CHAPTER 10

A BARGAINING MODEL OF MIGRATION

Getting the permission of the farm household

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Abstract. This chapter models migration decisions as joint individual and family decisions and develops a model in which family members can migrate on the condition that they remit more than they would have contributed as resident household member. The upper bound on remittances is set by their own net benefits after migration. The paper uses cross-sectional data collected in 2000 from northeast Ghana to investigate the effect of farm household population, family landholding and the perceived soil quality on migration and remittance decisions of members of the farm household in Northeast Ghana. Nested logit and Tobit models estimation techniques are employed. The empirical results confirm the negative effect that per-capita farmland size has on the probability of migration. More livestock sales coincide with fewer remittances. The core factors of the theoretical model could not be confirmed, however. Land quality appears to have no effect on migration or remittances. Local employment conditions help mitigate migration, however.
Keywords. migration; remittances; soil quality; man/land ratio; bargaining.

INTRODUCTION

Many migration studies in the past have focused on individual decisions and optimized individual behavioural models. In recent years, the focus on migration decision as family decision that could stimulate or prohibit migration of some members of the household has gained much attention. For example, studies such as Burger (1994), McElroy (1985) and Stark (1991) have indicated that migration decisions are often jointly made by the potential migrant and some non-migrants (the family). According to Stark (1991), migration by one person can be due to, fully consistent with, or undertaken in pursuit of rational optimizing behaviour by another person or a group of persons such as the family. Hence, these migration studies

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involving the farm economies have included farm household characteristics like size of landholding, household size, farm assets etc., in addition to individual characteristics such as education and age as explanatory variables.

A presumption of this paper is that during the period of rapid population growth the rate of migration from the farm communities is likely to be higher due to increasing pressure of population on land resources. The paper therefore investigates the importance of the farm household population, family total landholding and how the perceived soil quality of household's farmland affects the migration and remittance decisions of members of the farm household in northeast Ghana in recent periods. A member of a farm household may migrate to another community, either to an urban town or another rural area where land is in abundance, in search of a job or to undertake other economic activities. From the new location the migrant may send remittances in order to support the farm household to meet production-consumption needs. This paper presents a theoretical model that draws on the migration-modelling approach followed by Burger (1994) and extends his theoretical analysis to include a variable to measure the soil quality, which is important for sustainable farm production as an additional factor-variable that affects the farm household's migration decision-making process. Using cross-sectional data collected in 2000 for about 170 farm households in northeast Ghana, the empirical analysis is used to investigate the effects of the farm household and individual person characteristics on migration decisions and amount remitted. The nested logit model and the Tobit model estimation techniques are used to estimate the migration and remittance models, respectively.

The rest of the paper is organized as follows: In the next section, a brief review of migration models is presented. Then, our theoretical model for the migration and remittance decisions is presented. The amount remitted is considered to be at least equal to the amount that is required to get the permission to leave from the family members and at most just enough to keep migration attractive for the migrant. Next, the data source employed for the empirical analysis is outlined, before the section for the estimation functions and results for migration and remittance is presented. The discussion of this paper ends with a concluding section.

BRIEF REVIEW OF MIGRATION MODELS: NEW ECONOMICS OF LABOUR MIGRATION

It is understood that both the causes and the consequences of migration are context-dependent (De Haan 1999). The migration of labour geographically, out of rural areas and occupationally, out of farm jobs, is one of the most pervasive features of agricultural transformations and economic growth. The approaches to rural migration studies have revolved around some key models: the classical two-sector model, the neoclassical and expected-income (Todaro) two-sector models, human-capital models and the new economics of labour migration (NELM). Detailed reviews of these models, their contributions and limitations as well as some migration studies based on these models, are available in Taylor and Martin (2001) and De Haan (1999), and this section draws much from these two papers. The section briefly describes only the NELM models, which our analysis follows.

The fundamental view of the new economics of labour migration (NELM) is presented in Stark (1991)[1]. Under NELM, migration decisions are not taken by an individual person alone but are agreed upon by larger units of related persons, typically the other household or family members. The NELM contends that people act collectively to maximize income, minimize risks and loosen constraints created by market failures: missing or incomplete capital, insurance and labour markets. Through the remittances from migrants, migration is seen as an intermediate investment that facilitates the transition from familial to commercial production by providing the rural households with capital and a means to reduce their risks.

Because skill-related attributes of individual family members influence the cost and benefits of migration for households as well as for the individual, the human-capital theory has been incorporated into NELM models. The household perspective also implies critical interactions between individual and household variables, including assets and the human capital of household members. These variables influence the marginal cost of migration for households (including the marginal effect of migration on farm production) as well as the impacts of remittances and the income insurance provided by migrants on the expected utility of the household as a whole.

Taylor and Martin (2001) list four key implications to account for why the NELM models differ sharply from the migration models: (i) contrary to both classical and neoclassical theories, the loss of labour to migration may increase production in rural economies by enabling households to overcome credit and risk constraints on production; (ii) a positive income (or expected income) differential between urban and rural areas is not a necessary condition for migration. Migration in the presence of a negative urban-rural income differential is consistent with the NELM, provided that the variance of urban incomes and/or income covariance between the two sectors is sufficiently low; (iii) the individuals who migrate are not necessarily those that a traditional human-capital model would predict: the impact of an individual's out-migration on the productivity of other family members also matters; and (iv) equal expected income gains from migration across individuals or households do not imply equal propensities to migrate, as predicted by a Todaro model, when risk and/or relative income considerations also influence migration decisions. From a migration policy point of view, the NELM shifts the focus of migration policy from intervention in rural or urban labour markets to intervention in other (most notably rural capital and risk) markets, in which an underlying motivation for migration is found.

The classical and neoclassical models treat migration as the result of an individual decision-making process, while the NELM models consider the family or household as the unit of analysis. Methodologically, the NELM approach, with its focus on risk and market imperfections, requires the use of non-recursive farm household models to analyse both the determinants and impacts of rural out-migration. The classical and neoclassical models of migration behaviour do not explain the remitting of a share of migrant earnings back to the rural place of origin.

The explanation of remittances is a cornerstone of the NELM, representing one of the most important mechanisms through which determinants and consequences of migration are linked.

The consensus in the literature about the relationship between migration and rural development remains thin. The evidence suggests that migration does not usually lead to radical transformation of rural agriculture but that it often occupies a central part in the maintenance of rural people's livelihoods (De Haan 1999). Croll and Ping (1997) note from a series of field studies centred on villages of migrant origin in China that high rates of out-migration are caused by land scarcity, rising cost of agriculture and a strong desire of villagers to leave agriculture, and these in some cases lead to shortage of labour. Bigsten (1996) argues that high wages (pull factor) are more important than land scarcity (push factor) in explaining migration decisions.

It has been noted that in the absence of complete markets in an economy, the decision to send out migrants may have significant effects on other household economic activities (Taylor et al. 2003). While migrants are away, households have less labour to allocate to local production activities. If a migrant household's marginal product on the farm is positive, crop production will fall when the household sends out a migrant(s). Taylor et al. (2003) note that the adverse effect of loss of labour may be high since migrants tend to be younger and better educated than the average rural labourer. Rozelle et al. (1999) report a significant and negative effect of loss of labour on yields, but the same authors (Taylor et al. 2003) using the household farm survey data collected by Rozelle in another paper find out that although loss of labour to migration has a negative effect on household cropping income, the overall effect of migration on crop yields is positive. The loss in yield due to the reduction in available labour may be compensated for (partially) by remittances from the migrant(s) (Taylor et al. 2003; Rozelle et al. 1999), which are used to purchase additional inputs or rent substitutes for labour in cropping.

This paper adepts the NELM approach by including negotiations to explain migration and remittance decisions of farm households, given, among others, the marginal (value) product of labour. It shows that the remaining members of the household would appreciate the departure of a worker-cum-consumer, even when no money would be remitted, if consumption per person (i.e., remaining members) is greater than marginal value product per worker (barring any adjustment made). In the light of the findings from other studies, even though loss of labour may reduce yields, if the average consumption is greater than the marginal production value of the migrant lost, then the migration is appreciated. This suggests that factors that lead to higher (lower) marginal value productivity of labour would reduce (increase) the probability of migration and set up a higher (lower) limit for remittances as compensation.

THE THEORETICAL MODEL

Labour migration decisions among adult members of a household are mostly made for economic and, in recent periods, for environmental reasons. Many migration studies in the past have focused on individual decisions and optimized individual behavioural models. In recent years, the focus on migration decision as a family decision, under the new economics of labour migration (NELM), that could stimulate or prohibit migration of some members of the household has gained much attention.

The empirical estimates obtained by McElroy (1985) involve the maximum-likelihood estimation of a trinomial probit: an individual may stay at home without a job; stay at home with a job; or leave with a job. The approach adopted by Burger (1994) accounts for remittances and does not assume that the individual may stay at home without making any contribution to family income. Burger considered three options: stay and contribute (at least do farm work); leave without remitting; leave and remit. Burger considered a bargaining (agreement) situation in which the family and the prospective migrant consider how much the migrant should remit in return for the family's consent to his departure. This paper extends Burger's theoretical analysis to include the effect of the quality of the soil, which is important for sustainable farm production, as an additional factor-variable that affects the farm household migration decision-making process. The inclusion in the migration model of a variable to account for the soil quality and not just the size of land held by a household makes the model quite different from other known models for migration studies. The model is then applied to the cross-sectional data collected from farm households in northeast Ghana. The three options considered for an individual in the present study regions include: an individual stays and contributes to farm production and income, though there is increased pressure on farmland and its quality; an individual leaves without remitting but the pressure on farmland and its quality is reduced; an individual leaves and remits, and the pressure on farmland and its quality is reduced. The theoretical migration model which is built between the farm household and the potential migrant in this paper, using farm and individual characteristics, is therefore aimed at explaining the reasons why some farm household members leave while others stay behind. It shows, for example, that the remaining members of the household would appreciate the departure of a worker-cum-consumer, even when no money would be remitted, if consumption per person (i.e., for the remaining members) is greater than marginal value product per worker (before any adjustments made).

The model assumes that a household in the rural economy faces imperfect labour and land markets, but there are perfect markets for farm products and other inputs like fertilizer. A time constraint exists that equates household leisure and labour (farm and non-farm) time to total available time. The available landholding is allocated between cultivation Θ and fallow $(1 - \Theta)$, where $0 \leq \Theta \leq 1$. The existence of market imperfections suggest that the utility and profit maximization decisions of the farm household are not determined by separate decision-making processes (non-recursive), but they are jointly determined and the optimal household production and consumption levels are determined within an integrated framework (Lopez 1986).

The ability of the farm household to maintain farm production at a sustainable level (Y_s) and therefore the soil quality (Q) is influenced by the indirect effect of the current soil quality index (Q_t) on the household's utility over time through its effect on farm output (Y). Assuming that the household decides on farm labour and purchased (external) input for farm production in order to maximize the discounted utility per member (U) dependent on its consumption per capita (C) and leisure per worker ($T - h$) in each time period t and $t+1$, the household intertemporal (discounted) utility (U) maximization function is presented as:

$$U = \max_{C_t, h_t, X_t \Theta_t} u(C_t, T - h_t) + \rho E u(C_{t+1}, T - h_{t+1}) \tag{1}$$

subject to the total aggregate consumption for the time period t and $t + 1$:

$$p_c MC_t + p_x X_t = p_f Y_t + I_{e_t} \tag{2}$$

$$p_c MC_{t+1} + p_x X_{t+1} = p_f Y_{t+1} + I_{e_{t+1}} \tag{3}$$

farm production (actual output level) for each time period:

$$Y_t = f(Q_t, N_t h_t, X_t, \Theta_t A; Z_t) \tag{4}$$

$$Y_{t+1} = f(Q_{t+1}, N_{t+1} h_{t+1}, X_{t+1}, \Theta_{t+1} A; Z_{t+1}) \tag{5}$$

and an index of soil quality:

$$Q_{t+1} = Q_t (Y_{st} / Y_t)^{\delta} \tag{6}$$

where Y_{st} is the sustainable farm production level defined as:

$$Y_{st} = g(Q_t, N_t h_t, X_t, \Theta_t A; Z_t) \tag{7}$$

The subscripts t and $t+1$ are time periods, ρ is the rate of time preference and E is the mathematical expectation operator. The symbol C is consumption of goods (food and other items) per household member (person) in each time period. p_f, p_c and p_x are output, consumption-good and purchased-input prices, respectively, while T and h are total hours and average farm labour hours provided by a family worker per day, respectively. (The non-farm labour and income have been ignored here for simplicity.) Y is (actual) farm output and X is purchased farm input (including hired labour), A is the total landholding, Θ is the proportion of land cultivated, M is the size of the farm household, N is number of family workers ($N \leq M$) and Z includes exogenous factors. Also, I_e is exogenous income such as remittances. Q represents the soil quality index[2], while Y_{st} represents the sustainable production level.

The household's total aggregate consumption in each period is made up of the value of goods (food and other items) consumed and value of inputs purchased for farm production. These are assumed as the total farm expenditure, which is financed from the total farm income made up of the values of farm output ($p_f Y$) and exogenous income (I_e). Each of the factors, included in the production functions (equations 4, 5 and 7), is important for production and has presumably a positive effect on farm output. Higher soil quality and the use of more purchased input should, in each case, give higher farm output. Also, an increase in either the number of family workers (N), average farm labour hours provided per day by a family worker, the proportion of land cultivated (Θ) or total land available to the household (A) is expected to raise farm output. But is it assumed that in the short run, actual production function is more responsive to labour increases than the sustainable production function. That is, the marginal product of labour in equation (4), f_2, is greater than the marginal product of labour in equation (7), g_2. Equation 6 gives the relationship between the next-period soil quality (Q_{t+1}), the current-period soil quality (Q_t), sustainable production level (Y_{st}) and actual production level (Y_t), such that a greater actual production above sustainable level would suggest lower soil quality for the next period. The index of the soil quality is assumed to remain the same over time if the actual farm production is at the sustainable level.

The Lagrange form for the household utility maximization is given as:

$$\begin{aligned} L &= u(C_t, T-h_t) + \rho E u(C_{t+1}, T-h_{t+1}) \\ &\quad + \lambda_0 \{ p_f\, f(Q_t, N_t h_t, X_t, \Theta_t A; Z_t) + I_{e_t} - p_c MC_t - p_x X_t \} \\ &\quad + \lambda_1 \{ p_f\, f(Q_t (g/f)^{\delta}, N_{t+1} h_{t+1}, X_{t+1}, \Theta_{t+1} A; Z_{t+1}) + I_{e_{t+1}} - p_c MC_{t+1} - p_x X_{t+1} \} \end{aligned} \tag{8}$$

The Lagrange multipliers, λ_0 and λ_1 represent the shadow values of farm income in terms of additional utility in periods t and $t+1$, respectively; f and g are the actual and sustainable production functions, respectively. Assuming an interior solution we consider only the first-order condition for farm labour hour in period t, which gives:

$$\frac{\partial L}{\partial h_t} = -u_2 + \lambda_0 N_t p_f f_2 + \lambda_1 N_t p_f f_1 Q_{t+1} \delta \left[\frac{g_2}{g} - \frac{f_2}{f} \right] = 0 \tag{9}$$

The condition states that the marginal utility of leisure u_2 should equal the (utility of the) marginal contribution to income. This latter contribution is in the form of production itself (the factor $N_t\ f_2$) and by its effect on sustainability, which comes through the change in soil quality f_1, which itself is due to the indirect effect of labour. f_2 and g_2 are marginal products of labour hour for the actual and sustainable production functions, respectively. If the relative marginal production f_2 is greater than its equivalent of sustainable production technology g_2, the sustainability effect will be negative. For later use we rearrange equation (9) as:

$$\lambda_1 N_t p_f f_1 Q_{t+1} \delta \left[\frac{g_2}{g} - \frac{f_2}{f} \right] = u_2 - \lambda_0 N_t p_f f_2 \tag{10}$$

If h_t is optimal, then it follows from equation (8) that a change in utility per member (U), dL, following the departure of a worker from the farm (i.e., $dM_t = dN_t = -1$) and who remits $dI_e = I_e^*$ is given as:

$$dL = \lambda_0 \{ h_t p_f f_2 dN_t + dI_{e_t} - p_c C_t dM_t \} + \lambda_1 h_t p_f f_1 Q_{t+1} \delta \left[\frac{g_2}{g} - \frac{f_2}{f} \right] \tag{11}$$

The change in utility per member becomes positive if

$$I_e^* > p_f f_2 h_t + \frac{\lambda_1}{\lambda_0} \left\{ p_f f_1 Q_{t+1} h_t \delta \left[\frac{g_2}{g} - \frac{f_2}{f} \right] \right\} - G_t \tag{12}$$

where $G_t = p_c C_t$. That is, G_t is the aggregate value of consumption per person in period t. This is the optimal consumption level if a person stays on the farm. The change in utility per member for the remaining household members would be positive (the remaining members benefit) if the amount remitted by a migrated member is greater than the terms on the right-hand side of the inequality. There we see the marginal value product of labour ($p_f f_2$) times working time per person h_t minus consumption per person (G_t), adjusted for the effect of present production on the next-period income constraint. The higher the person's net contribution to the household income (production value minus consumption), the higher should be the compensating remittance. If the marginal labour effort led to more degradation, the compensation may be less. A person who hardly contributes but shares in the consumption, may have a negative lower bound for his remittances.

Substituting equation (10) into equation (12) gives a simplified form of equation (12) as:

$$I_e^* > \frac{u_2}{\lambda_0 N_t} h_t - G_t \tag{13}$$

It follows from equations (12) and (13) that, for $I_e^* = 0$, migration is permitted if

$$G_t > \frac{u_2}{\lambda_0 N_t} h_t \tag{14}$$

Equation (12) sets the lower bound of the amount to be remitted by a (potential) migrant. It indicates, from equation (14), that the remaining members of the household appreciate the departure of a worker-cum-consumer even when no money would be remitted ($I_e^* = 0$), if consumption per person in period t (G_t) is greater than marginal shadow income of a single adult worker. In these shadow costs the effects on future income are accounted for by virtue of equation (9). The more household members there are (greater N), the easier it is for this condition to be met.

The upper bounds for remittances from the farm family and potential migrant perspectives (derived from the potential migrant's intertemporal utility maximization problem: see Appendix 1 for derivation) are, respectively:

$$I_e^* < wh_t^u - (h_t^u - h_t^f)\left\{p_f\, f_2 + \frac{\lambda_1}{\lambda_0} p_f\, f_1 Q_{t+1}\delta\left[\frac{g_2}{g} - \frac{f_2}{f}\right]\right\} - G_t \tag{15}$$

and

$$I_e^* < wh_t^f - G_t \tag{16}$$

Equation (16) applies when we value the difference in working time before and after migration (h^u-h^f) using urban wages, rather than using the marginal farm product as in (15). The lower and upper bounds for remittances from the perspective of the farm family (equations 12 and 15 or 16) would be reduced to the derivations in Burger (1994), if the soil quality effect (i.e., the term including f_1) would not apply. The consideration of the soil quality would make a farm family and a potential migrant reach an agreement on migration that internalizes the effect of future income in the present decision. An agreement between the farm family and the potential migrant can only be reached if the upper bounds (equations 15 and 16) are above the lower bound for remittance (equation 12) that is imposed by the rural family[3]. Thus, the ranges of I_e^* that are acceptable to both the remaining farm household members and the migrant can be stated (using equations 12 and 15 and then equations 12 and 16), respectively, as:

$$p_f\, f_2 h_t + \frac{\lambda_1}{\lambda_0}\left\{p_f\, f_1 Q_{t+1} h_t\,\delta\left[\frac{g_2}{g} - \frac{f_2}{f}\right]\right\} - G_t$$

$$< I_e^* < wh_t^u - (h_t^u - h_t^f)\left\{p_f\, f_2 + \frac{\lambda_1}{\lambda_0} p_f\, f_1 Q_{t+1}\delta\left[\frac{g_2}{g} - \frac{f_2}{f}\right]\right\} - G_t$$

and

$$p_f\, f_2 h_t + \frac{\lambda_1}{\lambda_0}\left\{p_f\, f_1 Q_{t+1} h_t\,\delta\left[\frac{g_2}{g} - \frac{f_2}{f}\right]\right\} - G_t < I_e^* < wh_t^f - G_t \tag{17}$$

Equation (17) provides two influential factors: the bandwidth for testing the basis for migration and the level of the lower bound for testing the basis for remitting to the remaining household members at home. The wider the bandwidth, the greater is the probability that an individual member of the farm (if there is a suitable candidate) will migrate (Burger 1994). The bandwidth, from (17), is independent of the farm's current aggregated value of consumption per person (G_t), a characteristic of the willingness of the farm household to share whatever is on hand among members present, though changes in factors like migration that raise the level of the aggregated value of consumption per person would be appreciated. The upper bound of the bandwidth rises with higher wage levels that the person could command (say, by higher education) and by an increase in labour hours that are possible after migration. The lower bound falls when more persons are working on the farm, when less land or land of lesser quality is available or other factors diminish his marginal product. All the above reasons lead to a wider bandwidth and a greater chance of reaching a mutual agreement about leaving.

We have assumed that in the short run, actual production is greater (more responsive to labour increase) than the sustainable production level. Hence, the sustainable relative marginal product of labour per output (g_2/g) should be less than the actual relative marginal product of labour per output (f_2/f), and this would widen the bandwidth and therefore the probability of migrating, assuming that the number of labour hours provided for urban work is greater than that provided for farm work ($h_t^u > h_t^f$). Also, a greater actual production above sustainable level would suggest lower soil quality for the next period (from equation 6), meaning a wider bandwidth and therefore increase the probability to migrate.

If the level of the lower bound is expected to be high, then the amount of money that must be remitted once a person has migrated would be high. Thus, it would be expected that, among the migrants, those from farm households with larger values for the lower bound should be sending more monetary support. A higher rate of soil quality loss or poor soil quality status, for example, would mean a lower level for the lower bound and therefore the lower would be the agreed (bargained) 'price' to get a permission to migrate and, consequently, the lower would be the remittance to the farm household after migration. Thus, it would be expected that migrants from farm households experiencing poorer soil conditions are more likely to migrate, but they would typically be remitting less.

Remittances may be used, among others, to purchase fertilizer and other productive inputs for investment in farm production and for consumption purposes. Like in Burger (1994), the impact of land size [landholding (A) and allocation parameter (Θ) between the amount cultivated and fallow[4]] on the lower bound is less clear. If the farm household could find more land for farm expansion, landholding should increase the marginal product of labour, raising the lower bound and therefore the amount to be remitted. However, an increase in Θ from a fixed landholding would decrease the soil quality (weighted) for the next period (from equation 6), increase the marginal product of labour in the current period, but would leave the sustainable marginal product of labour per output (g_2/g) to be less than the actual marginal product of labour per output (f_2/f). The net effect on the lower bound and therefore the amount remitted is not very clear. The understanding could be that migrants remit less money to households that can expand the cultivated area. Household size (*M*) is expected to affect remittances positively while unearned income like transfer from other migrants to the household is likely to affect total remittances negatively, but not the probability of migrating. As the two factors, the bandwidth and the lower bound, are related, it can be deduced that between two potential migrants with the same wage, the one who was more likely to migrate (i.e., to have larger bandwidth) is also likely to remit less as the corresponding lower bound would be lower. Hence, a positive relationship would be expected between the inverse Mills ratio (which is inversely related to the probability that a person migrates) and the amount remitted to the farm household.

If the above considerations for the migration decisions apply, what can we expect to observe in reality? The households and prospective migrants that face a wide bandwidth and may agree on low levels of remittances, will indeed show migration to have taken place. In these households, the marginal labour product (MVP) has increased because of reduced labour input into farming. In households where the MVP is very high, such migration may not have occurred (unless compensated for by large remittances). Therefore, we expect to see less variability in marginal labour product than before, and the MVPs may not be such good predictors of migration. If all households had the same endowments in terms of land but different household sizes, we would expect some equilibration to occur, even to the extent that all households after migration have the same size again. At this point, the resident household with a remitting migrant is better off than a same-size household without such unearned income, and may even show higher levels of MVP due to the use of the remittances. We anticipate therefore that the explanatory power of the ex-post measured MVP is not high, even though it may determine the decision to migrate.

DATA

The farm household data examined in this section were collected in April 2000 from 30 villages; 10 villages each selected from three designated regions in northeast Ghana: Nangodi and Bawku-Garu regions in the Upper East Region and Langbensi region in the Northern Region of Ghana. A detailed description of field survey methods is available in Mensah-Bonsu (2003). After data cleaning, 166 compound households[5] out of the total 175 interviewed were included in the household-level analysis. The three rural areas have different population densities. The Nangodi area is a fastly growing and very densely populated district of Bolgatanga. The Bawku-Garu area is a slowly growing but densely populated district of Bawku-East, while the Langbensi area is part of the slowly growing and less densely populated district of East Mamprusi.

ESTIMATING MODELS AND RESULTS

Estimating models

Two models (the migration decision and remittance models) were estimated from equation (17). From the theoretical discussion of equation (17) the factors that may affect the bandwidth and therefore the probability of migration include the next period's aggregate value of consumption per person, the soil quality and the marginal value product of labour hour. It is expected that the factors that affect the marginal value product of labour like the farm size cultivated, and production knowledge (education) would also affect the probability of migration. No earning equation was estimated for the migrants, since data on migrants' earnings were not collected. This is because the pre-testing of the questionnaire indicated that it would have been very difficult to obtain any meaningful record on migrant earning levels from the resident-respondents. A functional model of a household's member migration decision (*m*) can then be expressed as:

$$m = m(\Theta A, M_{TH}, Q, f_h, Z_i) \tag{18}$$

where *A* (and Θ) is landholding (land allocation parameter) and M_{TH} represents the compound household size, *Q* is the soil quality, f_h the marginal product of farm labour during the farming season (calculated from the a translog production function estimated in Mensah-Bonsu (2003)), while Z_i includes individual and other household characteristics as well as dummy variables. The amount remitted is affected, similarly, by the factors affecting migration, though it is assumed that the relevant household size variable is the resident household size. The function (*R*) for the amount remitted by a migrant can be expressed as:

$$R = r(\Theta A, M_{RH}, Q, f_h, Z_i) \tag{19}$$

where M_{RH} is the resident household size and the other variables are defined as above.

The individual characteristics included the age and educational level attained by the individual household (adult) members. The farm household characteristics used included the changes in soil quality index between 1989 and 1999 (calculated from the estimates of soil quality indexes for farmland in 1989 and 1999 presented in Appendix 2) and the difference between a person's marginal value product during the whole farming season and his/her average consumption of farm crop produced, food and non-food purchased (excluding farm cost). In order to capture the effect of changes in the level of farm household's soil quality better, the estimation included only migration decisions taken in 1989 or thereafter. It was assumed that it is the change in the soil quality index (between 1989 and a current period [1999]) rather than the level which would influence migration levels in the current period (1999). This is because if the levels of soil quality were to improve between any two periods, then more people would stay at home and the migration level (probability) would be low in the current period. Members who had left the farm less than a year from the survey time were regarded as seasonal/temporary migrants and were included in the resident household. Also, only members aged 15 and up to 60 (adults) were included in the estimation. Persons who left the farm household for reasons of taking up a job or drought/famine were the only migrants included in the estimation. No restriction was placed on sex since a reasonable number of females (49.3 percent) have left the farm household for job and drought reasons, more than to be with spouses. The personal characteristics of the compound household heads were not included in the estimation as found in most studies, because in the present case all the heads of the compound households were residential and only three females (who were either widowed or single) were head. Instead, the mean values of the members' age and other household characteristics were used. The compound household size included all members (adults and children) either residential or non-residential. The mean values of variables are presented in the Tables together with the estimated results.

Estimation of the migration model

Two forms of migration regression estimations have been performed: including the soil quality variable in one and excluding it in the other. The compound household migration decision was specified as a dichotomous model and evaluated at the level of whether a member is a migrant or non-migrant. But it is important to note that the option of non-migration does not necessarily imply on-farm work. The dichotomous-choice nested logit model is therefore selected and the maximum-likelihood estimation method applied. Thus, the logit estimation of the migration decision proceeds in two steps. First, a logit for an option of off-farm work by a resident adult member is estimated and the inclusive value obtained (the estimation results is presented in Appendix 3) for each of the two forms of the migration model estimation. Then the logit for the choice between resident and migrant is estimated by including the inclusive value as an explanatory variable to account for the choices made within the non-migrants. The specification, properties of the logit model and its associate statistical distribution are well-known (Amemiya 1981; Maddala 1983). The logit maximum-likelihood estimator is consistent, even when the independent variables are not normal. In this paper, some of the variables are farm household-level variables, making such observations independent across the households but not necessarily within the households. Therefore, the assumption of independence is relaxed within the farm household and the regression estimation allowed for clustering of observations on the households. This procedure gives standard-error estimates adjusted (robust) for clustering on the household. The Wald test for significance suggests that the variables used as regressors jointly explained variation in the migration probability. The fit of the estimated models given by the pseudo R-squared is low; this is not very surprising as the maximum likelihood estimator characteristically is not chosen to maximize a fitting criterion but to maximize the joint density of the observed dependent variables (Greene 1993).

The estimated coefficients for the migration equations are omitted here but marginal effects of the regressors reported as marginal probabilities are presented in Table 1 for northeast Ghana as a whole. The Wald test conducted rejected the hypothesis that the inclusive value was not significantly different from 1, meaning nesting the logit model was important, as the parameter estimates would have been inconsistent without the inclusive value variable. Its inclusion, as has been done in the present case, therefore meant the results obtained are more efficient.

The important factors of migration are age, farm shadow wage and per-capita land held. The results obtained suggested that at younger ages an increase in age would significantly increase the probability of an individual migrating from northeast Ghana, particularly from the densely populated (Nangodi and Bawku-Garu) areas. But, old age significantly discourages migration from the study regions. The maximum effect of a person's age on the probability that he or she would undertake a migration option from northeast Ghana occurred at about 35 years for both models. Zhao (1999) using a rural household survey and including individual, household and community characteristics as explanatory variables found a similar shape for the effect of a person's age.

The estimated results of Table 1 indicated, in general, that the effect of an educational level attained on probability of migrating from the study areas was insignificant; contrary to the model assumption that a person's own educational attainment would favour the migration option. Burger (1994) found that a person's years of schooling increases his migration chance but that of the household head may or may not reduce the person's migration chance. Our results show that migration opportunities for lesser schooled household members are not much worse than for the better educated. This is related to the fairly large degree of rural-rural migration observed in Ghana (Owusu 2007).

The estimated net effect of the farm shadow wage (marginal value product of an adult farm worker) on migration probability contradicts the negative a prior expectation.

For Northeast Ghana as a whole, the net effects were significant and positive, with elasticities of 0.23 and 0.21 for the model with and without the soil quality index, respectively. The act of migration would raise the marginal value products of the remaining member and the more people migrate, *ceteris paribus*, the higher would be the marginal value products. This may explain the positive sign found in the estimated model. Other studies, such as Greenwood (1971) and Banerjee and Kanbur (1981) in India and House and Rempel (1980) in Kenya, have obtained positive effects of rural (origin) income on migration. It has generally been argued that increasing farm income increases the migration chances of a potential migrant since it increases the ability to finance the initial migration cost.

The estimation results indicate that per-capita land held had a negative and significant influence on the probability of migrating for northeast Ghana as a whole. Detailed results for the regions (not shown) give even stronger results for the densely populated (Nangodi and Bawku-Garu) areas. These findings support the theory of the effect of expansion of land cultivated on migration probability. It shows that increasing household size relative to farmland size (i.e., decreasing per-capita land held) in the future would increase the likelihood of a person migrating from such farm households and vice versa. That is, increasing population pressure on farmland enhances the migration decision of a person. Zhao (1999) also estimated a significant and negative effect for per-capita land, explaining that sinceland is a significant determinant of rural agricultural income, reduced land size tends to reduce rural income, which leads to increased motivation to migrate. Taylor et al. (2003), however, found a positive and significant relationship between per-capita land and the percentage of migrants in a farm household. In our model, a 10-percent increase in per-capita land holding decreases the migration probability by about 1.8 percent. The regional results show stronger effects in the densely populated areas.

Table 1. *Nested logit estimates of migration decision: northeast Ghana (basis is non-migration)*

Explanatory variables	Marginal probabilities: Model including ΔQ		Marginal probabilities: Model excluding ΔQ .		Mean values of regressor	Response to 10% change in regressor: Model inc ΔQ.	Response to 10% change in regressor: Model exc ΔQ.
Individual characteristics							
Age	0.028	***	0.028	***	30.37	9.61	9.61
Age^2	-0.0004	***	-0.0004	***	1079.31		
Sex	-0.020		-0.020		0.55		
School level[+]:							
Primary	0.004		0.004		0.09		
Middle/Junior sec.	0.002		0.006		0.10		
Senior secondary[++]	0.051		0.052		0.11		
Household characteristics							
Mean age	0.040	***	0.037	***	33.62	18.33	9.71
Mean age^2	-0.0005	***	-0.0005	***	1160.26		
Farm shadow wage (f_h)	2.99e-06		2.78e-06	**	9071.09	2.33	2.14
Farm shadow wage^2	9.66e-13		-9.37e-13		1.53e+08		
Per-capita land (A/M_{TH})	-0.031	***	-0.030	***	0.68	-1. 80	-1.74
Quality index change (ΔQ)	0.002		--		-0.65		
Inclusive value	-0.094	***	-0.096	***	0.086 & 0.096	-0.69	-0.79
Village characteristics							
Location:							
Langbensi	-0.078	***	-0.078	***			
Nangodi	-0.032	***	-0.034	***			
No of Observations	1136		1136				
Pseudo R-Sq.	0.3467		0.3391				
Log likelihood	-267.971		-271.069				
Predicted prob. of migration	0.0366		0.0373				

*** = Significant at 1%, ** = Significant at 5%, * = Significant at 10%

Note: Standard errors have been adjusted for clustering on households; [+]The comparison school level is no education. [++]Tertiary-level education dropped due to insufficient number of observations

Source: Estimated from Field Survey Data, April 2000

For northeast Ghana as a whole, the change in the soil quality between 1989 and 1999 appears not to influence the migration decision directly. Only in the Bawku-Garu area a significant negative influence was found. In this area, migration is also higher than in the other regions as shown in Table 1.

A significant effect is found for the inclusive value. The higher this value, the lower is migration. A higher value results from better opportunities for the resident household members, either on farm or off-farm. Improvements in local employment conditions affect migration through this variable.

Estimation of the remittance model

To estimate the effects of the migrant's personal characteristics and farm household characteristics on the amount remitted, we employed a Tobit model. The remittances, which were in cash and/or in kind[6], were recorded for the two periods (farming season and dry season: April 1999 – March 2000) in a two-way directional flow: migrant to compound house and the reverse. Only the remittance flow from the migrants to the farm household has been estimated and presented in this paper. As explanatory variables we used the difference between a person's marginal value product and average consumption, as dictated by the theoretical model, livestock sales, off-farm income, and other variables to reflect the situation of the resident household and that of the migrants as regressors. No earning equation has been estimated for the migrants as no information was collected on migrants' earnings, because the pre-testing of the questionnaire indicated that it would have been very difficult to obtain any meaningful record on earning levels of migrants from the respondents. A correction term for possible sample selection bias was calculated from the estimated migration equation and included as an explanatory variable. Since the migration equation estimation was restricted to persons who left the farm household for reasons of taking up jobs or drought/famine only, the error correction term (inverse Mills ratios) has been based on the probability that a person has migrated for these two reasons. Though the present study has no information on the earning levels of migrants it has been assumed that persons who have migrated for reasons of taking up a job or drought/famine are engaged in a form of employment and therefore have positive earnings. The inverse Mills ratios were calculated as the probability density divided by the cumulative distribution functions of the normal distribution from the migration model estimated for northeast Ghana.

The estimation results are presented in Table 2. Parameters are given with robust standard errors adjusted for clustering of two or more migrants in a household. The Wald test statistics indicated that the explanatory variables in the remittance equation were jointly significant at a one-percent level.

Table 2. *Tobit estimates of determinants of remittances in northeast Ghana (robust standard error estimates adjusted for clustering on households)*[7]

Regressor	Migrant's total remittance in a year: Marginal effect: Model including ΔQ	Marginal effect: Model excluding ΔQ	Mean values of regressor	Response to 10% change of a regressor: Model incΔQ	Response to 10% change of a regressor: Model excΔQ
Indiv. characteristics					
Age	10914.39	11583.79	28.92		
Age squared	-154.59	-163.76	902.86		
Sex	27613.19**	27211.46**	0.82	4.17	4.11
School level[+]:					
Primary	40058.62*	39588.70*	0.14	1.03	1.02
Middle/Junior sec.	36779.39*	35981.59*	0.14	0.95	0.93
Secondary	29411.45	30456.52*	0.16		0.90
Duration	5648.51	5244.23	5.16		
Duration squared	-1211.71	-1171.58	34.92		
HH characteristics					
Land-use ratio ($\Theta A/A$)	34515.58	43148.60	0.97		
Resident size (M_{RH})	563.76	600.50	14.98		
Livestock sales	-0.009*	-0.009*	428616.50	-0.71	-0.71
Off-farm income	-0.004	-0.004	1508489.00		
Diff in pers. MVP & AC	-0.010	-0.014	-112,351.30		
Quality index chg. (ΔQ)	1756.50	--	-0.58		
Inverse Mills ratio	53202.13	65750.47	0.5668 & 0.5716		
Village characteristics					
Location dummy:					
Langbensi	-59909.56	-61169.51***			
Nangodi	3431.65	21770.31			
Observation number	133	133			
Left censored	78	78			
Uncensored	55	55			
Wald chi-sq. (16)	55.95***	51.25***			
Log likelihood	-776.710	-776.382			
Pred. remit (+ values)	¢114,135	¢113,883			

*** = Significant at 1%, ** = Significant at 5%, * = Significant at 10%
Note: Marginal effects of determinants are conditional on being uncensored (Positive values)
[+]The comparison school level is no education. Tertiary-level education dropped due to insufficient number of observations
Source: Estimated from Field Survey Data, April 2000

While the estimated models do not contradict the theory, the estimated effects of the core variables are not significant. The factors that have significant influence on the amount of money remitted by a migrant to his/her farm household were the migrant's own personal characteristics like sex and educational level attained but not, for example, a person's net contribution to the household income. The existing conditions in the farm household (such as land-use ratio, resident size, off-farm income, quality status of their land resources) had no significant impact on the remittances, with the exception of the value of livestock sold. Male migrants remit significantly more than their female counterparts. The level of education of migrants had a significantly positive effect on the amount remitted, which suggested the importance of investment in human capital in the form of education for the farm households in the study regions. Various studies such as Rempel and Lobdell (1978) and Johnson and Whitelaw (1974) had similarly estimated a positive and significant effect of education on remittances. According to Rempel and Lobdell (1978), for some migrants, in the initial stages of urban residence, remittances represent a repayment of social debt arising from past assistance received from extended family.

The difference between the marginal value product per person during the farming season and the average consumption had a negative but insignificant effect on the amount remitted. Theory predicts that the larger the difference between the marginal value product per person and the average consumption, the larger would be the value for the lower bound for remittances and thereby for the average amount remitted. This could indicate that either the lower bound is irrelevant as migrants remit (much) more than this, or that the diversity of migrants (old and young, male and female) is beyond what the model can capture.

While the positive sign of the coefficient of the change in the soil quality index is as expected, the statistical insignificance leaves the theoretical model unconfirmed. The same holds for the effect of the inverse Mills ratio and for the effect of the proportion of land cultivated. A positive and significant effect of the size of the migrant's extended family or the number of consumers in the home area on the amount remitted has been found by Burger (1994) and Mohammad et al. (1973). The effect of farm household income from livestock sold on remittances is negative in both models. A 10-percent increase in income from livestock sold by the farm household reduces remittances by 0.71 percent. The negative effect of livestock income on remittance meant that it is possible for income from livestock sales and remittances to be substitute sources of income for the farm household. Accordingly, the farm households that sold more of their livestock asset to generate cash income received less remittance from migrated family members.

CONCLUSION

This chapter investigated the effect of farm household population, family landholding and the perceived soil quality status on migration decisions of members of the farm household in northeast Ghana. A theoretical model was derived that indicated the lower and upper bounds for remittances to make migration a win-win decision for family and migrant. Cross-section data collected in 2000 in northeast Ghana were used in the empirical analysis. The nested logit model and the Tobit model estimation techniques have been employed to estimate the migration and remittance models, respectively.

The logit model provides some evidence for significant influence on the migration probability of the age of a person, the farm shadow wage (marginal value product) and the per-capita land held by the household. The estimation results supportive of the theoretical model indicate that per-capita land held had a negative influence on the probability of migrating. The estimated effect is an elasticity of around 0.18. The implication is that increasing population pressure on farmland favours migration. The estimated net effect of the farm shadow wage (marginal value product of an adult farm worker) contradicts the negative prior expectation. For northeast Ghana in general, the net effects of farm shadow wage are significant and positive. This may indicate that the level of migration has already reached a mature stage where resident household sizes are in accordance with their natural endowment. Effects of land quality changes were only found for one of the sub-regions, the densely populated Bawku-Garu area. Higher quality reduces migration here.

The Tobit estimation results for the remittance equation indicate that the factors that have significant influence on the amount remitted are the migrant's sex and educational level attained. Apart from the value of livestock sold, no variables of the farm household had a significant effect on remittances.

This chapter concludes that increasing the farm household population relative to available land size (i.e., decreasing per-capita land held) would increase the rate of migration from the affected farming areas (in northeast Ghana). It suggests that migration is clearly a response to overpopulation. But local employment conditions are also important. More non-farm economic activities in the regions would help to reduce dependency on the land resources as well as curb migration. Otherwise no clear environmental effects on migration were found.

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NOTES

[1] Stark (1991) includes mostly reprints of some published journal articles on migration studies undertaken by Oded Stark, and with other research scientists.

[2] The soil quality index is defined as a weighted average of soil quality over both cultivated and fallow land. That is, land is assumed to be homogeneous, which implies that fallow land also improves the quality of the land that has just been used.

[3] The lower bound for remittance imposed by the family is the same for both family and migrant, but the upper bound for remittance is different from the perspectives of the family and migrant.

[4] Burger (1994) did not differentiate between landholding and amounted cultivated.

[5] A compound household includes two or more nuclear households.

[6] The monetary value of remittance in kind was either estimated with respondent or later after the survey in Cedis. The Cedi is the unit of currency used in Ghana. The average of the interbank quarterly exchange rate for the Cedi during the period April 1999 – March 2000 was about US$ 1 = 3,200 Cedis (calculated from ISSER 2002)

[7] Stata FAQ Statistics a procedure for obtaining robust standard errors for Tobit estimates using Interval Regression since Interval Regression is a generalization of Censored Regression (which is itself a generalization of Tobit). By the procedure right-censored and interval observations are both zero. Source: www.stata.com/support/faqs/stat/Tobit.html

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APPENDICES

Appendix 1. Derivation of upper bound for remittance

For the potential migrant the Lagrangian function for his intertemporal utility maximization problem is given as:

$$\begin{aligned} L = v(C_t, T - h_t^f) + \rho Ev(C_{t+1}, T - h_{t+1}^f) \\ +\lambda_0\{p_f\, f(Q_t, (N-1)_t h_t^* + h_t^f, X_t; Z_t) + I_{e_t} - p_c MC_t - p_x X_t\} \\ +\lambda_1\{p_f\, f(Q_t (g/f)^\delta, (N-1)_{t+1} h_{t+1}^* + h_{t+1}^f, X_{t+1}; Z_{t+1}) \\ +I_{e_{t+1}} - p_c MC_{t+1} - p_x X_{t+1}\} \end{aligned} \quad \text{(A1)}$$

The first-order condition for h_t^f, assuming an interior solution, is

$$\frac{\partial L}{\partial h_t^f} = -v_3 + \lambda_0 p_f f_2 + \lambda_1 p_f f_1 Q_{t+1} \delta \left[\frac{g_2}{g} - \frac{f_2}{f}\right] = 0 \quad \text{(A2)}$$

Rearranging equation (A2) yields,

$$\frac{v_3}{\lambda_0} = p_f f_2 + \frac{\lambda_1}{\lambda_0} p_f f_1 Q_{t+1} \delta \left[\frac{g_2}{g} - \frac{f_2}{f}\right] \quad \text{(A3)}$$

Consider that this person now works in an urban wage job, earning *w* Cedis per hour and remitting I_e^* Cedis per year and maximizing the same utility function intertemporally would imply that

$$\begin{aligned} v = v(C_t^u, T - h_t^u) + pEv(C_{t+1}^u, T - h_{t+1}^u) \\ +\lambda_0 (wh_t^u - I_e^* - p_c C_t^u) + \lambda_1 (wh_{t+1}^u - I_e^* - p_c C_{t+1}^u) \end{aligned}$$

and the first-order condition becomes

$$\frac{\partial v}{\partial h_t^u} = -v_3 + \lambda_0 w = 0 \quad \text{and} \quad \frac{v_3}{\lambda_0} = w \quad \text{(A4)}$$

The urban utility would exceed the farm utility if

$v^u > v^f$ or $v^u - v^f > 0$.

To find out how this condition changes when the arguments of the utility function, consumption and leisure, change, v^u is approximated to the first condition as

$$v^u = v^f + \lambda_0 dG_t^u + v_3 d(leis)$$

where $d(leis)$ is the differential in leisure (i.e., T - h^f when at home or T - h^u when in town). The condition now becomes

$$\lambda_0 dG_t^u + v_3 d(leis) > 0 \tag{A5}$$

If dG_t^u and $d(leis)$ represent the differences in consumption value and leisure, respectively, for this person between the two situations, then

$$dG_t^u = (wh_t^u - I_e^*) - G_t \text{ and}$$

$$d(leis) = h_t^f - h_t^u$$

$$\text{where } G_t^u = p_c C_t^u$$

Substituting in equation (A5) results in:

$$\lambda_0 (wh_t^u - I_e^* - G_t) + v_3 (h_t^f - h_t^u) > 0$$

and the upper limit for remittances is

$$I_e^* < wh_t^u - G_t + \frac{v_3}{\lambda_0}(h_t^f - h_t^u) \tag{A6}$$

which from the farm perspective, substituting for v_3/λ_0 from equation (A3) means that

$$I_e^* < wh_t^u - (h_t^u - h_t^f)\left\{ p_f f_2 + \frac{\lambda_1}{\lambda_0} p_f f_1 Q_{t+1} \delta \left[\frac{g_2}{g} - \frac{f_2}{f} \right] \right\} - G_t \tag{A7}$$

and from an urban perspective, using $v_3/\lambda_0 = w$ from equation (A4) means that

$$I_e^* < wh_t^f - G_t \tag{A8}$$

Appendix 2. Estimate of soil quality index for farmland

Q has been defined as the weighted average of soil quality over both cultivated and fallow land, and following a similar approach by Feder et al. (1988) an index of soil quality was estimated from some physical attributes of the soils. The estimation was done at plot level using a log-linear function as:

$$F = a_0 + a_1 \ln TC + \sum a_i Z_i$$

where F is the farmer's assessment of the quality status of the soil, TC is the number of trees and Z_i other attributes of the soil, and a_i (i = 0, 1, … n) are parameters. The other attributes used were location of plot (compound = 1, 0 otherwise), slope (flat = 1), extent of erosion (low = 1) and extent of the striga attack on plot (low = 1). The coefficients of the explanatory variables are used as weights to calculate the quality index (Ip) of a plot. That is, $Ip = a_1 \ln TC + \sum a_i Z_i$. The weighted soil quality Index (Q) of household's land is given by the sum of the weights of the plots' quality indexes using the land size as weight. The coefficients were estimated using a probit function and the results obtained for household's plot attributes in 1999 are presented in Table A1 below. A similar coefficient estimates for the household's plot attributes in 1989 are presented in Table A2.

***Table A1**. Probit estimates of the soil quality of farmers' plots, 1999*

Plot attribute	Coefficient	Coefficient correlation matrix				
		Trees	Locat.	Slope	Eros	Striga
Trees number (log)	0.169***	1.000				
Location: (Comp =1)	0.113	0.449	1.000			
Slope (Flat =1)	0.164	0.172	-0.019	1.000		
Erosion: (low =1)	0.690***	-0.029	0.011	-0.190	1.000	
Striga attack (low=1)	0.955***	0.094	-0.093	-0.105	-0.058	1.000
constant	-0.867***					
Observation	684					
LR	147.19					
Pseudo R-squared	0.1735					

Significant level: * = 10% level; ** = 5% level; *** = 1% level

Source: Estimated from Field Survey Data, April 2000

***Table A2**. Probit estimates of the soil quality of farmers' plots, 1989*

Plot attribute	Coefficient	Coefficient correlation matrix				
		Trees	Locat.	Slope	Eros	Striga
Trees number (log)	0.087	1.000				
Location: (Comp =1)	0.515***	0.447	1.000			
Slope (Flat =1)	0.024	0.225	0.008	1.000		
Erosion: (low =1)	0.866***	-0.099	-0.057	-0.186	1.000	
Striga attack (low=1)	1.211***	-0.097	0.024	0.147	-0.232	1.000
constant	-0.404					
Observation	684					
LR	109.66					
Pseudo R-squared	0.3109					

Significant level: * = 10% level; ** = 5% level; *** = 1% level
Source: Estimated from Field Survey Data, April 2000

Appendix 3. Logit estimates of off-farm work participation

***Table A3.** Logit estimates of off-farm work participation: northeast Ghana*

Regressor	Marginal probability Model including soil quality index variable	Model excluding soil quality index variable
Age	0.042***	0.041***
Age^2	-0.0005***	-0.0005***
Sex	-0.234***	-0.236***
School level:		
Primary	0.001	-0.004
Middle/Junior sec.	0.006	0.0123
Senior secondary	0.141*	0.142*
Tertiary	0.226	0.273**
Mean age	0.075**	0.068**
Mean age square	-0.0009**	-0.0008*
Farm shadow wage	5.23e-06	3.98e-06
Per-capita land	-0.056*	-0.049*
Quality index change	0.014*	--
Observation	1010	
Pseudo R-sqared	0.1105	
Log likelihood	-621.608	

*** = Significant at 1%, ** = Significant at 5%, * = Significant at 10%
Note: Standard errors have been adjusted for clustering on households
[+]The comparison school level is no education.
Source: Estimated from Field Survey Data, April 2000