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Full Length Research Paper

Small-scale maize farmers' decision to participate in contract farming: Implications for integration into the marketing chain

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In this study, the determinants of participation in contract farming by small-scale maize farmers were investigated. The probit model was used to estimate the coefficients in the empirical model. The results indicated that for farmers with access to information, training, farming systems, extension visits, membership in farmer organisations, and household income, and the probability of participating in contract farming was high and significant. However, for farmers with remittances and post harvest losses, the probability of joining contract farming was low and significant. Policy implication suggested educating farmers who receive remittances about the extra benefits in contract farming to integrate them into the marketing chain. Again, the study suggested policies that provided adequately trained and equipped extension officers for dissemination of technologies that have the potential to reduce post harvest losses to assist farmers to obtain enough farm income to expand their areas of operation and attract firms offering contract farming.

Key words: Panel data, contract farming, probit model, small-scale farmers.

INTRODUCTION

There has been a growing interest in contract farming among small-scale farmers in South Africa and elsewhere as a means to enter the mainstream of the economy. Contract farming operates on formal basis where an agreement is made between two parties (contractor and farmer) under defined circumstances between the contractor and the farmer (Ahn, 2004). According to Eaton and Shepherd (2001), problems arise where informal markets exist and farmers renege on the agreement by not paying loans or sell their goods to other buyers. Eaton and Shepherd (2001) suggest two preconditions can therefore be said to exist for contract farming to be successful. Firstly, the markets should be working and secondly legal framework should be in place. The smallholder farmer is the best client in contract farming taking into consideration that the initiative is there to enable them to have access to the agricultural marketing chains locally, nationally and probably globally. There are rules and regulations in contract farming which the farmer has to abide. However, it has been noted that the regulatory and legislative environment is sometimes quite weak resulting in high levels of default. It also provides small-scale farmers with access to markets, access to credit, and could also provide new technologies to farmers (Glover and Kusterer, 1990). Research has shown that participation in contract farming has resulted in the improvement of household income and welfare of resource poor farmers (Warning and Key, 2002). Nevertheless, some studies have shown that limited gains can result in contract farming participation by farmers when not properly managed (Sigh, 2002).

However, the positive aspects of contract farming, studies have shown that contract farming can pose a risk source in the farm operation, thus, leading to potential disadvantages for farmers. According to Eaton and Shepherd (2001) most of these negative aspects arise from the relationship between farmers and the agribusiness firms offering the contracts. Rehber, (2004) is of the opinion that in most cases the firms are in a position to exercise power and non-competitive behaviour

in the definition of terms and conditions on the contracts. For example, firms might renege on contracts if prices change unfavourably. Specified prices in contracts are based on future market behaviour; therefore significant negative changes could lead to hold-ups or complete cancellation of contracts through negotiations with farmers (Reardon and Barret, 2000). The dependency on a prescribed technology package offered by firms through contracts makes farmers become vulnerable to output and productivity manipulation by agribusiness firms offering contract to farmers. Research has shown that delivery schedules might be set by firms as to influence prices paid to farmers.

This strategy can happen in cases where prices changes occur frequently and unexpectedly and firms have to adjust delivery schedules to capture the benefits of the volatile market. Farmers lose flexibility in enterprise choice, by binding themselves to crop or livestock enterprise by contract.

In such cases farmers cannot adjust to production mixes in order to capture the resulting market opportunities. Again according to Singh (2002) long-term contracts can sometimes lead to a gradually decreasing real prices paid by firms to farmers.

Against this background this study was designed to investigate the determinants of farmers' participation decision in the joining of contract farming.

Objectives and hypotheses

Empirical evidence indicates that farmer's decision to join contract farming is determined by several socio-economic factors. The general objective of this study was therefore, to identify and determine the level of significance of some of these factors. Based on previous studies it was hypothesized that for farmers with access to information, training, farming systems, extension visits, membership in farmer organisations, and household income the probability of participating in contract farming would be high and significant. However, for farmers with remittances and post harvest losses, the probability of joining contract farming would be low and insignificant.

METHODOLOGY

Data collection

Data for the study were collected from 396 small-scale maize farmers in the Limpopo province of South Africa between 2007 and 2008. The sample comprised household heads growing maize as a major crop on 1 to 3 hectare plots and included both contract and non-contract farmers. A two stage sampling method was employed. The first stage involved a purposeful selection of 12 projects involved in the Grain Advancement project from four districts in the Limpopo province (Capricorn, Mopani, Greater Sekhukhune and Bohlabela). These project sites were selected purposely due to their inclusion in the project.

The second stage involved a random sampling method employed to select respondents from the 12 projects in the four different districts. The contract farmers among them were those small-scale farmers who received inputs and extension services from two firms (Progress Milling and Noordelike Transvaal Kooperasie commonly known as NTK) and sold their maize to the firms through contracts.

Econometric model

In this study, changes in participation decision of contract farming were considered for panel data information on the small-scale maize farmers over a 10-year period of observation. During the period a farmer could decide to join contract farming and receive benefits in the form of the supply of a set of farm inputs from companies offering contract farming. Characteristics of this decision-making process suggested a dichotomous choice model. In any given year *t*, the choice of a farmer *i* between entering contract farming or not could be determined by his or her utility associated with each option.

According to Hynes and Garvey (2009) the utility derived from entering contract farming can be expressed as:

$$U_{CFit}(Pit + F_{it} + C_{it}, \bar{A}_{it}, Z_{it}) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

and the utility from not entering contract farming scheme expressed as:

$$U_{it}(F_{it}, 0; Z_{it}) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where, P_{it} = contract farming payment; F_{it} = farm income; C_{it} = opportunity cost of revenue lost when farmer is enrolled under contract farming scheme; $\bar{A}_{it}$ = additional effort necessary to meet requirements of contract farming scheme; and Z_{it} = vector of farm and farmer characteristics affecting utility.

The 0 in equation (2) indicates that if the farmer does not choose to enter contract farming scheme, no additional effort is required in terms of adherence to recommended farming practices. The net income effect of the contract farming scheme is the supply of recommended production inputs less the opportunity cost. According to Chambers and Foster (1983), the decision function can be given as:

$$Y_{it} = Uit\,(Fit, 0; Zit) - U_{CFit}(Pit + F_{it} + C_{it}, \bar{A}_{it}, Z_{it}) \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The value of the decision Y_{it} is not observed but the discrete participation indicator which is observed is given as: Y^*_{it} = {0, if Y_{it} >0; 1, otherwise}. Where 1 represents participation in contract farming and 0 represents non-participation.

The decision function that the farmer evaluates when contemplating joining the scheme can be written as (Hynes and Garvey, 2009):

$$Y^*_{it} = U_{it}(F_{it}, 0; Z_{it}) - U_{CFit}(P_{it} + F_{it} + C_{it}, \bar{A}_{it}, Z_{it}) = X_{it}\beta + e_{it} \quad -- (4)$$

Where X_{it} is a vector of that gathers determinants of Y^*_{it}, β is a parameter vector and e_{it} stochastic error term. Taking into account changes in the participation decision over time, the following model using the random effects was specified:

$$Y^*_{it} = X_{it}\beta + e_{it} \quad i = 1\ldots N,\ t = 1\ldots T \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where Y^*_{it} is the indicator variable denoting whether farmer *i* participated in contract farming at time *t*, X_{it} is a vector of endogenous variable, $\bar{I}_i$ is farm income and α_i is the individual effect.

$$\alpha_i = \bar{I}_i\,\delta + \gamma_i \qquad i = \ldots, N \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

The dynamic random effects logit model was used to separate lagged contract farming status into contract farming status in the previous contract farming period and contract farming status in the previous calendar year. The dynamic random effect model was specified as:

$$Y^*_{it} = \zeta i + X_{it}\beta + Y^*_{it,t-1} + \eta_{it}, \qquad i=1, \ldots, N, t=1, \ldots, T \ldots (7)$$

$$\varnothing_i = \bar{I}_i \lambda + u_i \quad I = 1, \ldots, N \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(8)$$

The sample for the estimation of Equations (5)-(8) included farmers that participated in contract farming for all possible years. For the entry estimations, a set of results for the model using the whole time period available (10 years) was reported. Under the assumption of the logit models outlined above, it can be shown that the regression function model is a linear combination of endogenous variables as the logarithm of the odds ratio, $X_{it}\beta = In[Prob_{it}/(1-Prob_{it})]$ where $Prob_{it}$ is the probability that $Y^*_{it} = 1$ (Green, 2003).

To interpret $\beta = (\beta_1, \beta_2, \ldots, \beta_k)^t$, when the jth endogenous variable, x_{itj}, is a dummy variable taking a value of 0 or 1, β_j's were interpreted as follows:

$$\beta_j = (x_{it1} \ldots 0 \ldots x_{itK})'\beta \;—\; (x_{it1} \ldots 1 \ldots x_{itK})$$

$$= In\left[\frac{\Pr ob(y_{it}=1|x_{itj}=1)}{1-\Pr ob(y_{it}=1|x_{itj}=1)}\right] — In\left[\frac{\Pr ob(y_{it}=1|x_{itj}=0)}{1-\Pr ob(y_{it}=1|x_{itj}=0)}\right]\beta$$

and

$$e^{\beta_j} = \frac{\Pr ob(y_{it}=1|x_{itj}=1)/\left[1-\Pr ob(y_{it}=1|x_{itj}=1)\right]}{\Pr ob(y_{it}=1|x_{itj}=0)/\left[1-\Pr ob(y_{it}=1|x_{itj}=0)\right]};$$

For a unit change in x_{itk}, the odds are expected to change by a factor of e^{β_j}. Alternatively, if the jth endogenous variable is continuous,

$$\beta_j = \frac{d}{dx_{itj}} X' \quad \beta = \frac{d}{d_{itj}} \ln\left(\frac{\Pr ob(y_{it}=1|x_{itj})}{1-prob(y_{it}=1|x_{itj})}\right).$$

The β_j is interpreted as the proportional change in the odds ratio. The results were expressed in odds ratios, thus a coefficient less than 1 indicated a negative marginal effect.

The probit model was used to estimate the coefficients in the empirical model. The description of the explanatory variables with expected sign and unit of measurement are presented below:

$$CONTR = \beta_0 + \beta_1 INFO + \beta_2 TRN + \beta_3 FSYS + \beta_4 REM + \beta_5 LOSS + \beta_6 EXTV + \beta_7 MEMB + \beta_8 INCOME + e_i$$

Where dependent variable was defined as;

Contract farming (CONTR) =1, if farmers joined contract farming; 2, otherwise.

The independent variables are defined as: Access to information (INFO) = Scale: 5 Excellent to 1 Very poor; Training (TRN) = Number of training attended per year; Farming system (FSYS) = 1, dual; 2, maize production only; Remittances (REM) = 1, if farmer received remittances; 2, otherwise; Post harvest losses (LOSS) = Scale: 4 Very high to 1 Very low; Extension services (EXTV) = Frequency of extension visits per year; Membership (MEMB) = Number of organisations joined; Income (INCOME) = Total farm household income per year (R); and e_i = error term.

The provision of access to market information (INFO) to farmers was likely to increase farmers' acquaintance with possible contracting firms and also strengthen their negotiating skills (Makhura et al., 1998) and ability to understand contract signing agreements. This variable was hypothesised to have positive effect on the probability of joining contract farming. Farmers who received high numbers of training per year (TRN) would be better able to network with firms offering contracts than those who did not, hence increasing their sales of produce. In this study, the variable was therefore expected to have positive effect on the probability of joining contract farming. Farmers with only maize production as a farming system (FSYS) were likely to participate in contract farming in the main marketing stream compared with those with dual or mixed crop farming. It was hypothesised that this variable would have positive effect on contract farming. The absence of remittances (REM) was likely to induce farmers to sell their farm produce. Hence, farmers who received remittances would be reluctant to sell or join contract farming to increase their household income. For this reason, this variable was expected to have negative effect on contract farming. Post harvest losses (LOSS) reduce crop sales and eventually household income. Farmers who joined contract farming were most likely to sell their produce on time to avoid losses. It was hypothesised that the higher the rate of post harvest losses the lower the probability of participating in contract farming. The assumption on extension visits (EXTV) was that extension officers would not frequent farmers without sharing some valuable information with them. According to Matungl et al., (2001) interaction with extension officers tends to improve farmers' access to information and technical skills in farming. Increase in extension visits was therefore likely to positively affect contract farming. Membership of farmers in associations (MEMB), clubs, societies, etc., was considered to be most likely to increase collective actions and decisive reasons to join contract farming. Hence, the more the number of organisations a farmer joined the more likely he would get to know the benefits of contract farming and decide to join. A positive impact was therefore, expected of this variable on contract farming. It was assumed that farmers who received high farm income (INCOME) were those expected to participate in the mainstream maize market production and knew the benefits of contract farming (Kirsten and Sartorius, 2002). These farmers were likely to join contract farming to reap its benefits. Hence, the variable was expected to have positive effect on the probability of joining contract farming.

RESULTS AND DISCUSSION

The test of group means of variables employed in the model was presented in Table 1. Significant differences in farm size, remittances and harvest losses were indicated. The results showed that there were significant differences when considering the three variables between contract and non contract farmers at least at the 5% significance level for harvest losses, and 1% for both remittances and farm size variables. The inference was that contract farmers received more remittances compared

Table 1. Test of equality of group means.

Variable	Mean		Wilk' s λ	F	P-value
Farm size	9.12	11.41	0.978	8.764	0.003
Information	1.18	1.10	0.999	0.465	0.496
Training	1.00	1.01	1.000	0.003	0.953
Farm sys	1.92	1.75	0.995	2.141	0.144
Remittances	1.55	1.41	0.981	7.539	0.006
Harv Losses	1.24	2.45	0.990	3.898	0.049
Extension visits	3.02	3.08	0.998	0.640	0.424
Member	2.22	2.07	0.996	1.529	0.217
Income	944.52	1071.53	0.995	1.826	0.177

CF (n_1=211) No CF (n_2=184).

Table 2. Probit parameter estimates.

Variable	Estimate	Std. error	Z-statistic	Significance
Information	0.052*	0.030	1.716	0.086
Training	0.077***	0.027	2.798	0.005
F-arming Sys	0.171***	0.027	6.320	0.000
Remittances	-0.096*	0.052	-1.850	0.064
Harvest losses	-0.078***	0.027	-2.874	0.004
Extension visits	0.100**	0.039	2.565	0.010
Membership	0.065**	0.025	2.579	0.010
Income	0.001*	0.000	-2.058	0.040
Intercept	-1.549***	0.183	-8.482	0.000

Wald's χ^2 = 587.047; df= 370; P-value = 0.00. *** Estimate is significant at the 0.01 level; ** Estimate is significant at the 0.05 level; * Estimate is significant at the 0.10 level; Number of valid cases =379; Probit (P) = $\beta_{0+}\beta_i X_{i.}$

compared with no contract farmers; however, non contract farmers had larger farm sizes, and incurred more significant post harvest losses than their contract farmers' counterparts.

The results of the estimated probit model are presented in Table 2. From the results, all the independent variables had significant effects on the probability of a farmer deciding to join contract farming. Again, all the independent variables had the expected signs. The Wald's test chi-squared statistic was performed to test whether the parameters on the model were all equal to zero. The results showed that the coefficients in the specification of the model were significant at least at the 1% level of significance (P<0.01).

The results indicated that the probability of farmers joining contract farming was positively significant when considering farmers with access to information, training, maize cropping only, high extension visits, high membership in farmer organisations, and high income. However, for farmers with high remittances and post harvest losses, the probability of joining contract farming was low.

Access to usable information by farmers (INFO) was most likely to have a significant effect on their ability to generate profits from high sales.

The results of the study showed that farmers with more access to information were more likely to enter into contract farming. The odd ratio was however estimated to be low but significant. The results were in line with the stated hypothesis and conformed to similar studies by Jayne et al. (2004).

In this study, farmers training (TRN) was a variable that referred to the transfer of knowledge and skills on maize production and marketing, record keeping and entrepreneurship. Studies have showed that such training received by small-scale farmers improved their knowledge and understanding of production and marketing that improved production and sales. Training variable was positive and highly significant at the 1% level. The result was in line with the stated hypothesis and other studies (Ahn, 2004).

The results indicated that there was a positive significant relationship between farming systems (FSYS) and contract farming. The results were consistent with the stated hypothesis since farmers with maize production only were likely to participate actively in maize farming activities by joining contract farming which offers

such benefit. Remittances (REM) variable was significant with the expected sign. The implication was that farmers who receive remittances are less likely to join contract farming. The result could be due to that fact that farmers could utilise remittances to purchase farm inputs which could translate into increased marketable surplus. Remittances might also be enough for them to decide not to join contract farming for extra benefits in terms of increased income. The occurrence of post harvest losses (LOSS) may inhibit farmers from expanding their sizes in farm operation due to lack of farm income to finance such operations. This in turn reduces the potential to increase crop sales in the long run. Bearing in mind that firms would like to deal with farmers on large scale production, such farmers are less likely to engage in contract farming.

Research has showed that frequency of extension visits (EXTV) to impart useful information to farmers could result in increase knowledge, productivity and income. The results of the probit analysis showed that farmers who indicated that they received high extension visits per year were those who with high probability of participating in contract farming. The result was consistent with *a priori* expectations and similar studies by Pingali et al. (2005) and indicated that high frequency of extension visits increases the probability of joining contract farming. Farmer's participation in a number of farm organisations (MEMB) was positive and highly significant. The result indicated that the probability of joining contract farming increased with farmer participation in relevant farming organisations. Studies by Kamara et al (2006) indicate that farmer organisations, for example, commodity organisations are believed to be centres of information which can be accessed by farmers. Members and individuals are also motivated by other farmers to join beneficial organisations such as contract farming. Total income of farmers per year (INCOME) had positive and significant effect on contract farming. The implication was that farmers with high income per year are the ones most likely to join contract farming. High income is an indication of the size of operation and sale of farm produce. Hence, farmers with high income could be associated with those operating on large scale production and as a result become attracted by firms to sign contract with them.

Conclusion

The study revealed that access to information, training, mono farming system, extension visits, membership of organisations, and farm income positively determine farmers decision to join contract farming. Farmers who incur post harvest losses and those who receive remittances are less likely to join contract farming. Policy should target at educating farmers who receive remittances about the extra benefits in terms of increased income to attract them to contract farming. Again, policies that provide adequately trained and equipped extension officers for dissemination of technologies that have the potential to reduce post harvest losses should be encouraged to assist farmers to obtain enough farm income to expand their areas of operation and attract firms offering contract farming.

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