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Determinants of Time Spent in Non-farm Employment by Farmers in Northern Ghana

INTRODUCTION

Absorbing the large and rapidly increasing rural labour force in productive employment is one of the principal challenges of development, especially in sub-Saharan Africa. Many farm families have responded to increasing population densities, declining farm sizes and environmental stress by increasing the extent of their participation in non-farm pursuits to generate additional income for family needs, despite the impact of Structural Adjustment reforms in the 1980s that were largely designed to restore the profitability of agriculture relative to non-farm activities. Farm household surveys have shown that the rural non-farm economy accounts, on average, for 10–30 per cent of all full-time employment and 25–40 per cent of rural income in rural sub-Saharan Africa (Haggblade *et al.*, 1989).

One of the curious findings of research in this area in West Africa is that the share of non-farm income in total rural household income tends to increase over the income distribution, with higher-income rural households being more heavily involved, both absolutely and relatively, in on-farm activities (Reardon *et al.*, 1992; 1994). This is the opposite of what has been observed in Latin America and South Asia, where the rural rich tend to be landed gentry, or at least heavily involved in high-yield agriculture (von Braun and Pandya-Lorch, 1991; Adams and He, 1994).

A considerable amount of research on the rural non-farm economy in Africa has been carried out in recent years. Previous studies have concentrated on the characteristics of microenterprises in rural areas (Liedholm *et al.*, 1994), quantifying the share of non-farm in total income and employment to show the range of roles played by non-farm activities in the household economy (Eicher and Baker, 1992) or simulating farm–non-farm growth linkages through calculation of growth multipliers, where rural enterprise growth is typically a demand-driven spinoff of agricultural growth (Haggblade *et al.*, 1989; Delgado *et al.*, 1994). Very few studies have considered empirically the factors that influence the decisions of rural farm households in sub-Saharan Africa to participate in non-farm production and labour supply off-farm (see, for example, Reardon *et al.*, 1992).

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The hypotheses to explain the higher share of non-farm income for richer households which emerge from this work are that (1) agriculture is a less viable investment for most West Africans than for the better-off in South Asia, (2) wealth is less correlated with land ownership in West Africa than Asia, where land is also correlated with agricultural income, and (3) households in West Africa are faced by imperfect land and credit markets that allow some to participate in lucrative opportunities more easily than others. To the extent that non-farm activity requires capital, for example, households with higher agricultural income are relatively more likely to be able to overcome asset barriers to entry into non-farm activity where credit markets do not function.

The third hypothesis is the key for the present paper. Certain household characteristics are thought to be good proxies for the ability to overcome transactions costs of market participation for smallholder farmers in West Africa (de Janvry *et al.*, 1991). The contribution of the present paper is to investigate empirically the link between household characteristics, on the one hand, and on the other, the amount of time spent in income-oriented non-farm work, for a sample of farm households in Northern Ghana.

A HOUSEHOLD MODEL

The determinants of labour allocation by rural households is analysed using the conceptual framework of Huffman (1991). It is assumed that the decision unit is a risk-neutral single-family farm household with one utility function and that the husband and wife time are heterogeneous. The optimal allocation of time by husbands and wives between leisure, non-farm work and farm work is obtained by solving the following optimization problem

$$U = u(Q, L_1, L_2; \mathbf{Z}^c, \Omega); \tag{1}$$

$$T = T_{i1} + T_{i2} + L_i; T_{i2} \geq 0 \text{ for } i = 1,2; \tag{2}$$

$$Y = Y(T_{11}, T_{21}, H_{11}, H_{21}, X; \mathbf{Z}^p, \mathbf{M}, \Omega); \tag{3}$$

$$PQ = W_{12}T_{12} + W_{22}T_{22} + P_yY - P_xX - W_{11}H_{11} - W_{21}H_{21} + R \tag{4}$$

where U in equation (1) is the household's utility function, assumed to be monotonic, twice differentiable and strictly concave; Q and P denote the quantity and price of the consumption good purchased in the market; T is the total time available to the husband and wife; T_{i1} and T_{i2} are, respectively, time allocated by husbands ($i = 1$) and wives ($i = 2$), to farm and non-farm production; L_i is the leisure time of the husband or wife; H_{11} and H_{21} represent hired male and female labour; and X denotes purchased non-labour inputs. P_y and P_x are prices of farm output and non-labour inputs, respectively; R is non-labour income; $\mathbf{M}$ is a vector of fixed factors such as land; while $\mathbf{Z}^c$ and $\mathbf{Z}^p$ are vectors representing household characteristics affecting production decisions; and Ω is a vector of location-specific effects, such as population density and infrastructure.

Assuming interior solutions, the first-order conditions for utility maximization, subject to the specified constraints, gives the reduced-form time allocation equations for both husbands and wives to non-farm work, which are of the form:

$$T_{i2} = T_{i2}(W_{12}, W_{22}, W_{11}, W_{21}, P_y, P_x, P, R; \mathbf{Z}^c, \mathbf{Z}^p, \Omega). \quad (5)$$

The first stage of the analysis involves an examination of the probability of participation in non-farm work, using a Probit model, while a second stage deals with the extent of participation, using a Tobit model (Maddala, 1983). The probability of participation can be expressed as the probability that an individual's reservation wage is less than his (her) anticipated market wage. For the *i*th individual in the *h*th household, we can define:

$$D_h^i = \begin{cases} 1 \text{ if } i\text{th individual participates} \\ 0 \text{ otherwise} \end{cases}$$

where $l = 1, 2$. The probability of participation for the *i*th individual is then:

$$P_r\{D_h^i = 1\} = F[W_{ah}^i > W_{rh}^i]; \quad i = 1,2, \quad (6)$$

where W_{ah}^i and W_{rh}^i are the anticipated and reservation wages of the *i*th individual, respectively. Expressed in terms of the predetermined variables in the reduced-form labour supply function derived in equation (5), equation (6) can be written as:

$$P_r\{D_h^i = 1\} = F[W_{12}, W_{22}, P_3, R, K, \mathbf{Z}^c, \mathbf{Z}^p, \Omega]; \quad i = 1,2, \quad (7)$$

The function $F(\,)$ in equations (6) and (7) is a cumulative distribution function. A Probit model is used to examine the probability of participation, while a Tobit specification is employed to analyse the extent of participation in cash-oriented non-farm work.

DATA AND RESULTS

The data used in this study were obtained from a random survey of 256 farm households in 37 villages of four districts located in the Northern Region of Ghana. The data were collected between 1992 and 1993 through repeated visits. The dependent variable used to represent non-farm employment, separately for males and females, is time allocated to non-farm activities. Non-farm employment information collected for males and females includes non-farm self-employment off the compound, non-farm self-employment on the compound and off-farm employment for salaries and wages. Time spent at non-farm employment was recorded as hours per week and weeks per year.

Table 1 defines the variable labels and gives summary statistics. Table 2 presents the results of the estimates of the equations explaining the probability of participating in non-farm activities. The log-likelihood ratio test statistics for goodness of fit for the models for males and females are both significant at

TABLE 1 *Data definitions and descriptive statistics*

Variable	Variable description	Sample mean	Standard deviation
Dependent variables			
D^1	1 if husband participates in non-farm activities	0.59	0.56
D^2	1 if wife participates in non-farm activities	0.68	0.59
T^1	Total male hours allocated to non-farm activities*	886	740
T^2	Total female hours allocated to non-farm activities*	1403	1360
Independent variables			
AGE	Age in years	35.81	7.25
EDUCM	Number of years of schooling for husband	4.33	4.47
EDUCF	Number of years of schooling for wife	4.24	4.46
TTRADE	Terms of trade between farming and non-farming	1.02	0.39
CHILD	Number of children less than 6 years old	2.16	1.10
HHSIZE	Household size	7.25	2.89
AGWAGE	Village average wage rate for hired farm labour	15.27	6.38
INFRA	1 if individual is in a location with relatively adequate state of infrastructure	0.40	0.49
POPDEN	Population per square km	37.88	39.75
CREDIT	1 if the person is credit non-constrained	0.38	0.49

Note: *Calculated only for those who participated in non-farm employment; does not include search time or other transaction costs for finding non-farm work.

the 1 per cent level, and imply in each case that the independent variables taken together influence participation decisions. At young ages, a higher age increases the probability of labour supply to the non-farm sector. At older ages, the probability of participating in non-farm activities decreases as age increases.

A husband or wife who has relatively more schooling has a significantly higher probability of engaging in non-farm activities. This implies that additional schooling raises an individual's off-farm wage by more than it raises his or her reservation wage at farm and home activities. The marginal effect of a year of female schooling on the probability of participation is greater than that of male schooling, suggesting that a year of schooling raises the difference between a woman's reservation and market wage relatively more than for males.

TABLE 2 *Probit analysis of the off-farm labour participation decisions*

Variable	Males		Females	
	Coefficients	T-value	Coefficients	T-value
INTERCEPT	–0.762	–3.08	–0.651	–2.24
AGE	0.086	2.95	0.097	3.65
$AGE^2/100$	–0.120	–2.16	–0.144	–1.38
TTRADE	–0.112	–1.48	–0.198	–1.56
EDUCM	0.244	3.27	–0.096	–1.28
EDUCF	–0.182	–2.34	0.258	2.63
CHILD	–0.114	–1.22	–0.069	–1.35
INFRA	0.975	7.36	0.928	6.94
HHSIZE	0.359	2.38	0.131	1.08
AGWAGE	0.288	2.23	–0.218	–1.66
POPDEN	0.056	1.91	0.103	2.06
CREDIT	0.384	2.47	0.465	2.92
Sample size	199		199	
Log-likelihood ratio	76.61		87.35	

Note: Coefficients with *t*-statistics greater than 1.96 (absolute value) are statistically significant at the 5% level; an absolute value greater than 1.64 indicates significance at the 10% level.

Access to institutional credit also tends to increase the probability of participation. A higher farm wage increases the probability of participation by males. For females the effect is negative, although not significant. *INFRA* and *POPDEN* both have positive and significant impacts on the probability of off-farm work, indicating that a well developed infrastructural network influences the non-farm participation decisions of rural farm households. These variables may also reflect lower search costs for securing non-farm work for households located in more populated areas and better infrastructure, since these costs are not reflected elsewhere in the data. The coefficients for terms of trade for males and females have negative signs, but are not significantly different from zero, suggesting that relative prices between the farm and non-farm output products do not significantly influence participation decisions of households. The presence of children appears to have no significant effect on the participation decision of women in the study area, while adding a person to a household increases the probability of participation for males.

The results of the determinants of the extent of participation are presented in Table 3. The male and female non-farm wage rates used in the labour supply functions are estimated using the instrumental variable approach, based on a wage-predicting equation, including experience, education, infrastructure, farm size and population density as explanatory variables. The wage rate for self-employment is calculated as net non-farm income divided by the total time allocated to non-farm work in hours. The log-likelihood ratio test statistics for

TABLE 3 *Tobit model for non-farm labour supply of farm households, 1992*

Variable	Males		Females	
	Coefficients	T-statistics	Coefficients	T-statistics
INTERCEPT	4.085	5.17	4.897	3.18
ln PWAGEM	1.226	2.86	–0.591	–3.29
ln PWAGEF	0.673	1.32	1.698	2.08
AGE	0.019	3.96	0.016	2.67
AGE²/100	–0.009	–1.88	–0.008	–2.55
EDUCM	0.563	5.21	0.462	2.11
EDUCF	0.298	1.45	0.708	2.66
TTRADE	–0.382	–1.49	–0.135	–1.22
CHILD	–0.269	–1.25	–0.187	–1.57
HHSIZE	0.354	1.98	0.442	1.17
INFRA	2.782	7.36	3.481	6.26
POPDEN	0.915	2.63	0.718	1.96
CREDIT	0.585	2.98	0.738	2.77
Log-likelihood ratio	89.48		112.97	

Note: Coefficients with *t*-statistics greater than 1.96 (absolute value) are statistically significant at the 5% level; an absolute value greater than 1.64 indicates significance at the 10% level.

the Tobit model for males and females are also significant at the 1 per cent level and imply that the independent variables taken together influence labour supply to non-farm work.

Both male and female own-wage effects are positive and significant, suggesting that higher wages lead to substitution effects that are greater than the opposing income effects, leading to increased labour supply to non-farm employment – an upward sloping labour supply, supportive of the utility maximization hypothesis.

The estimated cross-effect of male wages on female labour supply is negative and significant. The cross-effect of female wages on male labour supply is positive, but not significant, indicating that males do not reduce their labour supply when their wives earn more from non-farm activities. Individual characteristics also show significant effects on the supply functions. Both male and female labour supply appear to exhibit a concave pattern in age, with older individuals working more, but at a decreasing rate. The male own-education has significant impacts on supply of male and female labour. Females' own-education seems to have impacts only on female labour supply, but not on male supply functions. The presence of children appears to have no significant effect on the labour supply to non-farm work of males and females in the study area. The coefficient for the household size variable is positive and significantly different from zero. This indicates that extra effort gained as a result of in-

creases in household size is directed to cash-oriented non-farm work instead of work on the farm.

The coefficients of the credit variables are positive and significant for both males and females, supporting the notion that farm households that have access to formal credit are more liable to invest in non-farm activities. They are also more likely to reinvest non-farm profits in non-farm ventures. The coefficients of terms of trade variables are negative, but not significant for either males or females.

As expected, locational characteristics such as state of infrastructure and population density increase the labour supply for both males and females. The positive coefficients for the two variables support the view that well developed infrastructure and high population densities are associated with a high level of non-farm work, and consequently high demand and supply for labour in these activities.

CONCLUSIONS AND POLICY IMPLICATIONS

This paper has investigated the impacts of household and locational characteristics on the participation decisions of rural farm households in cash-oriented non-farm pursuits in Northern Ghana, where the latter include both non-farm production for cash sale and wage labour outside the household. The theoretical expectations of the model are broadly confirmed by the data analysis.

Results suggest that several factors beyond household characteristics and farm income condition the household's participation in non-farm work. Access to credit, education, population density and the state of infrastructure are found to influence positively and significantly the probability of participation, as well as supply of labour to the non-farm sector.

These findings suggest that public actions and investments have impacts on the participation of rural farm households in non-farm pursuits. If rural farm households are to be helped to divert more of their labour time to non-farm income-generating activities to help maintain rural residence, there must be sources of gainful employment within commuting distance. It follows that the design of rural development policies, in addition to providing the necessary support to increase agricultural productivity, should also address the needs of rural non-farm pursuits. Providing training programmes to meet the needs of less educated rural households may have a high pay-off, while streamlining the acquisition of credit for poor rural households may reduce the financial constraint serving as a barrier to entry into non-farm business.

Further research in this area needs to investigate the differential determinants of non-farm earnings levels for men and women and to improve the handling of jointly determined participation decisions by men and women. The marginal impacts of improving infrastructure on education and net farm income on labour supply to the non-farm sector also need to be investigated.

REFERENCES

Adams, R. and He, J. (1994), *Sources of Income Inequality and Poverty in Rural Pakistan*, Research Report No. 102, Washington, DC: International Food Policy Research Institute.

Delgado, C.L., Hazell, P., Hopkins, J. and Kelly, V. (1994), 'Promoting Intersectoral Growth Linkages in Rural Africa Through Agricultural Technology and Policy Reform', *American Journal of Agricultural Economics*, **76**, 1166–71.

Eicher, C. and Baker, D. (1992), 'Agricultural Development in Sub-Saharan Africa: A Critical Survey', in Lee, R. Martin (ed.), *A Survey of Agricultural Economics Literature*, Vol. 4, *Agriculture in Economic Development, 1940s to 1990s*, Minneapolis: University of Minnesota Press.

Haggblade, S., Hazell, P. and Brown, J. (1989), 'Farm and Nonfarm Linkages in Rural Sub-Saharan Africa', *World Development*, **17**, 1173–1201.

Huffman, W.E. (1991), 'Agricultural Household Models: Survey and Critique', in M.C. Hallberg, J.L. Findeis and D.A. Lass (eds), *Multiple Job Holding Among Farm Families*, Ames: Iowa State University Press.

Janvry, A. de, Fafchamps, M. and Sadoulet, E. (1991), 'Peasant Household Behaviour with Missing Markets: Some Paradoxes Explained', *The Economic Journal*, **101**, 1400–1417.

Liedholm, C., McPherson, M. and Chuta, E. (1994), 'Small Enterprise Employment Growth in Rural Africa', *American Journal of Agricultural Economics*, **76**, 1177–82.

Maddala, G.S. (1983), *Limited Dependent and Qualitative Variables in Econometrics*, Cambridge: Cambridge University Press.

Reardon, T., Crawford, E. and Kelly, V. (1994), 'Links Between Non-farm Income and Farm Investment in African Households: Adding the Capital Market Perspective', *American Journal of Agricultural Economics*, **76**, 1172–6.

Reardon, T., Delgado, C.L. and Matlon, P. (1992), 'Determinants and Effects of Income Diversification Amongst Farm Households in Burkina Faso', *Journal of Development Studies*, **28**, 264–96.

von Braun, J. and Pandya-Lorch, R. (eds) (1991), *Income Sources of Malnourished People in Rural Areas: Micro-Level Information and Policy Implications*, Working Papers on Commercialization of Agriculture and Nutrition, No. 5, Washington, DC: International Food Policy Research Institute.