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Labour Force Participation in Agricultural Households of Nepal:A Probit Model Analysis

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Abstract

This paper has tested a simple probit model to detect the factors affecting the labour force participation in agricultural households of the western Hills of Nepal. The empirical evidence reveals that larger farm size and high non-labour income reduce the probability of labour force participation in agricultural households. Wage rate has positive effect on female labour participation. The positive effect on lower caste dummy with labour force participation indicates that cultural and social differences also have significant role in labour force participation in rural agriculture.

Introduction

Participation of labour force in farm household has great significance in developing countries for designing policies. Increased participation of labour force in agricultural sector has enormous effect on economic and social life of the people. It reflects the structural changes in labour force participation especially in rural settings, where family labour dominates the agricultural activities. Previous studies on labour force participation were based on the traditional neoclassical approach that stressed on economic rationality; and the individual or household labour force participation decision is determined by maximization of one utility function subject to individual or household budget constraints (Eberharter, 2001). It implies that family decision models treat labour supply decisions of one person as exogenous to the decision of the other household members (Lundberg, 1988). It is also generally assumed that labour of men and women as well as hired and family labour are perfectly substitutable in production (Jacoby, 1992). However, these studies do not specifically mention the relative efficiencies of men and women as well as hired and family labour in farm production, and other factors determining the participation of labour force in rural areas.

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In countries or regions where labour force participation is limited, village or district level wage rates, sex, castes or ethnicity, education level and village may be poor proxy for the participation of labour force. To obtain adequate estimates of these variables, a probit model could be employed. The aim of this paper is to present the estimate of the labour force participation of men and women in agricultural households, using data from household surveys of the three villages of Mardi Watershed Area, Kaski district in the western Hills of Nepal.

Application of the Probit Model

Binary choice variable has been used as dependent variable in several exercises of econometric model building. However, the problem arises when a linear statistical model is applied to run the regression. To address the situation, Maximum Likelihood Method is accepted as one of the alternatives of linear statistical model and Probit Model is used to estimate maximum likelihood function more meaningfully.

Probit Model achieves the objectives relating to the choice probability Pi to explanatory factors in such a way that the probability remains in the 0-1 interval (Griffith et al. 1993). This model is used to estimate the participation of the labour market and the factors that affect it. The nature of the household choices depends on both observable and unobservable characteristics of the individual, and the alternative available to the individual (ibid). Number of factors both observable and unobservable can affect the participation of labour market in the rural settings.

The model thus presents as follows:

$Pi = F(\alpha + \beta xi) = F(Zi)$

Where, F(Zi) is the cumulative normal probability function and Pi is the probability that the value of dependent variable is 0 or 1. Zi is assumed as theoretical continuous index that is determined by an explanatory variable x. Zi is not observable data, but it is determined based on the data, which distinguish individual observation, falls into one category or another. Probit Model, thus, solves problems of both obtaining the estimates parameters of a and ß, and the information about underlying index Zi.

$Zi = 0$ if $Zi < Zi^*$
$Zi = 1$ if $Zi = Zi^*$

Where Zi* is the critical cut off hypothetical variable to be observed. The probit model assumes that Zi* is a normally distributed with zero mean and unit variance. The standardised cumulative normal function is written as:

$$P_i = F(Z_i) = \frac{1}{2\pi}\int_{-\infty}^{Z_i} e^{-s^2/2}\,ds, \ldots\ldots\ldots\ldots\ldots\ldots 0 < P_i < 1$$

Where s is a random variable and normally distributed with zero mean and unit variance. The inverse of cumulative normal function is applied in order to obtain an estimate of the index Zi (Pindyck and Rubinfeld 1991), which is given as:

$$Zi = F\text{-}1(Pi) = \alpha + ßxi + ei$$

Here the probability Pi from the probit model can be interpreted as an estimate of conditional probability that the household will make a decision on the participation of labour market given the conditions of explanatory variables Xi, where Pi is referred as participate or not participate in the labour markets.

The male and female labour supply of family is also estimated in order to obtain the factors influencing the participation in the labour market in the farm sector. The functional form of the model is based on binary choice variables and the probit model is tested. The probit model is presented as follows:

$$= F(\alpha + ßXi) = F(Zi)$$

Where, Pi is the probability of participating in the labour markets that is either one or zero and Zi is assumed to be theoretical by continuous index, determined by an explanatory variables Xi. ß is $k \times 1$ parameters.

Data Used and the Estimates

The data used in this exercise were collected from the villages of Mardi Watershed Area of Kaski district in the western Hills of Nepal. A cross-section random sample survey of 250 farm households was undertaken during June-July 2002. The study area is rich in diversity of caste, ethnic composition, culture and natural beauty with climatic variation and mixed cropping system. Having seasonal transportation facility and close to business centre, the study area represents both the characteristics of family and hired labour to some extent. Hence, the study area is one of the best areas for addressing the factors of determining the participation of labour force in agricultural households. The survey is restricted to only three Village Development Committees (VDCs), i.e. Lahachok, Rivan and Lwang Ghalel VDCs of Mardi Watershed Area.

The data reveal information on households and location specific characteristics, farm and non-farm activities. Participation of each family member in labour force was also recorded with its detail characteristics. A total of 369 females and 325 males of the age of 15-60 years were found under this category. Detailed information on actual wage payments including meal expenses to the hired labour were collected on the basis of each crop rotation in the study area.

Table 1: Description, Mean, Standard Deviation of the Variables used in the Labour Force Participation in Agricultural Households

Variables	Description	Mean	Std. Dev
Income	Non-labour incomet	42514.04	71750.66
Land	Area of land planted/cropped by household either owned or rented or sharecropped by the farmers during survey year (in hectare)	0.56	0.40
Wage	Male village hourly wage ratet	9.49	1.77
Wage	Female village hourly wage ratet	16.16	2.19
Tochild	Total number of children less than 15 years/HH	1.96	1.28
M1560	Total number of male between 15-60 yrs/ HH	2.06	1.22
F1560	Total number of female between 15-60 yrs/ HH	1.74	0.04
MF61	Total number of adults >61 years/ HH	0.32	0.61
Edu	Level of Education in years (male)	1.54	0.93
Edu	Level of Education in years (female)	0.92	0.96
Castes	Dummies: 1=higher caste in Hindu, 2=medium and 3=lower caste otherwise 0		
VDCs	Dummies:1= Lahachok, 2=Rivan and 3= Lwang Ghalel Village Development Committees (VDCs) otherwise 0		

t= 2002 Nepalese rupees.

The summary of the key characteristics of the households is presented in Table1. Land is measured as the area planted/cropped by the household either owned or rented or sharecropped by the farmer in a survey year. Income from other sources except labour has also been considered as exogenous variables. Wage rates of male and female are considered as village hour for the survey year. Under the shallow labour markets, wage rate may be different for male and female as well as within and across villages. Numbers of family members within different age groups were also considered as exogenous variables.

Education is measured in terms of number of years spent by individual in school. The data show that male spent in average 1.54 years in schooling, while female spent less than 1 year in average. Other explanatory variables such as caste and village dummies were included as proxies for the management input.

Major Empirical Observations

The probability of labour force participation is estimated by considering observed wages of male and female, non-labour income, total land harvested and its quadratic form, age and age squares, total number of adult male and female in the household, caste and village dummies as explanatory variables. The binary dependent variable (labour market participation of male and female in Table 2) is coded as one for those males and females who worked in the labour market for wages; hence a positive coefficient means an increase in the probability of labour force participation. The probit models of male and female labour supply functions are presented in Table 2.

Table 2: Probit Analysis of Participation of Male and Female Labour Force

Variables	Male	Female
Constant	1.2(1.35)	-5.00(1.41)***
Wage	-0.01(0.06)	0.13(.08)*
Income	-9.7(2.78)***	-0.00(3.48)***
M1560	-0.02(0.11)	0.32(0.12)**
F1560	0.04(0.11)	-0.17(0.13)
Edu	-0.35(0.12)**	0.08(0.14)
Age	0.09(0.04)**	0.17(0.06)***
Agesquare	-0:00(0.00)**	-0.00(0.00)***
Land	-2.07(0.91)**	-3.49(1.14)***
Landsquare	0.86(0.59)	1.28(0.88)
Caste2	0.06(0.28)	0.02(0.37)
Caste3	0.46(0.22)**	1.34(0.27)***
VDC2	0.34(0.25)	0.61(0.29)**
VDC3	0.64(0.22)**	0.81(.31)**
Pseudo-R^2	0.03	0.37
LR(χ^2 (13))	89.26	114.99
Prob > χ^2	0.00	0.00
No. of Observations	325	369

Note: standard errors are given in parentheses.
***one percent level of significance; ** five percent level of significance;
*ten percent level of significance.

(i). The higher LR χ^2 (13) ratio test[1] of male labour force participation shows that the model has good explanatory power. The estimated parameters show that the non-labour income, the farm size harvested and the education level are significant determinants with negative sign at 95 percent confidence level implying that the probability of labour force participation decreases if the male individual has a higher level of non-labour income, larger farm size and higher education level. Rich people with large farm size and non-labour incomes are more likely to work in their own farm due to social and cultural differences. It is also notable that the relatively rich and educated people in the society consider participation in labour force as inferior to their social status. The significance and positive effect of age imply that the probability of labour force participation increases with an increase of age. But its quadratic form shows that it increases at a decreasing rate. The Caste3 dummy (Lower caste) is significant and positive at 95 percent confidence interval implying that the probability of participating in labour force in this case is higher than in Caste1 (upper caste) case. Lower castes are more likely to be socially deprived with relatively higher incidence of poverty. In addition, illiteracy rate is also relatively higher among lower castes than the so-called upper castes. So they may not have other opportunities on off-farm sectors. The significance of village dummy three (Lwang Ghalel) shows that the probability of participating in labour force is higher than the households of village one (Lahachok). It might be that the higher percentages of lower caste households were residing in village three. The insignificance of male wage rate implies that farm wage rate does not affect for participation in labour force for male. It may be due to more preference to work in off-farm sector as Lopez (1984) has mentioned.

(ii). The estimated model of female labour force participation has shown its explanatory power with higher value of probability of observed conditional estimates. The significant positive effect of female wage rates implies that higher wage rate increases the probability of female participation in labour force. It may be due to less preference to work outside the villages. Because, women are relatively restricted to go outside for labour work than their male counterparts. Likewise, positive sign and significant age suggest that the probability of participating the female labour force increases with an increase in the age but at a decreasing rate. The significance and positive effect of lower caste (caste3) dummy implies that the probability of participating female in labour force in this case is higher than in Caste1 (higher caste), which is similar to male probit model as well. Village dummies two (Rivan) and three (Lwang Ghalel) are significant and positive implying that the probability of participating female in labour force in these villages is higher than the households in village one (Lahachok). On the other hand, the parameters of non-labour income and farm size are significantly different from zero with negative signs implying that a higher non-labour income and a larger farm size reduce the probabilities of participation female in labour force, which is the similar result as of Carson and Sheldon (2003) in the Canadian context. However, education of the individual female is not significant implying that the education of female may not have any significant impact on the probability of participation in labour force.

[1] It is done by the probability of each outcome (1/ total number of explanatory variables) with observed conditional estimates (Log Likelihood/total number of observations). If the probability of observed conditional estimates is higher, then the model has good explanatory power.

Higher non-labour income as well as farm size seems to be stronger in order to affect the participating labour force in both male and female probit models. Likewise, the lower caste dummy (caste3) is also significant and positive indicating that caste system has significant role in labour force participation, which are same as reported by Kingdon and Unni (1998) in the Indian context. The probit models suggest that the rural labour market is not only governed by the market forces but also by other forces such as household composition, individual characteristics and social dimensions. It is perhaps due to high transaction costs and missing markets in the study area.

Conclusion

This paper has estimated the labour force participation of male and female in agricultural households, using data from the three villages of Mardi Watershed Area of Kaski district in the western Hills of Nepal. The probit model used has examined the determining factors of labour force participation of male and female in the rural settings.

The application of probit models on labour force participation for male and female labour has revealed that larger farm size and high non-labour income reduce the probability of participating in labour force. The positive effect of lower caste dummy with labour force participation indicates that cultural and social differences have significant roles in labour force participation. The probit model for female population implies that wage rate has positive impact on female labour participation. The negative effect of education for male implies that educated male members may have more preference to off-farm work.

In general, the social differences such as caste system although already abolished by law, have still significant impact on the well functioning of labour markets in Nepal. The significant differences among villages also indicate that the factor markets are not functioning smoothly in the villages in the same manner. This may be due to high transaction costs, limited access to off-farm sectors and partly missing markets in the study area.

To increase labour force participation, effective policies are needed in Nepal towards greater integration of factor markets to reduce the transaction costs and missing markets, and social disparities among different caste groups.

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