Determinants of Smallholder Farmer Labour Allocation Decisions in Uganda

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ABSTRACT

There is growing evidence of the increasing role of nonfarm activities in the rural livelihoods. However, empirical evidence on the factors that influence smallholder farmers to diversify into nonfarm activities is still scanty. The study analyses the factors that influence household labour allocation decisions and demand for hired farm labour. It was carried out in central, Masaka and southwest regions of the country, which have divergent production constraints and opportunities. The study shows that household members respond positively to increases in shadow wages and negatively to increases in shadow incomes, which implies that they respond to economic incentives. Increase in wage rates negatively affects use of hired labour. Household size has no effect on the use of hired labour, implying that economic rationing of hiring labour has more to do with the wage than household characteristics. Education and road access have a positive effect on time allocated to off-farm activities. Access to off-farm opportunities, however, takes away the most productive labour from farm production. Investment in road infrastructure and education could help to alleviate the bottlenecks in the labour market.

1 Introduction

Development policies for the rural sector have always targeted improving farm productivity to combat rural poverty. Despite this bias, there is growing evidence in developing countries that the rural sector is more than farming (Reardon et al., 1998). Understanding the factors that influence labour allocation decisions between farm and nonfarm is crucial to formulate policies that would improve on the welfare of smallholder farmers.

Rural household members are motivated to enter the nonfarm labour market to earn high incomes from the nonfarm sector (pull factors) and due to push factors (e.g. risk in farming, poorly functioning financial market and missing insurance markets) (Reardon et al., 2001). However households may fail to join the nonfarm sector due to high entry costs, low education levels and limited access to information. Where markets do not operate in a competitive way, personal and institutional constraints play an important role in determining participation in nonfarm activities (Reardon et al., 1998). Household wealth, private and public asset endowments and regional characteristics (e.g. agro climate) can play a critical role as they may enhance or hamper the profitability of the household endowment base (Escobal, 2001). Some household members are not able to work outside the household for reasons of age, gender and customs (Udry et al., 1995).

The main objective of this paper is to analyse the factors influencing labour supply and demand among resource poor farmers in Uganda. The paper also analyses the factors that influence individual household members' choices between farm and off-farm work labour supply. Also explored is the effect of market incentives on household labour demand decisions

The paper is organised as follows. Section 2 provides a brief background of the study area and the contribution of nonfarm activities to household income. The theory on smallholder household labour allocation decisions is reviewed in section 3. Section 4 provides a brief description of the model specification and estimation procedure, and a description of the data used in the analysis. Estimation results are presented and discussed in section 5. Finally, some concluding remarks are given in section 6.

2 Study area and contribution of nonfarm activities

Study area

This study was implemented in the banana-based production system of southern Uganda, in three regions (central, Masaka and southwest) (Figure 1) characterized by varying levels of productivity and divergent production constraints and opportunities. In particular, the three regions are characterised by differences in resource availability (land and labour) and use, which contribute to differences in production systems in the study region. Access to land is highest in the central region and lowest in the southwest while use of hired labour on the farm is highest in Masaka and lowest in the central region (Bagamba, 2007).

In the central region, management of major perennial crops (coffee and banana) declined and most farmers diversified into production of annual crops and nonfarm employment. On the other hand, banana production in the southwest of the country increased through both acreage expansion and output per unit area whereas production of traditional annual crops (millet and cassava) decreased over the years (Gold et al., 1999). Crop production is more diversified in the central region with a significant proportion of land (53.2%) allocated to the most important annual crops in the country (maize, millet, cassava, sweet potato and beans), while 29.6% is allocated to the main perennial crops (bananas and coffee) and the rest (17.2%) is allocated to other crops (Bagamba, 2007). In Masaka, most land is allocated to bananas and coffee (53.9%) while 35.7% is allocated to the main annual crops and 10.4% to other crops. The southwest is the least diversified in terms of crop production, with only three important crops: bananas, millet and beans accounting for 85.1% of the land allocated to crops.

Data used for this study was collected from study sites for the IFPRI/NARO/INIBAP project that was implemented in 2003-2004. The population domain was purposively selected to cover banana producing areas, which correspond roughly to the central and southwest geographical zone in Uganda, and the Kagera region of Tanzania (Figure 2).

In this study, the sample was post-stratified based on differences in regional production characteristics. The final sample comprises three regions. The first, termed here "central," is largely located in the Central Region of Uganda, the historic locus of banana production. The region lies north of the equator and borders with lake Victoria in the south while to the extreme east, it borders with Kenya. The region falls under the bimodal rainfall region and receives an annual rainfall of 1100 mm. Topography is of the Central African Plateau at an average of 1050m with summits ranging from 1000m - 1400m. Vegetation is mainly broad-leaved savannah dominated by species of Combretum.

The second, referred to here as "Masaka," consists of Masaka and Rakai districts. The region is located south of the equator and borders with Lake Victoria in the East. The general level of summits is up to 1800m, with soils that are deep, excellent porosity, good permeability and high infiltration rates. Vegetation is acacia savanna, with the grass layer dominated by *Themeda triandra* and *Cymbopogon afronardus*.

The third, called the “southwest,” represents the southwestern area of Western Region of Uganda, at areas to which the locus of banana production has more recently shifted. Most of the area is above 1400m except in the dry cattle corridor where altitude ranges from 1000m –1500m.

Non-farm activities

Two features, concerning wages, are highlighted in Table 1. First, farmers in the central region pay higher wage rates than in the southwest. Secondly, farmers in the central region pay lower farm wage rates than the going casual wage rates, while those in the southwest pay wages that are higher than the casual wage rates in their region. These findings reflect the differences in the level of development of the nonfarm sectors in the two regions. The high casual wage rates in the central region imply that the nonfarm sector for unskilled labour is more developed and more remunerative than the farm sector.

By contrast, farmers in the southwest pay hired labour at wages that are higher than the going casual wage rates. Three possible reasons could be advanced for this observed behaviour: (1) most farmers are smallholders and have limited bargaining power, (2) majority employ labour at periods of peak labour demand when wages are high, and (3) farmers employ outside labour for harder tasks and hence changed higher wage rates.

The above interpretation is supported by the data showing important differences in amount and source of nonfarm income between the study regions. Households in the central region obtain most of their income from nonfarm self-employment (64%) compared to the southwest, where self-employment off-farm as a share of total nonfarm cash income is 30%. In the central region, the income from nonfarm sources is greater (U.Sh 727400) than the income from crops (U.Sh 498500) for the average household.

3 Theoretical background

There are two basic approaches in the analysis of time allocation in literature: (1) perfect labour markets thus the assumption that household production and consumption decisions are separable (Ahn et al., 1981; Barnum and Squire, 1979; Rosenzweig, 1980) and (2) constraints in the labour market, which give rise to the assumption of nonseparability between production and consumption decisions (Abdulai and Regmi, 2000; Benjamin, 1992; Jacoby, 1993; Lopez, 1984; Skoufias, 1994).

Under the assumption of perfect labour markets, individuals are willing to participate in off-farm work as long as their marginal value of farm labour (reservation wage) is less than the off-farm wage rate (Becker, 1965; Gronau, 1973). Thus poor households have a stronger incentive to diversify into off-farm activities because they earn a lower marginal value of farm labour.

However, with rationing in the labour market, farmers may not be observed to participate in the off-farm labour even if the reservation wage rate is less than the marginal value of labour (Blundell and Meghir, 1987). Moreover, mobility barriers within the rural nonfarm sector limit the poorly endowed households from accessing high return niches (Barrett et al., 2001). Thus the actual participation of farmers in off-farm activities depends on the incentive and the capacity to participate (Reardon, 1997). Variables that raise the reservation wage reduce the probability and level of participation in off-farm work while the variables that raise the value of marginal product of labour in off-farm employment increase the probability and level of participation in off-farm work. Hence the direction of the influence of individual characteristics (age, gender and education), location and household assets (farm and nonfarm equipment) on off-farm employment is indeterminate since they may affect both the reservation and off-farm wage. In presence of credit and insurance constraints, farm income, assets and other income may improve the household's access to off-farm work.

4 Empirical estimation

4.1 Labour supply

Hours worked (farm + off-farm) by the individual household member were regressed on the shadow wage rates and shadow income, individual characteristics (gender, age and education level), demographic characteristics (household size, dependency ration and babies in household). Under conditions that favour nonseparability between production and consumption decisions, use of shadow wages and shadow income allows one to obtain direct estimates of wage and income elasticities that area useful for welfare analysis (Huffman, 1988). Instrumental variable methods were used to account for the potential endogeneity of the estimated shadow wages and shadow income (Skoufias, 1994). Labour supply estimates were obtained for the household head.

A two stage least squares technique (2SLS) was used in the estimation to address the endogeneity problem, which would arise from including some variables on the right-hand side (i.e. shadow wage and shadow income). We first estimated the shadow wage and shadow income functions and obtained predicted values of shadow wage and shadow income. We excluded some of the variables used in the first stage to identify the model in the second stage. Shadow wage rates were determined from marginal value products of household crop production while shadow incomes were obtained from the following equation (Bagamba, 2007):

$$M = f(l_F; x) - w_h l_h - w_f l_f + w_f E + y \quad (1)$$

Where M = household full income, $f(l_F; x)$ = value of crop production, w_h = village wage rate, w_f = opportunity cost of family labour, l_h = amount of hired labour, l_f = family labour input, E = total household time endowment and y = exogenous household income.

4.2 Simulations of labour supply

The primary motivation of agricultural household models is to analyse impacts of exogenous shocks on household farm behaviour (Taylor and Adelman, 2003). Comparative statics analysis is used to determine the sign and, in empirical models, the magnitude of impacts of exogenous factors on production, consumption and household resource use. Policy makers can only influence exogenous prices and other factors to bring about desired change in the target variable (e.g. production and resource employment). Comparative static results are often explored to analyse the impact of exogenous prices and other factors when dealing with a situation where households face missing markets.

Consider the labour supply function of the form:

$$l = f(w^*, M^*, w, D; z) \quad (2)$$

where $\begin{cases} w^* = g(w, D; z) \\ M^* = h(w, D; z) \end{cases}$

where *l* is the target variable (labour supply), and is a function of endogenous variables *w** (shadow wage rate), *M** (shadow income) and exogenous variables w (village wage rate), *D* (distance to paved road) and z (household characteristics).

The total derivative with respect to village wage rate (w) is given by:

$$\frac{dl}{dw} = \frac{\partial l}{\partial w^*}\frac{dw^*}{dw} + \frac{\partial l}{\partial M^*}\frac{dM^*}{dw} + \frac{\partial l}{\partial w} \qquad (3)$$

The first-right hand term in equation (3) represents the indirect effect of the change in w on *l* through its influence on shadow wage rate (Price effect). The second right-hand terms resents the indirect effect of the change in *w* on *l* through its influence on shadow income (Income effect. The third right-hand term represents the direct effect of the change in w on *l*. Since the variables involved were expressed in logarithm for, the outcome is the elasticity of labour with respect to wage rate.

The price effect was computed by multiplying the elasticity of shadow wage with respect to village wage (appendix 1) and the elasticity of labour with respect to shadow wage rate (appendix 3). The income effect was computed through multiplying the elasticity of shadow income with respect to village wage rate (appendix 2) by the elasticity of labour with respect to shadow income (appendix 3). The direct effect is the coefficient of wage rate in the labour supply equation (appendix 3).

The total derivative with respect to D is given by:

$$\frac{dl}{dD} = \frac{\partial l}{\partial w^*}\frac{dw^*}{dD} + \frac{\partial l}{\partial M^*}\frac{dM^*}{dD} + \frac{\partial l}{\partial D} \qquad (4)$$

The same procedure used above, for village wage rate, was used to compute the elasticity of labour supply with respect to D.

4.3 Hired labour demand

For hired labour demand, data was not observed for some of the cases in the sample as the optimal choice for such cases would be a corner solution, $y = 0$. Two problems arise if we apply OLS on the data. First, when $y \geq 0$, E(y|**x**) (where **x** refers to a vector of explanatory variables) cannot be linear in **x** unless the range of **x** is fairly limited (Wooldridge, 2002). Second, the predicted values of y can take on negative values for some combinations of x and β. For randomly drawn observations i from the population, the problem can be transformed into the statistical model:

$$y_i^* = x_i\beta + u_i \qquad u_i \mid x_i \sim N(0,\sigma^2) \tag{5}$$

$$y_i = \max(0, y_i^*) \tag{6}$$

Equations (5) and (6) constitute what is known as the standard censored Tobit model (Tobin, 1956).

Define a binary variable d=1 if y>0 and d=0 if y=0. Then d follows a Probit model:

$$\begin{aligned} E(y \mid x, y > 0) &= x\beta + E(u \mid u > -x\beta) \\ &= x\beta + \sigma\left[\frac{\phi(x\beta/\sigma)}{\Phi(x\beta/\sigma)}\right] \end{aligned} \tag{7}$$

where $\phi(.)$ is the standard normal density function. The quantity $\frac{\phi(.)}{\Phi(.)} = \lambda$ is called the inverse mills ratio. Positive values of λ imply that there are unobserved variables that increase the probability of selection and a higher than average score on the dependent variable. Negative values of λ imply that there are unobservable variables, which increase the probability of a lower than average score on the dependent variable. OLS estimation of y on x, using the sample for which y>0, results in inconsistent estimates of β due to the correlation between λ and x in the selected subpopulation. The model parameters are estimated more efficiently by Heckman maximum likelihood procedure to correct for selection bias.

4.4 Time allocation decisions

The multinomial logit (mlogit) is used to analyse the individual household member's choice between farm work, home production and off-farm work

The mlogit model has response probabilities

$$P(y = j \mid X_i) = \frac{\exp(X_i\beta_j)}{\sum_{j=1}^{4}\exp(X_i\beta_j)} \tag{8}$$

$P(y = j|X_i)$ denotes the probability associated with farm, off-farm and home production choices of an individual household member i with: j = 1 if the individual participates in farm production; j = 2 if the choice is off-farm employment; j = 3 if the choice is home production; j = 4 if choice is leisure.

Setting $\beta_1 = 0$, the mlogit model can be rewritten as

$$P(y=j \mid X_i) = \frac{\exp(X_i\beta_j)}{1+\sum_{j=2}^{4}\exp(X_i\beta_j)} \quad (j=2,3,4) \tag{9}$$

and $P(y=1 \mid X_i) = \dfrac{1}{1+\sum_{j=2}^{4}\exp(X_i\beta_j)}$

When j = 2, β_2 is a K x 1 vector of unknown parameters, we get the binary logit model. In our data set, each individual participated in either one, two or in all the three work choices: farm, off-farm and home production. To capture the level of involvement in the alternative activities, we included the importance weight (*iweight*) in the mlogit model that captures the hours worked by the individual per day in each of the three work choices. Equation (9), on inclusion of weights, becomes

$$p(y=j \mid X_i) = w_j \frac{\exp(X_i\beta_j)}{1+\sum_{j=2}^{4}\exp(X_i\beta_j)} \Bigg/ \sum_j w_j \tag{10}$$

and $p(y=1 \mid X_i) = w_j \dfrac{1}{1+\sum_{j=2}^{4}\exp(X_i\beta_j)} \Bigg/ \sum_j w_j$

where w_j = weights (hours per day in activity j).

4.5 Data

Village, household and individual level data was collected from March 2003 to April 2004 from the stratified random sample depicted in section 2. Village level data included elevation, distance to tarmac road, wage rates and prices. Household level data included demographic characteristics, production, income and access to credit. Plot level data included crop production characteristics, inputs and outputs. Individual household member characteristics included gender, age and education level.

The variables are defined in Table 3. The individual household member was assumed to be the lowest decision making unit regarding labour supply decisions. To avoid the statistical bias that arises from the interdependence between individuals belonging to the same household, only one individual per household was retained in the sample to analyse the determinants of individual participation in farm, off-farm and home production.

5 Results and discussion

5.1 Test for nonseparability

To test for non separability, the following function was estimated:

$$\ln(MPL) = a + b\ln(w') + e \qquad \text{where } w' = w / p$$

The null hypothesis of separability holds if the joint F-test for parameters, *a* and *b*, being equal to 0 and 1 respectively is not rejected. The joint null hypothesis, a=0, b=1, is rejected in all cases, implying that farmers in all the three regions exhibit allocative inefficiency in terms of farm labour employment (Table 3). Same results have been obtained in literature for developing countries (Abdulai and Regmi, 2000; Jacoby, 1993). The deviation from the textbook condition: w* = w is a sign of imperfections in the labour and food markets. Thigh value of the F-statistic for the central region confirms the existence of bind labour constraints and imperfections in the food market in the region. This is in complete disregard of the fact that the region is in close proximity to major urban centres where the nonfarm sector is more developed. However, it is possible that the labour market is segmented and some household members (women and children) are segmented in the labour market. Moreover, the amount of hired labour used on farm is quite low compared to the other two regions (Masaka and southwest). Also buying prices, for food, are high and hence farmers are better off-producing their own food (Bagamba, 2007).

5.3 Labour supply

The elasticities of labour supply with respect to shadow wage and shadow income are presented in Table 4. The labour supply response to shadow wage is positive and negative for shadow income.

Elasticities of labour supply with respect to shadow wage rate are highest for Masaka. This implies that farmers from Masaka would benefit most from productivity increase as this is translated to high increases in labour supply.

The effect of shadow income on labour supply is negative but only significant for the overall sample and Masaka region. The negative effect is indicative of leisure being a normal good and hence increases in income levels result to a decrease in work hours.

5.4 Simulations of labour supply

Wage rate

Simulation results presented in Table 5 show that increase in wage rate is associated with an increase in shadow wage and shadow income, with the exception of the southwest where the wage rate is negatively related to shadow wage and shadow income. Differences in results obtained for the central and the southwest can be explained by the nature of labour markets prevailing in the two regions. In the central region, labour is rarely hired in for farm production. On the contrary, the off-farm labour market is more vibrant due to the proximity of the region within easy reach of the key urban centres. The conditions of the labour market are such that farmers are net suppliers, rather than hirers, of labour. Thus, a wage increase results in an increase in work effort of household members reflected in higher values of marginal productivities. The effect of wage rate through the marginal productivity (price) effect is unambiguously positive while the income effect is negative. The direct effect of wage rate is negative which, together with a negative income effect, results in a total effect on labour supply that is negative.

In Masaka, a wage increase has a positive effect on shadow price and show income but the elasticities are quite low compared to those obtained for central region. The opportunities to hire out labour are also limited. A wage increase is most likely associated with higher farm productivity, unlike in the central region where wages are associated with productivity in the nonfarm sector. The price effect is positive while the income effect is negative. The price effect dominates the income effect resulting to an overall effect that is positive.

In the southwest, a wage increase has a negative effect on shadow wage and shadow income, implying that farm productivity reduces as wage increases. The negative effect of wage rate on farm productivity is expected since the households are net hirers of labour. Higher wages are associated with a high cost of labour and low use of hired labour in farm production resulting in low farm labour productivity. The effect of wage rate on labour supply is negative while the income effect is positive. Increase in wages reduces the income available to the individual household members. Leisure is normal good; hence individuals reduce its consumption in favour of work hours. However, the price effect dominates the income effect and the total effect on labour supply is negative.

Road access

Access to tarmac roads is predicted to have a small impact on labour supply (Table 6). Pender et al. (2004) also obtained statistically insignificant results of the impact of access to all-weather roads on crop production. In central region and Masaka, marginal productivities and shadow incomes are predicted to be higher for households located away from the tarmac road. The magnitude of the impact is higher for central region. The direct effect of distance to tarmac road is negative in all cases implying that remoteness reduces work hours for individual household members. The overall effect of distance to tarmac on labour supply is negative for central and positive for Masaka implying that household members in remote areas supply less labour for central region and more labour for Masaka region.

For the southwest, the impact of road access on shadow wage is positive implying that remote households have lower marginal productivities. The effect of distance to tarmac on labour supply, through both the price effect and income effect, is negative. The overall effect on labour supply is negative implying that remote households work fewer hours.

5.5 Demand for hired labour

Estimates for hired labour demand are presented in Table 7. The inverse mills ratio (λ) has a negative sign, which implies that there are unobserved variables, which increase the probability of hiring labour but reduces the level of employment (work hours) of hired labour.

The effect of wage rate on labour demand is negative except for the Central region where the effect is positive but not significant. However, wage rate increase in central Uganda significantly reduces the probability of using hired labour by farm households. This is consistent with the low use of hired labour by households in the region, which is attributed to high cost of labour (wage rate). In Masaka, the probability of using outside labour, by farm households, is positively associated with higher wages. This is possible if high wages are associated with high farm productivities; hence farmers with higher farm productivities use higher outside labour. It is only in the southwest where both use of hired labour and amount used are negatively related to wage rate. Increase in wage rate increases the cost of production and it is rational for farmers to use less outside labour.

The effect of farm size on amount of hired labour is positive but not significant for the central region, negative for Masaka, and positive and statistically significant for the southwest. In the southwest, outside labour is cheap and accessible; hence larger farm sizes are associated with higher use of outside labour.

Household size has no significant effect on amount of outside labour used by farmers in all the study regions, although it is associated with less number of farmers using outside labour ($p = 0.1$) in the central region. Economic rationing of hiring labour has more to do with market wage than family size and composition. Education has no significant effect on amount of outside labour used. However, it has a positive effect on the number of households that use outside labour.

Distance to the tarmac road significantly reduces the amount of outside labour used by farmers in the southwest but not in Masaka and central region. The effect on number of farmers that use outside labour is also negative, the effect being stronger and more significant for farmers in the southwest. Development of road infrastructure in the southwest seems to be one of the key factors that influence production decisions in the region since it is isolated from the major market centres.

The impact of credit access on hired labour is negative for both central and southwest but statistically significant (10%) only for the southwest. This is, most likely, because borrowers are less likely to afford paying for hired labour. Moreover, farmers are reported to prefer investing credit money into off-farm activities (e.g. trading) than investing it in farm activities (Katwijukye and Doppler, 2004). Exogenous income has a positive effect on hired labour demand, but only statistically significant (1%) for the southwest, implying that unearned labour income influences labour allocation decisions in favour of hired labour.

5.6 Determinants of time allocation decisions

Central

Results for time allocation decisions in the central region are presented in Table 8. The effect of shadow wage and shadow income on time allocation decisions is not significant. However, the study shows that individuals with high shadow wages tend to employ their labour in off-farm activities. This is consistent with Ellis's assertion (1993) that family members whose real opportunity cost of time is lower than the marginal productivity of labour (MPL) work on the farm while family members whose real opportunity cost of time is higher than MPL work off-farm. Time allocation is highly influenced by farm characteristics, individual household member characteristics and market access.

Farm size is negatively related to amount of time allocated to off-farm activities. This is consistent with the assertion that farmers undertake off-farm activities because of constraints in getting access to farming land (Matshe and Young, 2004).

Gender has no significant effect on time allocated to farm production. Being male increases the chance of working off-farm but decreases the time in home production activities. This is consistent with results from other studies which show that men are more likely than women to participate in nonfarm activities (Abdulai and Delgado, 1999; Newman and Canagarajah, 2000) but contrasts the view by most scholars that growth in nonfarm activities would benefit women more than men (Newman and Canagarajah, 2000).

The effect of age on time allocation is not statistically significant. However, results show that young and old individuals are employed most in farm production while middle-aged individual members tend to work in off-farm activities. Education has a negative effect on time allocated to farm production while the effect is positive for time allocated to off-farm activities. The result is consistent with that obtained by Newman and Canagarajah (2000) for Uganda and Ghana where they find that high education is an important determinant of participation in nonfarm activities. They conclude that education is more rewarded in nonfarm activities than in agriculture.

The effect of distance away from tarmac road, on work hours, is positive for farm production but negative for off-farm activities. This implies that households situated near the tarmac road have more off-farm opportunities available than household members in remote areas. High transaction and transport costs for households further away from the roads prohibit individuals from supplying their labour to the off-farm activities and instead work more hours in farm production.

Masaka

The study shows that participation rate in off-farm production is quite low compared to central region, while participation rate is high in farm production (Table 9). Time spent on home activities and leisure, by household heads, is comparable to that spent on the same activities in the central region.

The study further shows that the shadow wage increases the probability of working in both farm production and off-farm work while the shadow income reduces time allocated to both activities. However, the effects are not statistically significant. The only variable that has statistically significant effect on time allocation is gender. Being male has a positive and significant (1%) effect on time allocated to off-farm activities. The effect on time allocated to home production is negative and significant at 1%.

Southwest

Results of time allocation decisions for the southwest are presented in Table 10. Most of the time is allocated to farm production followed by leisure activities. Time allocated to off-farm activities is almost the same as that allocated to home activities.

The effect of shadow wage and shadow income on time allocation decisions is similar to that of central region, where increase in shadow wage reduces time allocated to farm production and increases time allocated to off-farm activities. An increase in shadow income results in more time allocated to farm production and less time allocated to off-farm production.

Farm size has a negative effect on off-farm work, the effect being significant at 10% level. This result shows that push factors such as limited access to farming land contribute to farmers' diversification into nonfarm activities. Being male increases the probability of working off-farm, the effect being significant at 1% level.

Road access has a positive impact on time allocated to off-farm work and negative impact on time spent on home activities.

6 Conclusions

The main objective of this paper was to analyse the factors that influence labour supply and demand among smallholder farmers in Uganda. Factors that influence household members' choice between farm and off-farm work were also determined. Findings have implications for policies to support improved labour supply decisions in the rural sector.

Household members were found to respond positively to changes in shadow wages and negatively to changes in shadow income. These results imply that total work time of individual household members was influenced by changes in the household's economic conditions.

Simulations of labour supply revealed that farmers from Masaka would benefit most from a wage increase while negative elasticities were observed for other regions and especially the southwest. In contrast, farmers in central and southwest would benefit most from improvement in road infrastructure while negative benefits from road improvement in terms of labour supply were realised for Masaka farmers. The results imply that where labour markets are least developed, farmers would benefit most from productivity increases. However, for farmers to benefit from market development, the labour market must be accompanied by development in road infrastructure to reduce on the transaction costs.

Use and amount of hired labour were negatively related to changes in wage rate. Household size had no significant effect on use of hired labour, implying that economic rationing of hiring labour has more to do with market wage rather than the family size and composition. Road access was found to have a statistically significant positive effect on labour demand in the southwest. The same effect was observed for unearned income.

Results on the time allocation decisions revealed that farm size had a significant negative effect on the amount of labour supplied to off-farm work. This result is consistent with the assertion that farmers seek off-farm employment due to push factors (constraints in accessing land for farm production). The results also confirmed that factors such as education and road access, which improve the opportunity cost of labour in the off-farm sector, affect positively the amount of time allocated in off-farm activities. The implication of this result is that investment in education and road infrastructure would favour the off-farm sector against on-farm employment. Men would benefit most from development of the off-farm sector, as most of the household individuals employed in the sector are men.

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Table 1 Wage rates paid by farmers and earnings per hour from the nonfarm sector

Variable	central region		Masaka		southwest	
	Mean	SE	Mean	SE	Mean	SE
Wage rate (casual)	466.0	13.3	343.3	15.5	218.5	2.13
Agricultural wage	396.5	15.1	337.3	16.2	228.3	3.8
Non-agricultural wage	444.1	15.5	359.4	21.0	324.2	11.1
Salary (regular wage)	507.3	14.2	339.4	23.3	1288.4	175.3
Self-employment	554.9	36.8	419.2	25.3	344.3	19.7

SE = standard error

Table 2 Definition of variables

Variable	Variable definition
workhrs[1]	Total hours worked (farm + off-farm) by individual (hours/day)
farmhrs	Hours in farm production (hours/day)
offfarm	Hours in off-farm activities (hours/day)
homehrs	Hours in home production activities (hours/day)
leisure	Non-productive time (hours/day)
a	Area cultivated by household (acres)
w	Village wage rate for casual labour (U.Shs/day)
w*	Shadow wage rate (marginal value product) for household
M*	Shadow income for individual household member
D	Distance to tarmac road (km)
hhsize	Family size (adult equivalent)
depratio	Dependency ratio (dependants/family size) = $\frac{<14\,years + >64\,years}{hhsize}$
babies	Number of babies in household
gender	Gender individual household member (1 = male and 0 = female)
age	Age of individual household member (years)
age^2	Age squared
educ	Education level of individual household member (years)
postprim	Number household members that attended post primary school
credit	Amount credit (x 1000) received by household in six months prior to interview
y	Non earned income by household (x 1000) (remittance + rent + interest)

[1] excludes home time

Table 3 Test for allocative efficiency

Variable	central	Masaka	southwest
w*	112 (73.3)	144 (58.0)	208 (76)
w	433.5 (157)	267.8 (106.1)	227.4 (27.2)
Wald test (F-value)	1512	174.6	51.4
Amount oh hired labour (SE)	123.4 (24.6)	213.3 (30.3)	191.6 (29.1)
Proportion that use hired labour	0.45	0.74	0.55

Values in parenthesis are standard deviations

Table 4 Elasticities of labour supply

Region	Shadow wage	Shadow income
central	1.382	-1.114
Masaka	2.743	-1.355
southwest	1.059	-0.279

Table 5 Response to a 10% increase in wage rate (% increase)

Variable	central	Masaka	southwest
shadow wage	5.11	1.26	-1.97
shadow income	2.93	0.31	-6.89
labour supply			
direct effect	-5.64	ND	-3.72
price effect	7.06	3.46	-2.09
income effect	-3.26	-0.42	1.89
total	-1.84	3.04	-3.91

ND = Not determined

Table 6 Response to an additional 1 km to the distance from the tarmac road (% increase)

Variable	central	Masaka	southwest
shadow wage	0.011	0.001	-0.007
shadow income	0.005	0.0003	0.012
labour supply			
direct effect	-0.025	-0.0004	-0.013
price effect	0.015	0.0027	-0.007
income effect	-0.006	-0.0004	-0.003
total	-0.015	0.0019	-0.024

Table 7 Maximum likelihood estimates of household demand for hired labour (robust standard errors)

variable	central		Masaka		southwest	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
ln(work hours)						
Constant	2.507	0.92	11.879**	4.38	13.147*	2.28
Ln(w)	0.247	0.66	-1.297**	-3.06	-1.856^	-1.73
Ln(a)	-0.005	-0.04	0.216	1.21	0.07	0.47
hhland	0.029	1.58	-0.006*	-2.24	0.032**	2.83
hhsize	0.025	0.46				
gender	0.198	0.58	0.809*	2.37	0.54	1.6
age	0.046	1.02	0.034	0.76	0.094	1.42
age^2	-0.0005	-1.10	-0.0003	-0.73	-0.001	-1.28
educ	-0.002	-0.06	-0.025	-0.52		
D	0.022	1.46			-0.106**	-3.44
credit	-0.002	-0.83			-0.006^	-1.88
y	0.0004	0.77	0.005	1.04	0.0003**	4.12
southwest						
Masaka						
X^2	12.06		21.23		100.22	
Probability	0.359		0.007		0.000	
n	291		129		136	
Uncensored	129		72		70	
selection						
Consatant	9.093**	4.31	-6.468	-2.36	11.14	1.31
Ln(w)	-1.474**	-5.19	1.265**	2.82	-1.622	-1.05
Ln(a)	0.227**	2.76	0.061	0.38	0.311^	1.77
hhland	0.04^	1.69	0.03	0.83		
hhsize	-0.06^	-1.77				
gender	-0.432^	-1.81	-0.554^	1.77	-0.838*	-2.23
age	-0.006	-0.19	-0.026	-0.73	-0.081	-1.54
age^2	0.0001	0.43	0.0004	1.09	0.001^	1.77
educ	0.057**	2.81	0.078^	2.06	0.057	1.33
D	-0.021^	-1.90			-0.063**	-4.11
credit	-0.003^	-1.92			0.008	1.25
y	0.0002	0.62	-0.005	-1.17	0.007^	1.69
ρ (SE)	-0.886	(0.064)	-0.941	(0.061)	-0.23	(0.3)
σ (SE)	1.362	(0.146)	1.278	(0.156)	0.973	(0.091)
λ (SE)	-1.207	(0.207)	-1.203	(0.211)	-0.224	(0.302)
X^2 (ρ=0)	22.39**		10.69**		0.55	

^, * and ** represent 10%, 5% and 1% level of significance

Table 8 Determinants of time allocation decisions, Central region

Variable	Farm		Off-farm	
	dy/dx	z	dy/dx	z
Share	0.346		0.204	
w*	-0.004	-0.81	0.004	0.92
m*	3.83e-07	0.38	-3.04e-07	-0.37
w	0.00004	0.12	-0.0003	-0.97
a	-0.003	-0.16	0.023	1.32
hhland	0.006	0.98	-0.013*	-2.00
postprim	0.009	0.52	0.017	1.09
gender	0.016	0.31	0.195**	5.69
age	0.009	1.06	-0.012	-1.56
age^2	-0.0001	-1.02	0.0001	1.13
educ	-0.008	-1.25	0.007	1.3
D	0.002	0.5	-0.01**	-3.02
Credit	-0.0002	-0.68	-0.0001	-0.69

y = Pr(choice = j), j = 1…4 and 1 = farm production, 2 = off-farm production, 3 = home production, 4 = leisure. Home production and leisure coefficients not included in the table.

Table 9 Determinants of time allocation decisions, Masaka

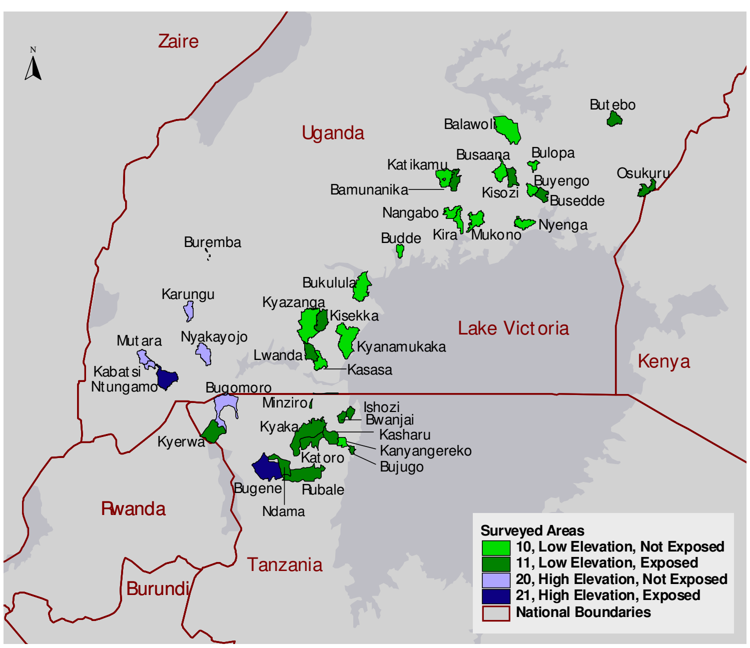
Variable	Farm		Off-farm	
	dy/dx	z	dy/dx	z
Share	0.477		0.072	
w*	0.007	1.2	0.002	0.82
m*	-6.73-07	-0.62	-3.5e-07	-0.55
a	-0.0009	-0.04	-0.003	-0.11
hhland	-0.007	-0.97	-0.006	-1.1
postprim	0.009	0.28	0.006	0.5
gender	-0.039	-0.41	0.125**	3.32
age	0.011	0.65	0.0003	0.05
age^2	-0.0001	-0.59	-0.0003	-0.17
educ	-0.002	-0.2	0.008	1.6
D	0.0005	0.38	0.00003	0.05
Credit	0.0004	0.32	0.0001	0.29

Table 10 Determinants of time allocation decisions, southwest

Variable	Farm		Off-farm	
	dy/dx	z	dy/dx	z
Share	0.413		0.1	
w*	-0.006	-1.33	0.004	1.6
m*	5.68e-07	1.05	-2.7e-07	-0.98
a	0.052	1.36	-0.026	-1.17
hhland	0.021	1.10	-0.02^	-1.78
gender	-0.166	-0.92	0.177**	4.50
age	0.005	0.35	-0.003	-0.48
age^2	-0.0001	-0.42	0.00002	0.32
educ	-0.008	-0.83	0.001	0.25
D	0.001	0.24	-0.01**	-3.68
Credit	0.0001	0.04	0.0008	1.22

Figure 1: Map of Uganda showing study regions

Figure 2 Sites sampled for survey



Source: (Smale et al., 2006)

Appendix 1 First stage estimates of labour supply of household head (predicted shadow wage), robust standard errors

Variable	central		Masaka		southwest	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
C	1.199	0.77	4.477**	8.35	6.486**	4.44
Ln(a)	-0.056	-0.55	0.114**	3.68	0.131**	4.07
Ln(w)	0.511^	1.97	0.126^	1.67	-0.197	-0.75
D	0.011	0.99	0.001	1.80	-0.007**	-3.00
hhland	0.021**	3.17	0.008**	9.16	0.018**	7.04
hhsize	-0.055*	-2.44	-0.016	-0.97	-0.028*	-2.26
depratio	0.322^	1.95	0.169	1.13	0.041	0.31
postprim	0.008	0.38				
gender			-0.084	-1.13	-0.215**	-2.76
age	0.017	1.59	-0.015	-1.38	0.008	0.65
age^2	-0.0002^	-1.9	0.0002	1.55	-0.0001	-0.76
educ	-0.005	-0.48			0.012^	1.76
Credit	0.0004^	1.84			-0.001	-0.48
R^2	0.245		0.283		0.344	

Appendix 2 First sate estimates of labour supply of household head (predicted shadow income), robust standard errors

Variable	central		Masaka		southwest	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
C	11.108**	10.17	13.37**	37.79	17.552**	12.31
Ln(a)	-0.03	-0.35	0.141**	6.18	0.186**	6.06
Ln(w)	0.293	1.53	0.031	0.58	-0.689**	-2.69
D	0.005	0.63	0.0003	0.62	-0.012**	-5.22
hhland	0.018*	2.64	0.008**	14.00	0.018**	6.72
hhsize	-0.064**	-5.38	-0.039**	-3.19	-0.044**	-4.02
depratio	0.501**	3.35	0.314**	2.78	0.308*	2.54
postprim	0.024	1.24				
gender			-0.109*	-2.36	-0.204**	-2.72
age	0.011	1.26	-0.007	-0.94	0.008	0.74
age^2	-0.0001	-1.43	0.0001	0.76	-0.0001	-0.90
educ	-0.014*	-2.52			0.013^	1.74
Credit	0.0004*	2.62			-0.001	-1.51
R^2	0.237		0.479		0.301	

Appendix 3 Labour supply estimates (2SLS), robust standard errors

variable	Central		Masaka		Southwest	
	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
C	-22.07	-1.09	18.392	0.38	-122.55*	2.28
Ln(w*)	1.606	1.02	-2.298	-0.62	8.831*	2.28
Ln(M*)	9.064^	1.86	0.185	0.02	24.633*	2.45
lnw* x lnm*	-0.59	-1.63	0.192	0.27	-1.724*	-2.4
ln(w)	-0.564*	-2.5			-0.372	-1.08
Ln(a)	0.084*	2.61	-0.016	-0.2	-0.081	-1.10
D	-0.025**	-3.29	-0.0004	-0.35	-0.013**	-3.52
hhland	-0.016	-1.69	-0.0174*	-2.53	0.021	1.17
postprim	0.038^	2.07				
gender	0.503**	6.5	0.211*	2.25	0.279^	1.83
age			0.026	1.33		
age^2			-0.0003	-1.48		
educ	-0.002	-0.21			-0.003	-0.31
Credit	-0.001**	-3.5			0.002	1.43
R^2	0.348		0.263		0.362	