationship.

Corn is often retained for household use and a possible reason for the low GMs apart from crop failure and poor management is that smallholders have difficulty estimating the yield of a commodity which they do not sell. The regularity and extent of corn growing implies that smallholders do regard it as an important crop for household food security.

Sugar cane is comparable with rice but has the disadvantage of being an annual crop and hence large outlays are required with returns not being generated until one year later. Sugar cane is not as 'cash flow friendly' as rice and is declining in popularity in East Java as (world) price continues to decline. The survey did not distinguish between first year and ratoon sugar plantings.

The only significant difference in land use (Table 3) between smallholder groups is that contractors plant significantly larger areas of rice than do non-contractors. This translates into significantly higher cropping and, with seed corn areas also included, significantly higher on-farm GMs. With regard to other agricultural activities, there are no significant differences between contractors and non-contractors with regard to tree crops (timber, fruit, plantations), mixed crops and sugarcane.

5. Model Specification and Empirical Results

5.1 Contract Participant Selection

Pioneer selects at group level for its contract and groups are selected on the basis of their previous contractual performance, disease and pest status and proximity to both other groups and to the plant in Malang. Selection at smallholder level is undertaken by a decision process occurring within the group. We are interested in identifying the characteristics of smallholders who participate in the contract and the extent to which they are either self selecting or their selection effectively reflects the preferences of Pioneer acting through its agency within the group. There are a number of ways smallholders may derive benefits from the Pioneer contract that would encourage them to self select for the contract:

1. The contract helps spread risk which should be favoured by those with limited opportunities for offsetting risks such as smaller, less diversified farms with limited access to credit or older (more risk averse) farmers.
2. The contract provides information on production and marketing of crops hence should be attractive to less educated and 'smaller' farmers unable to achieve scale in information gathering.
3. The contract increases on-farm demand for labour hence should be attractive to farmers with larger households facing high costs obtaining off-farm work.
4. The contract provides credit and advances of farm inputs hence should be attractive to farmers facing high borrowing costs.
5. Contracting is a group activity hence should be attractive to farmers with experience with agricultural and community groups.

If these factors contribute to the likelihood of contract participation then farmers are likely to be self-selecting since the contract is attracting those smallholders that benefit most. If these factors do not contribute to likelihood of selection then the alternative hypothesis, that Pioneer effectively does the selecting, is preferred. The latter is especially the case if size or scale contributes to likelihood of participation since larger farms may have lower unit costs making them attractive candidates for selection by Pioneer.

Initially, a probit analysis was conducted using the explanatory variables listed in Table 4. Land enters the analysis as three variables: land owned, land rented in and land rented out. It is assumed land rental arrangements are fixed in the short run and these categories of land are

viewed differently by smallholders for management purposes. The three land variables can be viewed collectively as approximating total land under management and hence capture both land investment and scale effects. Two types of labour, household labour and off-farm labour, are specified with large households hypothesised to be more likely to participate in contracts and households with off-farm work less likely. Farm machinery is a sunk investment with high transaction costs in re-selling or renting out and hence its ownership is hypothesised to increase the likelihood of contract participation. Credit enters the model as two variables. First, as a zero-one variable denoting whether the smallholder is credit constrained and, second, as number of loans taken out in the last two years. Smallholders were deemed to be credit constrained if they had not borrowed in the previous two years despite reporting that they needed to borrow. Human capital is captured through age of the head of household and zero-one variables for his or her education level. Older or better educated smallholders have more experience and knowledge and hence derive less benefit from contract participation. Social capital is captured through the number of community groups, including agricultural groups, household members participate in and by another variable for the number of agricultural groups the head of the household belongs to.

Table 5 reports the marginal contribution, evaluated at the sample mean, of each variable to the likelihood function and its associated *z* value. The results indicate the probability of entering a contract increases positively with the size of the enterprise measured by land under long-term management and with activity in credit markets. Contractors are younger, likely to belong to more farm groups but less community groups and their education level is irrelevant. Thus, the alternative hypothesis seems most plausible. That is, farmers are unlikely to be self-selecting and Pioneer effectively selects farmers who are larger, in terms of land under long-term management, presumably to get more reliable supply at lower unit cost. The probit model predicted contractors correctly 69 per cent of the time and non-contractors 73 per cent of the time (Table 6).

5.2 Contracting and Gross Margins

Empirical testing was undertaken to determine whether contracting contributed to gross margins where the latter were defined as the return to land, machinery and human capital. The gross margin equation was specified as:

$$gm_i = \alpha_1 + \alpha_2 status_i + \beta x_i + \varepsilon$$

where gm_i is gross margins for smallholder *i*, $status_i$ = 0 for non-contractors and 1 for contractors and x_i is a vector of exogenous variables: *mahhage*, *educdum1*, *educdum2*, *mfahown*, *mfharent*, *mfout* and *magass* (Table 4) and ε_i is an error term with the usual constraints.

An empirical issue arises over whether *status* is endogenous and this was dealt with using the following steps. A two stage least squares specification was estimated using the linear probability model in the first stage and the forecast of *status* from this equation was used as an explanatory variable in the second stage where gross margins were estimated using ordinary least squares (Angrist, 2000). The variables used in the first stage were similar to those in the probit analysis (Table 7). The Hausman test was then conducted and the hypothesis that *status* is endogenous rejected using the student *t* test (Doran, 1989, pp. 356-61). The gross margins equation was then re-estimated using ordinary least squares. The results using the two stage least squares (Table 8) and ordinary least squares estimators (Table 9) were almost equivalent with R^2 for the OLS result being 0.472 compared to 0.464 for the 2SLS result and coefficient magnitudes and standard errors were much the same.

The results indicate that *status* contributes to profits after controlling for the effects of land and farm machinery and education and age of household head. Focussing on the ordinary least squares results, all of the coefficients were significant at the 0.01 level except *status*, significant at the 0.05 level, and age and one of the educational dummies which was insignificant. It appears kindergarten education level contributed to profitability over 'no education' however more advanced education had no effect. The insignificant coefficient on the age variable may indicate a threshold level of years of experience was all that was needed for additional profitability and, given the older sample, all had met it. Testing with a quadratic term for age failed to capture such a threshold as a non-linearity. The coefficient on *status* was Rp. 1.33m (USD147) compared to a mean value of *gm* of Rp. 3.69m (USD410) across the sample. With average household income per annum around Rp. 9.5m (USD1,054), selection for the contract is, on average, welfare increasing, though not hugely so.

6. Discussion and Conclusions

Transaction cost theory predicts that a contract such as the Pioneer seed corn example in East Java will be successful in terms of both its persistence and the benefits conferred on participants if it results in sustainable reductions in transaction costs. From the description of

the contract in Section 3 and of the raw survey results in Section 4, most of the benefits that might be expected to accrue to smallholders from this type of contract are extant in the Pioneer contract.

From the smallholder's perspective, the contract provides a low cost way for smallholders to access seed corn markets using Pioneer's well established international marketing network. Without this network, and the processing facility in Malang that supports it, it seems unlikely this product would be produced on any scale, if at all, by these smallholders. The contract provides a credit facility in cash and kind and as such it allows constraints faced by smallholders in credit markets to be overcome with collateralisation of future production and reduced borrowing costs resulting in credit at commercial bank rates. The contract also allows production diversification, reduces risk associated with high cost farm inputs and provides a guarantee of price regardless of quality. No evidence was found of contracts dominating farm plans and reducing diversification and high levels of entry to and exit from the contract indicated there was little if any dependence on the contract in meeting basic income needs. Finally, growers participating in the contract receive high quality information on how to grow a technically complex crop in a situation where it is unlikely that the same type of technical help could come from government extension services.

The results of the probit analysis indicated smallholders were unlikely to be self-selecting and hence smallholders who might have benefited most from the contract were not necessarily selected. However, the gross margin analysis indicated that the smallholders who were selected experienced enhanced profitability. That is, the contract allowed them to make more productive use of their capital.

Glover and Kusterer (1990), Runsten and Key (1996) and Key and Runsten (1999) argue that farm contracts in developing countries often fail, hence, it is interesting to conjecture why the Pioneer contract has been successful. We believe that the striking difference between the Pioneer contract and those reported elsewhere is the way the institution of the grower group works within the contract. Glover and Kusterer (1990) and Singh (2000) report NGOs acting as intermediaries between agribusiness firms and smallholders in Central America and that grower representative groups often perform political and negotiation tasks in contract farming situations in developed countries. However, the grower groups we found in East Java were traditional, reflecting the need for careful management of irrigation systems over the centuries, and were led by HGGs who could exercise considerable power over the commercial decision making of individual members.

Pioneer gets tangible benefits from dealing with groups rather than individuals. The *costs of drafting, negotiating and enforcing contracts* are lower if the firm negotiates with 40 to 50 HGGs rather than 10,000 individual smallholders. Grower differences within the groups can be solved internally using traditional dispute resolution systems and written contracts need only be struck with the HGGs. In terms of enforcement costs, Pioneer benefits by selecting contract participants at group level rather than individual level since, providing the contract serves collective interests, the group has incentives to deal with contractually errant members. Enforcement costs, an important source of contract failure elsewhere, becomes a problem that can be dealt with by the group using its existing power structure. *Maladaption costs when contract specifications are not met* are also an important source of contract failure. Pioneer is in the enviable position of being able to sell sub-standard seed corn to the consumption market hence can offset some of the costs incurred when quality is below standard. However, again, the grower group plays a role in preventing maladaption to the contract. Members have a collective interest in preventing any individual from departing from Pioneer's growing guidelines since this would jeopardise the contract for the whole group and not just for the errant member. *Set-up and running costs associated with governance* are greatly reduced in a group environment since the Pioneer field employee works at grower group level. His costs of conflict resolution are reduced by the collective nature of grower interests and regular meetings of the group allow him to spend less time face-to-face with individuals. Finally, financial transactions are supervised by the HGG at group level including grower payments and provision of contracted inputs. We concluded that Pioneer achieves transacting scale by contracting with farmer groups that are like small firms with powerful Chief Executive Officers rather than with many individual smallholders and that this accounts at least partly for the success of the contract.

References

Angrist, J. (2000), Estimation of limited dependent variable models and zero-one endogenous regressors: simple strategies for empirical practice. *NBER Technical Working Paper 248*, Cambridge: National Bureau of Economic Research.

Birchall, C.C. (2002), *pers. com.*, School of Rural Science & Agriculture, University of New England.

Clapp, R.A.J. (1988), Representing reciprocity, reproducing domination: ideology and the labour process in Latin American contract farming, *Journal of Peasant Studies* 16(1), 5-39.

Commonwealth Development Corporation (CDC) (1989), *Review of Smallholder Development Programs*, Vols 1 & 2, London.

Coulter, J., Goodland, A., Tallonaire, A. and R. Stringfellow (1999), *Marrying Farmer Co-operation and Contract Farming for Agricultural Service Provision in Sub-Saharan Africa*, Guide to Developing Agricultural Markets and Agro-Enterprises Series, World Bank.

de Janvrey, A., Fafchamps, M. and E. Sadoulet (1991), Peasant household behaviour with missing markets: some paradoxes explained, *Economic Journal* 101(November), 1400-1417.

Dietrich, M. (1994), *Transaction Cost Economics and Beyond*, Routledge, London.

Doran, H.E. (1989), *Applied regression analysis in econometrics*, Marcel Dekker, Inc. New York and Basel.

Dorward, A. (2001), The effects of transaction costs, power and risk on contractual arrangements: a conceptual framework for quantitative analysis, *Journal of Agricultural Economics* 52(2), 59-73.

Eaton, C. and A.W. Shepherd (2001), *Contract Farming: Partnerships for Growth*, FAO Agricultural Services Bulletin 145, Food and Agricultural Organisation, Rome.

Friedland, W. (1994) 'The new globalisation: the case of fresh produce, in A. Bonanno *et al*. (eds) *From Columbus to Conagra*, University of Kansas Press.

Glover, D. and K. Kusterer (1990), *Small Farmers, Big Business: Contract Farming and Rural Development*, Macmillan, London.

Goodman D. and M.J. Watts (eds) (1997), *Globalising Food: Agrarian Questions and Global Restructuring*, Routledge, London.

Hayami, Y. and K. Otsuka (1993), *The Economics of Contract Choice*, Oxford University Press, Oxford.

Key, N. and D. Runsten (1999), Contract farming in Africa: an application of the new institutional economics, *World Development*, 27(2), 38-401.

Jaffee, S. (1994), *Exporting High Value Food Commodities*, Washington, DC: World Bank.

Key, N and D. Runsten (1999), Contract farming, smallholders, and rural development in Latin America: the organisation of agroprocessing firms and the scale of outgrower production, *World Development* 27(2), 381-401.

Little, P.D. and M.J. Watts (eds) (1994), *Living under Contract: Contract Farming and Agrarian Transformation in Sub-Saharan Africa*, Madison, University of Wisconsin Press.

Runsten, D. (1992), Transaction costs in Mexican fruit and vegetable contracting: implications for Association and Participation, Paper presented at the XVIII International Congress of the Latin American Studies Association, Atlanta.

Singh, S. (2000), Theory and practice of contract farming: a review, *Journal of Social and Economic Development*, 3(2), 255-63.

Stiglitz, J.E. (1974), Incentive and risk sharing in sharecropping, *Review of Economic Studies* 41(2), 219-256.

Torres, G. (1997), *The Force of Irony: Power in Everyday Life of Mexican Tomato Workers*, Oxford Press, Oxford.

Williamson, O.E. (1979), Transaction cost economics: the governance of our contractual relations, *Journal of Law and Economics*, 22:233-62.

Wilson, A. (1990), The political economy of contract farming, *Review of Radical Political Economics* 18(4), 47-70.

Tables

Table 1: Characteristics of smallholder households

		Total Sample Means	Contractor Means	Non-Contr. Means	Test
H/hold char.	Age of household head (yrs)	51.3	50.1	52.5	1.77*
	Education of hh head (yrs)	6.7	6.8	6.6	-0.29
	Dependency percentage (%)	23	21	25	1.85*
	Number of persons per hh	4.1	4.1	4.1	0.13
	Land managed by hh (yrs)	14.1	12.7	15.6	2.18**
Assets	Total value of ag. assets (Rp.'000)	284	367	201	-1.67*
	Total value of non-ag. assets (Rp.m)	4.5	5.0	4.0	-0.9
	Area of land owned (ha)	0.47	0.51	0.44	-1.18
	Area of land rented (ha)	0.18	0.25	0.11	-3.36***
	Area of land owned and rented (ha)	0.65	0.76	0.55	-3.27***
	Area of irrigated land worked (ha)	0.48	0.59	0.36	-4.62***
	Area of land rented out (ha)	0.06	0.05	0.06	0.12
	No. of loans started in the last 2 years	0.48	0.57	0.40	-1.94*
	Smallholders who have savings (%)	42	47	36	3.46*
	Value of livestock (Rp.m)	2.24	2.43	2.06	-0.7
	Value of all assets (Rp.m)	45.8	51.6	39.9	-2.08**
Labour use	Tot. labour days spent off-farm	173	160	187	1.34
	Off-farm income, % of total income	50	39	60	4.80***
	On farm labour use, % of total	63	68	57	-3.07**
Community links	Group membership (no.)	1.7	1.4	1.9	2.16**
	Group membership incl Pioneer group (no.)	2.1	2.4	1.9	-2.33**
	Spent on community activities (Rp.m)	0.9	1.1	0.7	-1.31

Test of difference between contractors and non-contractors using t-test or Pearson chi^2 as appropriate.

*significant at the 90% level, ** significant at the 95% level, *** significant at the 99% level.

Table 2: Crop GMs per hectare per season, contract and non-contract farmers

	Rice		Seed Corn	Corn		Sugar Cane*	
	contract farmer (Rp.000)	non-contract farmer (Rp.000)	contract farmer (Rp.000)	contract farmer (Rp.000)	non-contract farmer (Rp.000)	contract farmer (Rp.000)	non-contract farmer (Rp.000)
Income	**5,394**	**4,054**	**6,294**	**2,778**	**2,296**	**3,802**	**3,384**
Costs							
Seed	77	88	0	38	36	209	296
Fertiliser	669	610	965	698	638	492	481
Pest control	70	69	192	68	54	4	0
Weed control	10	1	21	16	1	2	0
Labour	662	675	985	821	839	122	159
Draft	236	320	139	126	229	1	0
Spray equipment	2	4	0	1	6	0	0
Water pump	0	101	0	1	1	1	0
	191	76	244	132	46	131	126
Bawon	271	249	0	23	74	1	408
Total Cost	**2,188**	**2,608**	**2,547**	**1,924**	**1,923**	**964**	**1,469**
Gross Margin	**3,206**	**1,850**	**3,744**	**854**	**373**	**2,838**	**1,915**

* Sugar cane is an annual crop while rice and corn are seasonal, in order to be able to compare GMs all income and input costs for sugar cane have been divided by three. *Barongan* costs are contract services costs paid as a set fee, *bawon* costs are costs for services paid as a percentage of yield.

Table 3: Testing for differences between areas of crop sown and gross margins; contractors and non-contractors

		Total Sample Means	Contractor Means	Non-Contr. Means	Test
Area	Corn (ha.)	0.20	0.17	0.22	1.25
	Rice (ha.)	0.56	0.68	0.44	-2.79***
	Sugar Cane (ha.)	0.08	0.07	0.09	0.86
	Mixed crops (ha.)	0.02	0.02	0.02	-0.39
	Tree crops (ha.)	0.06	0.05	0.07	1.22
Gross Margin	Corn (Rp.m/hh)	0.14	0.13	0.14	0.32
	Rice (Rp.m/hh)	1.51	2.13	0.89	-3.63***
	Sugar Cane (Rp.m/hh)	0.61	0.60	0.62	0.10
	Total crop# (Rp.m/hh)	2.76	3.49	2.01	-2.54**
	Total tree crop (Rp.m/hh)	0.42	0.37	0.46	0.64
	Total livestock (Rp.m/hh)	0.79	1.01	0.57	-0.75
	Total farm (Rp.m/hh)	5.00	6.90	3.10	-3.89***
	Total off-farm (Rp.m/hh)	4.5	4.4	4.6	0.19

not including Pioneer seed corn crop.

Test of difference between contractors and non-contractors using t-test.

** significant at the 95% level, *** significant at the 99% level,

Table 4: list of variables in the statistical analyses

mahhage	age of h/hold head
educdum1	education of h/hold head = kindergarden
educdum2	education of h/hold head = greater than kindergarden
mhhlab	number of working age members (14 - 65 years) in each h/hold
mofflab	days of h/hold labour spent working off-farm
mfhaown	number of hectares owned by h/hold
mfharent	number of hectares rented in by each h/hold
mfout	number of hectares rented out by each h/hold
magass	value of agricultural machinery owned by h/hold
mqcred	credit constrained (= 0) opr unconstrained (= 1)
mqnoloan	number of loans taken out in previous two years
mshhgp	number of community (including agricultural) groups that h/hold members are members of
groupdum1	belong to one agricultural group
groupdum2	belong to two agricultural groups
groupdum3	belong to more than two agricultural groups

Table 5: Results for probit analysis showing marginal probabilities and associated z values

	dF/dx	z
mahhage	-.0075054	-2.45
educdum1	0.0043247	0.05
educdum2	-0.0440127	-0.44
mhhlab	0.0382305	-0.44
mofflab	-0.0001745	-0.83
mfhaown	0.0732532	0.99
mfharent	0.2724795	2.22
mfout	-0.052439	-0.27
magass	2.06e-07	1.28
mqcred	0.12388	1.49
mqnoloan	0.1252614	2.33
mshhgp	-0.070098	-2.78
groupdum1	0.2886221	4.24
groupdum2	0.5208776	4.59
groupdum3	0.3542156	1.12

Table 6: Prediction Performance of Probit Model

			total
prediction	0	1	
0	102 73.4%	37 26.6%	139 100%
1	45 31%	100 69%	145 100%
total	147 52%	137 48%	284 100%

Table 7: Results for Linear Probability Equation: Coefficients and t Values

	Coefficient	t
mahhage	-.005313	-2.45
educdum1	-0.0011671	-0.02
educdum2	-0.0231731	-0.28
mhhlab	0.033126	1.41
mofflab	-0.0001084	-0.59
mfhaown	0.0828855	1.29
mfharent	0.2205782	2.77
mfout	-0.0477264	-0.28
magass	1.82e-08	0.55
mqcred	0.1076389	1.48
mqnoloan	0.1047717	2.51
mshhgp	-0.0584178	-3.38
groupdum1	0.255606	4.38
groupdum2	0.6542701	6.06
groupdum3	0.3813996	1.15
constant	0.4567479	2.68

Table 8: Results for Two Stage Least Squares Estimation

varname	coef.	t
status	3029344	2.11
mahhage	-24294	-0.80
educdum1	1356288	2.15
educdum2	1015829	0.87
mfahown	8764332	5.61
mfharent	8582245	2.94
mfout	-1.10e+07	-4.64
magass	3.061594	7.45
constant	-1916549	-0.92

Table 9: Results for Ordinary Least Squares Estimation

varname	coef.	t
status	1323924	1.92
mahhage	-33152.26	-1.15
educdum1	1341074	2.13
educdum2	968006.9	0.83
mfahown	8370035	5.75
mfharent	9079874	3.27
mfout	-1.12e+07	7.50
magass	3.130021	7.50
constant	-760024.3	-0.40