

**THE DETERMINANTS OF RURAL NON-FARM EMPLOYMENT
AND INCOMES IN BOLIVIA**

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ABSTRACT

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This thesis examines the factors influencing non-farm employment and income among rural households in Bolivia. Two econometric models are used to estimate the determinants of a) participation in nonagricultural employment, b) the determinants of the intensity of participation and c) the income level of rural households by sector. To estimate participation and intensity of participation, a double hurdle model is applied whereas to estimate income determinants, ordinary least squares (OLS) and tobit models are implemented.

The results suggest that gender plays an important role in participation, intensity of participation and level of income. Women tend to focus on nonagricultural self employment activities. Education is also an important determinant in all three models especially nonagricultural wage employment and highly skilled employment. The ecoregion also influences whether a household engages in agricultural work or not. Finally, those individuals who reside in dispersed rural areas are less likely to find employment other than agricultural wage labor.

Education must be an important component of any policy intervention, focused on training, and recognizing the heterogeneity of the ecoregions. Policy makers should also note the high share of nonagricultural wage employment in household activities.

This thesis is dedicated to my beautiful children Anika and Joaquin
and to my unconditional partner, Cristóbal.

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ACRONYMS

CIES Internacional	Centro de Investigación Económico y Social
MAPA	Market Access and Poverty Alleviation
NAE	Nonagricultural Employment
OLS	Ordinary Least Squares
PRSP	Poverty Reduction Strategy Paper
RNFE	Rural Non-Farm Employment
UDAPE	Unidad de Análisis y Políticas Económicas
USAID	United States Agency for International Development

1. INTRODUCTION

Perceptions of how income diversification affects the rural economy have dramatically changed in recent years (Escobal 2001; de Janvry and Sadoulet 2001). In Latin America many studies have found that the share of rural non-farm employment (RNFE) in rural areas is high and ranges from 40-50 percent of the total income (Berdegue, et al., 2001, Elbers and Lanjouw, 2001, Escobal, 2001, da Silva, 2001; Reardon 2001). These findings have promoted a wave of policy interventions among countries dealing with structural problems in rural poverty and unemployment. In countries in Latin America, RNFE has increased significantly. Berdegué et al. (2000) state that by the 1990s, the percentage of total household income derived from nonagricultural employment (NAE) ranged from 38% in El Salvador and Honduras, to 42% in Nicaragua and even up to 68% in Haiti. Moreover, the income derived from these activities has also increased and continues to have a positive trend.

In Bolivia, recent government policies and strategies have been designed with the objective of reducing poverty. One of those strategies is focused in the development of the rural and agricultural sector and the generation of nonagricultural opportunities in the rural areas (Castro, 2005). This strategy is particularly important since it acknowledges the elevated degree of diversification in the rural areas, which was not traditionally regarded as important. The creation of micro and small enterprises is envisioned as a way to create non-farm employment opportunities for the poor in the rural areas (Gennrich, 2002; PRSP, 2001; Paz, 1997), although this approach may diminish the significance of temporary or permanent wage employment (Comisión Europea, 2000). In

either case, it is expected that the reactivation of a local economy generates activities which are expected to absorb the rural labor surplus and thereby slow down migration to the urban areas (Lanjouw and Lanjouw, 2001).

Following similar research efforts in other countries of Latin America, several studies in Bolivia have observed a high share of total rural income coming from nonagricultural activities, although agricultural production is still the most important source of income (Ormachea, 2002, Jimenez and Lizarraga 2003, Comisión Europea, 2000). Ormachea (2002), states that the rural employment composition has undergone important changes, evidencing an increase in employment from non-farm sources. These changes are due to several factors which include: low contributions from peasant agriculture compared to more modern sectors; low productivity of the peasant agriculture; and changes in the organization of the market for agricultural goods which promote more capital intensive activities. In an analysis of structural changes in Bolivia, Urioste (1989) explains that the difficult situation in the rural areas has forced peasants to look for alternate sources of income. The major issues discussed that affect peasants are small landholdings, a lack of access to credit and low repayment capacity, and increasing costs of agricultural production. Of course these are only a few salient factors, among a myriad of issues influencing these trends in rural employment and rural incomes in Bolivia.

Despite these important findings, neither of the studies mentioned above empirically tested the determinants of participation and income related to rural non-farm activities. The studies have relied on limited data on rural incomes and therefore, have failed to

provide detailed information about the dynamic of the rural non-farm sector. This thesis uses a new data set to analyze the determinants of non-farm employment choices and incomes in selected regions of rural households in Bolivia, addressing three specific questions:

- i) What are the determinants of an individual's participation in non-farm employment?
- ii) What is the level of labor allocated to the different non-farm activities?
- iii) What are the determinants of household's rural non-farm incomes?

The remainder of this thesis is organized in five parts. Chapter 2 discusses the rural non-farm sector and its components. Chapter 3 describes the conceptual framework which serves as the base for this study, analyzing how the labor supply is affected by the incentives and capacities of households. Chapter 4 presents the empirical analysis describing the data, econometric models, methods and variables used. Finally, Chapters 5 and 6 present the results, conclusions and recommendations.

2. INCOME DIVERSIFICATION AND NON-FARM EMPLOYMENT

Income diversification activities in the rural areas have come to be recognized as rural non-farm employment or RNFE in the literature. The rural non-farm sector, as explained by Lanjouw and Lanjouw (2001), is a set of economic activities carried out in the rural areas that are not agricultural. Table 1 below, illustrates the types of activities that fall under each of the four main categories of employment carried out in the rural areas.

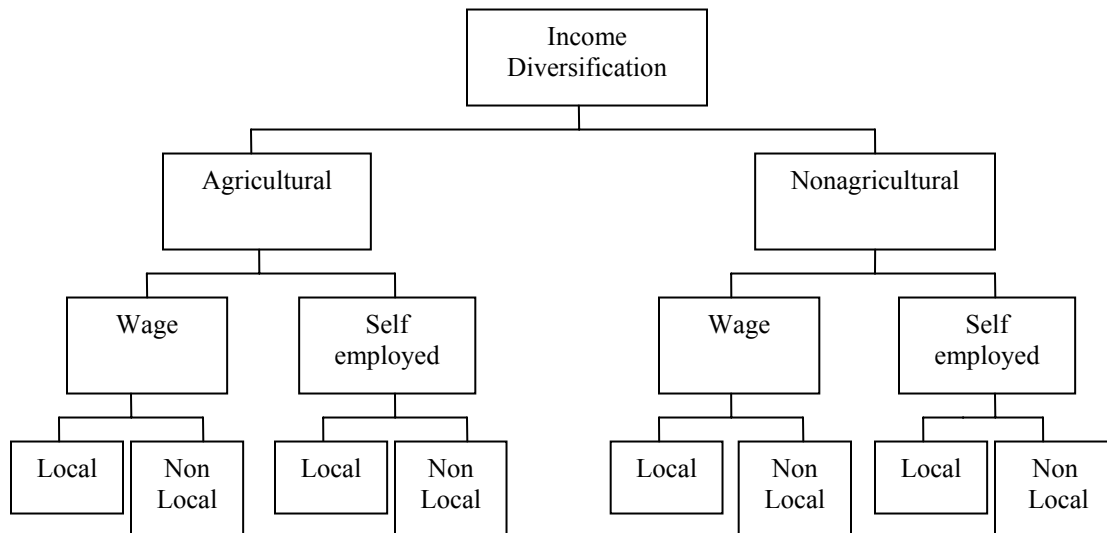
Table 1. Classification of farm and non-farm activities in the rural areas

Sector	Activity
Agricultural wage employment	Hired farm worker in crop and livestock farming
Agricultural self employment	Own farm activity
Nonagricultural wage employment	Wage employment in manufacturing and/or services; food processing.
Nonagricultural self employment	Own enterprise in manufacturing and/or services.

As Barrett et al. (2001) illustrate, diversification of activities in the rural areas can be classified into several categories. The major categories presented in Figure 1 below are: sectoral, functional and spatial. Sectoral refers to the agricultural and nonagricultural sectors; functional refers to wage and self employment categories; and spatial refers to the locality of employment. Here it is important to define the spatial component of RNFE and to indicate where employment takes place. In this study, any activity carried out in the community where the household resides or in another neighboring community or town is considered local. Presumably, local would also be considered rural, however it is difficult to discern this from the data set since the rural-urban classification has not been specified. The non local category is defined as any activity carried out in another

place where a person spends the night. This may be in another community, town, city or country.

Figure 1. Structural diagram of the general categories of income sources



Source: Author's typology adapted from Barrett et al. (2001)

One can go into further detail, distinguishing between different skill requirement levels in each of the sectors. For example, Elbers and Lanjouw (2001) make the distinction between two categories of wage employment: “high-productivity” or “low productivity” jobs. Similarly, Dirven (2004) classifies jobs as “low productivity” and “higher productivity”, emphasizing the different entry requirements into the labor market. Escobal (2001) disaggregates each of the two major categories of non-farm employment, self employment and wage employment into “high skilled” and “low skilled”. In this study, we will follow the distinction between jobs that are “high skilled” and those that are “low skilled” in order to differentiate the high/low capital requirements and also higher/lower returns of some activities. Low skilled activities are characterized by

having low entry barriers and low rates of return, making access and exit from the market easy (Dirven, 2004).

3. CONCEPTUAL FRAMEWORK: DERIVING LABOR SUPPLY

In order to explore the topic of non-farm employment, this study uses a utility maximization framework under the agricultural household approach (de Janvry and Sadoulet, 1995). The household approach is justified when both production and consumption decisions are interrelated (Caillavet, 1994), and when household characteristics play an important role in determining household behavior, as is the case in imperfect markets (Lofgren and Robinson, 1999).

From the constrained utility maximization problem, de Janvry and Sadoulet (1995) derive a labor supply function of the form:

$$(1) \quad L^S = f(p, k, z)$$

Where: L^S = Labor supply

p = Vector of input and output prices

k = Vector of capital available to the household

z = Vector of household characteristics

Under the same behavioral model, Corral and Reardon (2001) explain the variables in the labor supply function in terms of a household's *incentives* and *capacities*. The *incentives* are expressed as the "returns and risks" in the forms of prices of inputs and outputs, wages, and production risks in the model above. The *capacities* are expressed as the vectors of capital and household characteristics of a household which make it able to

respond to the *incentives*. These assets are described as the level of education, amount of cattle owned, and amount of land owned for example (Corral and Reardon, 2001).

Reardon (1998) explains that *incentives* either “pull” or “push” individuals into the labor market. The potentially higher returns to labor that could be obtained from working off the farm would “pull” or lure households into diversifying. Lanjouw and Lanjouw (2001) similarly explain that households which are “pulled” into non-farm activities participate as a means of obtaining more income and improving their current living conditions. By contrast, factors such as risk to the farm production, lack of access to credit, for example will tend to “push” households into nonagricultural activities. Households that are “pushed” into nonagricultural activities resort to diversification as a safety net.

The *capacities* are assets, at individual and household level which are vectors of capital including human capital, physical capital, social capital and organizational capital. These capacities will place households in relatively better positions to respond to incentives. A household may have the incentive to participate in non-farm employment, say because of higher wage rates offered, but if the capacities are not in place (such as skills to qualify for the job), then even though the incentives are in place, the household will not be able to take advantage of them.

4. THE EMPIRICAL ANALYSIS

The following section includes a description of the data, variables and econometric models used to test empirically which household characteristics determine nonagricultural labor supply and income. Section 4.1 covers the data, specifically the type of survey carried out and the sampling technique used to gather information. Section 4.2 describes the dependent and independent variables, following the specification of the theoretical labor supply function. Finally, Section 4.3 describes the econometric models and specifications implemented to test first, the determinants of participation and intensity of participation, and second, the determinants of household income by source.

4.1 Data

The baseline survey entitled “Characteristics of the rural households in the Altiplano, Valles and Yungas – Agricultural Year 2001-2002”, was designed and carried out in Bolivia during the months of June-July 2002, by CIES Internacional, a consulting firm based in La Paz, Bolivia. This activity was financed by the United States Agency for International Development (USAID) through the Fundación Valles and the Market Access and Poverty Alleviation (MAPA) project. The survey was designed to collect information specifically on household income in selected rural areas of Bolivia. Data were collected in three macro ecoregions, the Altiplano, Valles and the region of the Yungas, located in the department of La Paz. The Altiplano is located in the highlands at 9,800- 13,000 feet over sea level and is characterized for being arid and having low agricultural productivity. The Valles by contrast is located between the mountain chains

of the Andes which form fertile valleys. This region is located between 5,900 and 9,500 feet above sea level. The region of the Yungas is formed by steep valleys with subtropical vegetation, located at 1,900 – 2,300 feet above sea level.

After stratification by region, the sample was also stratified between populated centers and dispersed areas¹, both located in the rural areas. In this survey, a rural area is defined as an area with 2,000 inhabitants or less. The survey excluded towns with more than 25,000 inhabitants. The survey sample includes 3,300 households (3,299 usable household observations, covering 10,548 individual observations) selected at random from 121 municipalities in six departments of Bolivia, which are: Chuquisaca, Cochabamba, La Paz, Potosí, Tarija and Santa Cruz², all distributed between the two macro ecoregions mentioned above, Valles and Altiplano. Chuquisaca, Santa Cruz, Tarija and a part of Cochabamba are located in the Valles and, La Paz, Potosi and another part of Cochabamba are located in the Altiplano. Of the 121 municipalities surveyed, 76 are located in the Valles, 37 in the Altiplano and 8 in the Yungas zone. Of the 3,300 rural households surveyed, approximately 30% or 735 households are located in rural populated centers and 70% or 2,565 households are located in rural dispersed areas.

The framework for the baseline survey takes into account information developed for the Population and Housing Census 2001, which in turn is based upon the Cartographic Update for the 2001 Census” (CIES Internacional, 2002). According to the last national

¹ Populated centers are defined as a group of 50 or more households that make up organized blocks. Dispersed areas are any populated area where the households have no particular organization, and where the inhabitants are dedicated primarily to agricultural activities

² Six of the nine departments were considered; Beni, Pando and Oruro were left out of the study since they did not form part of the scope of activities by the MAPA project.

census carried out in 2001, a rural area is defined as a geographic area with a population of 2,000 inhabitants or less. A three-stage sampling technique was used to select the households. The technique reported by CIES Internacional follows:

“The selection of the census sectors [first stage selection] as the sampling unit in the populated and dispersed centers was done based on a weighted probability. Its selection is justified due to the fact that the data base of the Cartographic Update constructed census sectors of standard size; consequently, the populated center holds approximately 120 households on average, and the dispersed area holds 280 households on average”.

“The second sampling stage, the census segment, corresponds to a smaller geographic region than the census sector. This area contains 20 households in the populated center and 45 households, on average, in the dispersed areas. For purposes of the sampling design, two contiguous segments in the populated center were added together so that both sum up to 40 households, and maintain the 45 households in the dispersed areas. These areas had equal probability of selection like the selected census sectors in the first level”.

“The last and third sampling stage is the inhabited household. Its probability of selection is weighted. A total of 15 households were chosen per census segment. The selection of the households was performed at random; that is to say, starting with the first household surveyed, every third household was surveyed after that. In order to obtain an equally distributed sample throughout the country, non statistical representation was given to the existing municipalities within the sampling framework. In total, the selection corresponds to 220 sampling units (clusters) distributed in a total of 121 municipalities, with one or two points per municipality” (CIES Internacional, p.10).

It is noteworthy that the population includes households with and without agricultural production since the objective of the survey was to collect data on incomes in rural households, independent of their activities.

4.2 Definitions and descriptions of the dependent and independent variables

The dependent variables measure participation, intensity of participation and incomes for each non-farm activity choice. These activities are agricultural wage employment, nonagricultural wage employment, and nonagricultural self employment. The

independent variables show individual characteristics, household characteristics and location characteristics. Each empirical variable is linked to the categories of variables described in the conceptual labor supply model described in Chapter 3. Below are descriptions of the dependent and independent variables. Tables 2 and 3 below provide a list of the dependent and independent variables used in the study.

4.2.1 Dependent variables

The dependent variables on participation are defined as: nonagricultural self employment, agricultural wage employment, nonagricultural wage employment, and, low skilled wage employment and high skilled wage employment (Escobal 2001). All of these activities measure the probability of an individual participating in primary employment activities in the rural areas.

These dichotomous dependent variables are functions of a vector of individual characteristics, a vector of household assets, and location characteristics. The next dependent variable, days worked per year, measures how much time an individual dedicates to non-farm activities, *given* their participation on the non-farm labor market. A “jornal” or day of work is a common measure of labor in the rural areas of Bolivia. The variable in this study aggregates (or disaggregates) the number of hours, days, weeks and months of work declared by an individual; eight hours of work per day make up a day’s work. The dependent variable on the determinants of household income is a function of household characteristics which seeks to establish which characteristics are more important in determining a household’s level of income from different sources.

Table 2. List of dependent variables for nonagricultural labor supply models

Dependent variable description	Value
Participation in nonagricultural self employment	1=Yes, 0=No
Participation in agricultural wage employment	1=Yes, 0=No
Participation in nonagricultural wage employment	1=Yes, 0=No
Participation in nonagricultural wage employment – Low skilled jobs	1=Yes, 0=No
Participation in nonagricultural wage employment – High skilled jobs	1=Yes, 0=No
Days per year worked in wage activities of those who participate	Number of days
Incomes derived from nonagricultural activities	Income in Bs.*

*Exchange rate for 1.00 US\$ was 6.83 Bolivianos (Bs.) by December 2001

4.2.2 Independent variables

The study considers a set of explanatory variables that corresponds to the theoretical variables expressed in the labor supply equation stated in Chapter 3. Each variable is listed in Table 3 below and is described next.

In order to analyze the determinants of an individual's participation in non-farm activities, a set of variables at the individual level are first considered including age, level of education, gender, and whether the individual is the head of household or the spouse. The variable on educational level is modeled quadratically to show the marginal rate of return of having additional years of education and how it impacts participation, intensity of participation and level of income. Two additional variables on education were considered: whether an individual can read and write and the average years of education of adults in the household. After performing a Pearson's correlation test, it was observed that these variables were highly correlated amongst each other and therefore, were dropped from the model.

The household asset variables are expressed as the vectors of capital in the theoretical model. These predetermined variables include: landholding, value of livestock and adult members in the household. Landholding is measured as the total area of land owned by an individual, in hectares. Livestock is measured as the value of total livestock owned at the end of the previous agricultural period (June 2001) before income was registered for the period of June 2001-June 2002. Lastly, the number of adults in the household takes into account all individuals in the household over the age of 12 years who are considered to be part of the economically active population.

It is prudent to note the potential correlation between the independent variables and other unobserved variables (in the error term) as well as the potential ambiguous causal relationship or simultaneity between the independent variable and the dependent variables in the model (Wooldridge, 2002). Having livestock could be a determinant of participation, but it could also be a result of additional incomes from non-farm activities. Having more adult members in the household may increase participation and level of incomes; but it may also be a choice variable as households may choose to have more children or live with extended family members as a way to obtain higher incomes. Under the presence of endogeneity, the potential effects are biased and inconsistent coefficient estimates, but an effort was made to minimize this risk by looking for appropriate predetermined variables.

Other explanatory variables include distance to nearest market which serves as a proxy for input and output prices, theoretical variable described in the labor supply function. This variable is useful to understand which types of activities have an effect on

participation and income derived from each activity. Lastly the location variables describe two major macro ecoregions of the country, Valles and Altiplano and the zone of the Yungas, located in the department of La Paz. These variables represent two distinct agro ecological regions, and a sub tropical zone, the Yungas. Reardon and Taylor (1996) state that in places where there is contrasting agroclimatic variability, there will also be significant differences in income composition. Likewise, a location variable identifying dispersed areas is included due to the expected effect on household access to labor and product markets.

Table 3. List of independent variables for nonagricultural labor supply models

<i>Independent</i>	<i>Definition</i>	<i>Value</i>
<i>Individual</i>		
Female	Individual gender (female=1)	1=Female,0=Male
hh_head	Individual is household head	1=Yes, 0=No
hh-spouse	Individual is spouse of household head	1=Yes, 0=No
Age	Individual age	Years
Education	Number of years of education completed by each household member	Years
education2	Number of years of education completed by each household member squared	Years squared
<i>Household</i>		
hh_female	Gender of head of household (Female=1)	1=Female,0=Male
hh_age	Age of head of household	Years
hh_leved	Completed level of education of household head	Years
hh_leved2	Completed level of education of household head	Years squared
adults in hh	Adult workers in household over age 12	Number
landholding	Landholdings per household	Hectares
Livestock	Value of livestock per household as of June 2001	In Bs.*
distance_hr	Distance from household to nearest fair/market	Hours
<i>Location</i>		
Valles	Valles macro eco-region	1=Yes, 0= No
Altiplano	Altiplano macro eco- region	1=Yes, 0= No
Dispersed area	Populated center or dispersed area	1=dis, 0=pop

*Exchange rate for 1.00 US\$ was 6.83 Bolivianos (Bs.) by December 2001

4.3 Econometric Models and Estimation Methods

In order to address the three research questions stated in Chapter 1, three different econometric models are used to analyze the determinants of participation in

nonagricultural employment, intensity of participation and resulting income. First the econometric models will be discussed. In a following section, the dependent and independent variables used to implement these models will be explained.

4.3.1 Determinants of participation and intensity of participation by sector

The double-hurdle model was chosen for the initial analysis because it allows for the distinction between the determinants of participation and the level of participation in non-farm activities through two separate stages. This model was developed by Cragg (1971) and has been applied by Matshe and Young (2004) who model household labor allocation decisions in Zimbabwe and also by Serumaga-Zake and Naudé (2003) who apply the model to the rate of return of education in South Africa through the decision of participation and employment. In their study, Matshe and Young (2004) state that by separating the model into two stages, it is possible to establish that the two decisions are sequential.

The first stage of this model examines participation in three main categories of employment: nonagricultural wage employment, agricultural wage employment and nonagricultural self employment. Two additional equations evaluate participation in high and low skilled wage employment. The distinction made between the latter two is based on “whether earnings respectively fall below, or exceed, the average earnings of someone with agricultural wage labor as a primary activity” (Elbers and Lanjow, 2001). The analysis of the decision to participate is estimated by means of the following probit regression:

$$(2) \quad P(y=1|x) = \beta_0 + \beta_i X_i + u$$

Where: P is the probability of participation by an individual in a non-farm activity; β_i is the vector of parameters, X_i is the vector of exogenous explanatory variables and u is the error term.

In order to estimate this model, the survey probit procedure under survey data analysis in the statistical package STATA 8 was used. The “census segment” was defined as the primary sampling unit (PSU). Accounting for PSU effects allows controlling for unobserved variables within clusters that share similar if not identical characteristics (Deaton, 1997).

The sample stratification for the ecoregions made some of them to be over represented and others under represented, which is not consistent with the random sampling condition necessary to produce unbiased estimates (Wooldridge, 2002). Therefore, in order to compensate for the inequitable distribution of the sample size between the macro ecoregions, these were weighted. The weights were calculated by dividing the proportion of population of the survey by the proportion of the sample size for each region. This adjustment factor was included as part of the regressions in the survey procedure to avoid over representation of larger regions over smaller ones.

The second stage of the model determines the level of participation, conditional on participation, and is implemented using a truncated regression. This regression examines

the determinants of how many days per year an individual allocated to non-farm activities. This stage involves a truncated regression that can be specified as:

$$(3) \quad L = L^* \text{ if } L^* > 0 \text{ and } P^* > 0$$

$$L = 0 \text{ otherwise}$$

$$L^* = \beta_0 + \beta_i X_i + u$$

Where: L^* is the observed level of participation, β_i is the vector of parameters, and X_i is the set of exogenous explanatory variables. Five equations are estimated for determinants of nonagricultural self employment, agricultural wage employment, nonagricultural wage employment and for high and low skilled employment as well. The analysis uses a truncated regression with survey weights, and robust standard errors.

4.3.1.1 Hypotheses on employment determinants

Based on the conceptual framework and the research questions, the model specified above is used to test the following hypotheses:

- Residence in populated centers, where individuals have greater access to infrastructural capital assets, will have a positive and significant effect on participation in nonagricultural activities, especially nonagricultural wage employment, high skilled employment and nonagricultural self employment.
- Individuals who come from wealthier households participate in nonagricultural activities more than those who do not.

4.3.2 Determinants of household income

A set of models are specified for the analysis of the determinants of household income derived from activities in the following categories: agriculture, nonagricultural self employment, agricultural wages, nonagricultural wages and total income.

The equations analyzing the determinants of total income, nonagricultural self enterprise and agricultural income are estimated following a standard ordinary least squares (OLS) model using a linear regression for survey data. As with the probit models under this procedure, PSU clusters and survey weights were incorporated. The equations estimating agricultural and nonagricultural wage incomes were regressed using tobit, a censored regression model. Because these two dependent variables have many observations at zero, estimating them using an OLS would yield biased and inconsistent results (Pindyck and Rubinfeld, 1991).

Due to Tobin (1958), the tobit model allows for the analysis of censored data, originally applied to variables censored so that they could not fall below zero. In this study the presence of zeroes in the dependent variables of income derived from wage, are due to non participation in wage activities, not from zero income obtained from wage employment. Therefore, by using a tobit model, the zero observations are accounted for and the censored regression provides a more accurate estimation (Wooldridge, 2002). However, the presence of heteroskedasticity may cause inconsistent coefficient estimates by the standard tobit estimator (Wooldridge, 2002). In light of this potential problem, Kennedy (2003) suggests the use of robust estimators such as Powell's censored least

absolute deviations (CLAD) to control for heteroskedasticity. This estimator was tested but for the purpose and scope of this study, the tobit proved to be an appropriate model.

The OLS specification models for total income, nonagricultural self enterprise and agricultural income follows:

$$(4) \quad Y_i = \beta_0 + \beta_i X_i + u$$

Where: Y_i is the dependent variable representing income earned from each of the non-farm activities, explained by β_i which represent a vector of parameters and X_i is a vector of exogenous explanatory variables (Pindyck and Rubinfeld, 1991).

The two tobit equations take the following specification:

$$(5) \quad Y_i^* = \beta_0 + \beta_i X_i + u$$
$$Y_i = Y_i^* \text{ if } Y_i^* > 0$$
$$Y_i = 0 \text{ otherwise}$$

Where: Y_i^* is the unobserved latent variable, Y_i is the actual observed outcome, β_i is a vector of unknown parameters and X_i is a vector of exogenous explanatory variables (Wooldridge, 2002).

4.3.2.1 Hypothesis on income determinants

Based on the conceptual framework and the research questions, the empirical models of income seek to test the following hypothesis:

- More capacities existing in the household in the form of physical assets and level of education will cause an increased likelihood of a household's participation in non-farm activities and thereby, level of income obtained.

5. RESULTS

The following section first describes the zones and households, in order to place the results in context. Next, the regression results are analyzed and discussed.

5.1 Conditioning household characteristics and sources of income in Bolivia

5.1.1 Zone and household characteristics

The Valles, Altiplano and Yungas have unique geographical characteristics which also make their economies distinct. The Valles are characterized by warm tempered climate with very fertile soils. They are large producers of vegetables, cereals, legumes, and tree fruits. The Valles also have dairy cattle for milk production. By contrast, the Altiplano is characterized by high plateaus, and an arid climate, unfavorable for extensive agricultural production. Because of the characteristics of the Altiplano, and a considerable rural exodus, the population density is low (Enciclopedia de Bolivia, p.249). The main agricultural enterprises in this region are wheat, barley, and potatoes, and dairy cattle. In the subtropical zone of the Yungas, the warm and humid weather and fertile lands make it very apt for the production of coffee, sugar, tree fruit, bananas, and coca.

Table 4 below summarizes survey results for the three regions. Households and landholdings are relatively small, averaging 0.91 hectares per household in the Valles, 1.08 hectares in the Altiplano and 1.77 hectares in the Yungas. Access to markets is difficult; data from the National Institute of Statistics affirm that 64% of the roads in Bolivia are mostly dirt roads.

Table 4. Mean characteristics of individuals and households in rural Bolivia, by macro ecoregion: Agricultural Year 2001-2002

Variables	Macro eco-region			
	Total	Valles	Altiplano	Yungas
Number of individuals (observations)	10548	6703	2698	1147
Number of households	3299	2010	915	374
<i>Individual characteristics</i>				
Individual gender (% male)	50.0	50.5	47.9	53.4
Individual age (years)	34.3	34.0	35.5	33.1
Individual can read and write (% Yes)	80.7	79.4	80.0	90.7
Years of education completed (number)	5.0	5.0	4.8	5.9
<i>Household characteristics</i>				
Gender of household head (% Female)	11.0	10.9	11.7	12.3
Age of household head (years)	47.5	47.7	47.6	45.8
Level of education of household head (years)	6.5	6.4	6.3	7.2
Number of adults in household (over age 12)	4.0	4.1	3.6	3.8
Access to electricity (%)	43.0	47.7	24.2	55.7
Access to potable water (%)	64.0	67.9	47.7	79.5
Distance from household to market (km.)	19.3	18.4	23.0	16.3
Total value of livestock per household (in Bs.)	4751.2	5604.9	4169.3	1131.3
Household land size (in hectares)	1.5	.91	1.08	1.77
Dispersed area (%)	78.0	76.7	84.7	70.9

Regarding household assets, the Altiplano seems to be the most disadvantaged region, with access to electricity and potable water at 24% and 48% respectively, is lower than the other two regions. The average years of education per person ranged from 4.8 in the Altiplano to 5.9 in the Yungas. Literacy is also highest in the Yungas at 90%.

5.1.2 Sources of income by region and income strata

In the following section, five sources of household income are analyzed. These follow the income source classification discussed in Chapter 3, with the addition of unearned income. Although this source of income is not included in the models, since the relevance of the study lies on the earned sources of income, it is useful to recognize the contribution of pensions, remittances and rents to the household income. These sources

of unearned income are only included so as to provide a more complete picture of the income composition of rural households.

Agricultural income is defined as including all income from crop and livestock production minus expenses, home consumption and production losses. Income earned through nonagricultural self employment activities includes agricultural processing and entrepreneurial activity in the areas of services and manufacturing. Agricultural wage income and nonagricultural wage income are gross incomes derived from those pursuits.

Table 5 below shows income shares by source of income, per region. Approximately 42% of total income is derived from agricultural production and 11% from agricultural wages. All other earned income from non-farm activities sums up to 46% of total income. This study shows that approximately 49% of the working population is involved in nonagricultural activities. The most important categories of non-farm work are: construction, artisan work, commerce and services. Also, an important share of the working population is unskilled workers or laborers, especially in the Valles and Altiplano (see Table 16 in Appendix).

Agricultural production income alone represents nearly half of all income in the Altiplano and the Yungas. However, in the Yungas, approximately 75% of the population participates in agricultural wage activities as agricultural peons. This figure contrasts with the share in the Altiplano (33%) which may be explained by the types of agricultural production particular to each region. The Altiplano is more oriented towards subsistence

agriculture, whereas the Yungas region has more intensive and commercial agriculture demanding more labor force. Interestingly, Table 5 shows that the Valles has a more balanced distribution of income shares than the other regions, however, the Altiplano seems to have a more diverse and balanced participation in the different activities in non-farm employment. This can be explained by the fact that households in the Altiplano will diversify more because of the higher risk involved in agricultural production in that ecoregion.

Most of the activities that households in the Altiplano are involved in are in construction and artisanal work. In the Valles, by contrast, few participate in artisanal work; instead, the shares are highest in construction work and unskilled wage labor. Also important is nonagricultural wage employment, particularly in the Valles and Altiplano (22 and 21% respectively). In the Yungas, the share of nonagricultural wage employment reaches 9%, however, employment in this category is better remunerated than in the Altiplano. Also in the Yungas, the share of nonagricultural self employment is the highest and, the level of income, on average, of those who engage in this activity will be three times higher than the Valles and five times higher than the Altiplano (see Table 14 in Appendix). Possibly, these substantial differences may be explained by the fact that the Yungas has a more diverse agricultural production which is mostly destined towards commercial markets. In the Altiplano, agricultural wages represent only 5% of total income. The Yungas also has the highest share of self enterprise activities among the regions, whereas the Valles have the highest share of income from nonagricultural wage activities.

**Table 5. Sources of rural income of rural households in Bolivia:
Agricultural Year 2001-2002**

Source of income	Region			Total
	Valles	Altiplano	Yungas	
Agricultural Production Income	37%	48%	49%	42%
Agricultural Wage Income	13%	5%	15%	11%
Nonagricultural Wage Income	22%	21%	9%	20%
Nonagricultural Self Employment	16%	12%	20%	15%
Unearned Income	12%	13%	6%	12%
Total Income	100%	100%	100%	100%

Table 6 below illustrates how income is distributed by income quartiles. For the highest quartile, 32% of income comes from nonagricultural wage employment. Not only is this share the highest, but also the level of income obtained, on average, from nonagricultural wage activities for the highest income quartile is nearly three times as much as the third quartile and 14 times greater than the lowest quartile. From Table 2 in the Appendix, one can observe that the highest and lowest income quartiles show larger variability compared to the 2nd and 3rd income quartiles.

The income shares of the highest quartile are relatively well balanced across activities, demonstrating the capacity of the wealthier households to diversify. On the other hand, the share of income for the lowest quartile is heavily dependent upon agriculture which accounts for 55% of earnings followed by 15% of unearned sources, 13% from nonagricultural self employment and 8% from nonagricultural wage income. The income obtained from nonagricultural wage employment, steadily increases with higher income quartiles. By contrast, while agriculture represents a larger share of income, it is not the

highest provider of income for those who participate in this sector. Households in the lowest income quartile appear to diversify as much as households in the other quartiles, but likely do so as a result of being *pushed* into participation. The second and third income quartiles are more balanced among activities than the poorest, but they show a similar tendency toward reliance upon agriculture as the main source of income.

**Table 6. Share of income source by income quartiles, by sector:
Agricultural Year 2001- 2002**

Source of income	Quartiles			
	Low	2nd	3rd	High
# of households	3,329			
Agricultural Income	55%	48%	38%	25%
Agricultural Wage Income	9%	13%	14%	9%
Nonagricultural Wage Income	8%	16%	25%	32%
Nonagricultural Self Employment	13%	11%	14%	23%
Unearned Income	15%	12%	9%	10%
Total Income	100%	100%	100%	100%

5.2 Regression results

5.2.1 Determinants of participation in nonagricultural activities

Tables 7 and 8 present the first stage of the double-hurdle estimation, namely, the probit model using a survey probit procedure with survey sampling weights and using census segments as primary sampling units (PSU) to control for fixed effects. The STATA 8.1 econometric software was used to estimate this model. Separate regressions were performed for nonagricultural self employment, agricultural wage employment and nonagricultural wage employment. Two additional equations were estimated for low-

skilled jobs and high-skilled jobs in wage employment. Regression results show the marginal effects on participation given a one unit change, or a discrete change, in the explanatory variables. Based on the results presented in Table 7, the role of individual and household factors will be discussed and how each influences the decision to take part in non-farm activities.

Table 7. Determinants of individual participation in non-farm activities; results estimated using survey probit: Agricultural Year 2001-2002

<i>Dependent variables:</i>						
	Nonagricultural self employment		Nonagricultural wage employment		Agricultural wage employment	
<i>Variables</i>	Marginal Effect	P-value	Marginal effect	P-value	Marginal effect	P-value
<i>Individual characteristics</i>						
Female	0.021	(0.06)	-0.052	(0.00)	-0.132	(0.00)
hh_head	-0.026	(0.07)	0.122	(0.00)	0.085	(0.00)
hh_spouse	-0.011	(0.40)	0.034	(0.03)	0.038	(0.01)
Age	0.002	(0.00)	-0.002	(0.00)	-0.002	(0.00)
education	0.020	(0.00)	-0.005	(0.11)	0.000	(0.92)
education2	-0.001	(0.10)	0.001	(0.00)	-0.001	(0.00)
<i>Household characteristics</i>						
hh_female	-0.030	(0.27)	0.052	(0.00)	0.058	(0.00)
hh_hage	-0.001	(0.34)	-0.002	(0.00)	-0.001	(0.03)
adults in hh	0.011	(0.06)	0.012	(0.00)	0.003	(0.26)
total_land	0.000	(0.40)	0.000	(0.31)	0.000	(0.70)
livestock	0.000	(0.83)	0.000	(0.10)	0.000	(0.32)
distance	-0.009	(0.02)	-0.001	(0.54)	-0.001	(0.43)
<i>Location characteristics</i>						
Valles	0.080	(0.02)	0.124	(0.00)	-0.077	(0.00)
Atiplano	0.034	(0.43)	0.169	(0.00)	-0.140	(0.00)
dispersed areas	-0.322	(0.00)	-0.057	(0.00)	0.052	(0.00)
Number of observations	10548		10548		10548	
Number of PSUs	220		220		220	
F(15, 205)	14.82		45.58		27.07	
Prob > F	0.000		0.000		0.000	

Table 8. Determinants of individual participation in low-skilled and high-skilled activities in agricultural and nonagricultural wage employment; results estimated using survey probit: Agricultural Year 2001-2002

<i>Dependent variables:</i>				
	Low- skilled wage employment		High-skilled wage employment	
<i>Variables</i>	Marginal effect	P-value	Marginal Effect	P-value
<i>Individual characteristics</i>				
female	0.012	(0.20)	-0.222	(0.00)
hh_head	0.072	(0.00)	0.130	(0.00)
hh_spouse	-0.014	(0.21)	0.127	(0.00)
age	-0.002	(0.00)	-0.001	(0.02)
Education	-0.005	(0.16)	-0.011	(0.00)
education2	0.000	(0.81)	0.001	(0.00)
<i>Household characteristics</i>				
hh_female	0.057	(0.00)	0.055	(0.00)
hh_age	0.000	(0.61)	-0.003	(0.00)
adults in hh	0.007	(0.02)	0.009	(0.00)
total_land	0.000	(0.29)	0.000	(0.74)
livestock	0.000	(0.34)	0.000	(0.42)
distance	0.000	(0.74)	-0.002	(0.04)
<i>Location characteristics</i>				
Valles	-0.041	(0.06)	0.061	(0.00)
Altiplano	-0.045	(0.03)	-0.007	(0.72)
dispersed area	-0.014	(0.36)	0.001	(0.92)
Number of observations	10548		10548	
Number of PSUs ⁽¹⁾	220		220	
F(15, 205)	11.95		54.85	
Prob > F	0.000		0.000	

(1) PSU is census segment

Among individual characteristics, the results suggest that females are more likely to participate in nonagricultural self employment. Agricultural wage employment, nonagricultural wage employment, and high-skilled jobs seem to be more accessible to men. This may be a reflection of the fact that 60% of women in fertile age have children and are dedicating themselves to domestic activities. Similar outcomes were found by Matshe and Young (2004) in Zimbabwe. Carafa (1993) highlights the participation of women in the rural areas in several activities ranging from domestic to agricultural

production and commercialization, recognizing the multiple roles that women play in regards to household welfare and economy. This, as Glick and Sahn (1997) acknowledge, may have a strong influence on the types of activities women will become involved in.

Additional years of education increase the likelihood of participation in nonagricultural wage employment and high skilled employment. A large portion of the wage jobs are not local and appear to be acquired through temporary migration (see Table 22 in Appendix). It makes sense that individuals with more capital, financial and physical assets will have an increased possibility of migrating and working outside their community, especially if they reside in a populated center, with easier access to urban locations. The quadratic variable on level of education shows the marginal rate of return of education on the dependent variables. With the quadratic model it was possible to determine that the education has a U-shaped effect in nonagricultural wage employment and high skilled employment. This means that those with few years of education are less likely to participate in nonagricultural wage employment and highly skilled jobs. But, as the number of completed years of education increases, then education has a positive effect on participation in both activities. The minimum number of years of education completed before an individual begins to increase their likelihood of participation is four for nonagricultural wage employment, and five for highly skilled wage employment. Lizarraga (2001) explains that in the rural areas of Bolivia, most youths attend primary school, but few continue to secondary school. This is in part due to a lack of access to a

schooling system, but also because of the opportunity cost of obtaining an education versus the necessity of employment.

An interesting result in the regressions is the positive and significant effect of education on participation in nonagricultural self employment. This is worth mentioning since studies in non-farm employment, in particular studies in Nicaragua, Guinea and Mali (Corral and Reardon, 2001; Glick and Sahn, 1997; and Abdulai and CroleRees, 2000) found the relationship between education and non-farm self employment to be unimportant or not significant. In this case however, education is important for increasing the likelihood of participation, but additional years of education will not contribute to the likelihood of participation in nonagricultural self employment.

Households headed by women increase an individual's likelihood of participation in agricultural and nonagricultural wage employment increases, as well as low and high skilled wage employment. Furthermore, for every additional member in the household, 12 years or older, participation in all forms of employment significantly increases. This is expected and logical since the household, especially if it is run by a female will rely on the members of the family to generate additional income.

Being from a dispersed rural area as opposed to being from a populated center decreases the likelihood of participation in almost all forms of non-farm activities. As Barrett et al. (2001) explain, "being in remote areas is costly and causes factor and product market failures". By contrast, residing in a town or "populated center" makes the options of

participation in wage and self employment more accessible, generating more income opportunities for individuals (Elbers and Lanjouw, 2001, Barrett et al. 2001). Likewise, residing in a more favorable climatic and geographic environment, as is the region of the Valles, gives rise to more opportunities to diversify and participate in nonagricultural self employment, nonagricultural wage employment and high skilled employment. Reardon and Taylor (1996) found that in environments that are so favorable, the incentives are in place to diversify locally, whereas in places like the Altiplano, where the agroclimatic conditions are difficult, individuals are “pushed” into diversification in another zone or perhaps within a zone if the income source is not agriculture.

5.2.2 Determinants of the level of participation in nonagricultural activities

The results of the probit estimation discussed in the previous section allowed us to understand which characteristics play an important role in determining the probability of participation in different kinds of employment. In this section, the analysis will focus on the second stage of the model which examines the time dedicated to employment, given participation. The results are presented in tables 9 and 10. Before proceeding to the analysis, it is necessary to mention that the result of the Wald statistic in the model for agricultural wage employment was not significant. Some of the coefficients in the model are significant but no interpretation can be made of those, since it may be only by coincidence that they explain, or not, the model for agricultural wage. Nonetheless, given the characteristics of agricultural wage labor and its seasonality, the intensity of participation is likely to be based more on a demand and supply basis rather than on whether individuals possess certain skills or assets.

As was expected from the hypothesis on intensity of participation, the results and findings in this section regarding education are positive. The intensity of participation in nonagricultural wage employment and high skilled employment increases with higher education levels.

On household size, an additional adult member in the household will contribute to an increased level of participation in agricultural wage activities and nonagricultural self employment. In Bolivia, for cultural reasons, the family ties are such that the younger members of the family provide for and take care of the elderly, and therefore, the elder members of the family probably do not participate intensively in nonagricultural activities, plus having additional members in the family is viewed as a potential of more opportunities for the generation of income.

It is interesting to note that those individuals who reside in the Valles and Altiplano will participate significantly more in nonagricultural wage activities than those living in the Yungas, yet they have very opposite geographic and climatic conditions. This leads to assume that perhaps individuals in the Valles are pulled into nonagricultural wage employment, whereas individuals in the Altiplano are pushed into diversification. Conversely, individuals residing in the Yungas will participate more in agricultural wage activities than those who reside in the Valles, and at an even larger scale to those residing in the Altiplano. In the case of the Yungas and Valles, these results are consistent with the theory that Reardon and Taylor (1996) pose, that the favorable conditions of a region will tend to create more opportunities for diversification, especially in activities that

provide higher returns. Also from the results, it can be concluded that residing in a dispersed rural area definitely decreases the amount of days per year worked in all nonagricultural activities. By contrast, the shorter the distance from the household to a nearest market has a positive effect on the intensity of participation in all three forms of employment. This may be so because the transaction costs are lower for households who have relatively easier access to markets.

Table 9. Determinants of level of individual participation: Results estimated using a truncated regression on days per year worked. Agricultural Year 2001-2002

<i>Dependent variable:</i>	Days per year worked in:					
	Nonagricultural self employment		Nonagricultural wage employment		Agricultural wage employment	
<i>Variables</i>	Marginal Effect	P-value	Marginal effect	P-value	Marginal effect	P-value
<i>Individual characteristics</i>						
Female	-10.346	(0.26)	6.029	(0.36)	-11.662	(0.04)
hh_head	20.980	(0.27)	21.641	(0.07)	6.932	(0.47)
hh_spouse	-1.106	(0.96)	-0.240	(0.99)	-7.777	(0.50)
Age	-0.134	(0.83)	0.343	(0.38)	-0.089	(0.78)
Education	1.282	(0.69)	7.505	(0.00)	-2.184	(0.16)
education2	0.210	(0.20)	-0.148	(0.20)	0.182	(0.12)
<i>Household characteristics</i>						
hh_gender	16.300	(0.18)	11.618	(0.14)	2.226	(0.70)
hh_age	-0.228	(0.66)	-0.212	(0.52)	-0.530	(0.06)
Adults in hh	6.460	(0.01)	1.977	(0.20)	2.618	(0.02)
total_land	-0.381	(0.00)	-0.195	(0.12)	0.025	(0.00)
livestock	-0.008	(0.07)	-0.002	(0.33)	0.000	(1.00)
Distance	1.147	(0.33)	-1.192	(0.04)	0.354	(0.38)
<i>Location characteristics</i>						
Valles	14.183	(0.26)	43.679	(0.00)	-12.269	(0.00)
Altiplano	-9.238	(0.54)	23.454	(0.10)	-55.279	(0.00)
Dispersed area	-27.800	(0.00)	-35.699	(0.00)	-16.823	(0.00)
Number of observations	763		1611		1750	
Wald χ^2 (15)	116.68		329.89		13.67	
Prob > χ^2	0.000		0.000		0.550	

Table 10. Determinants of level of individual participation. Results estimated using a truncated regression on days per year worked: Agricultural Year 2001-2002

<i>Dependent variables:</i>				
	Low- skilled wage employment		High-skilled wage employment	
<i>Variables</i>	Marginal Effect	P-value	Marginal effect	P-value
<i>Individual characteristics</i>				
Female	7.729	(0.12)	1.215	(0.87)
Hh_head	7.849	(0.44)	18.679	(0.10)
Hh_spouse	-10.291	(0.35)	-0.220	(0.99)
Age	0.072	(0.83)	0.035	(0.92)
education	0.759	(0.69)	6.484	(0.00)
education2	0.108	(0.34)	-0.065	(0.51)
<i>Household characteristics</i>				
Hh_gender	13.793	(0.02)	-7.574	(0.34)
Hh_age	-0.383	(0.14)	-0.348	(0.29)
adults in hh	2.841	(0.06)	3.100	(0.01)
total_land	-0.108	(0.26)	0.024	(0.05)
Livestock	0.000	(0.99)	-0.001	(0.43)
Distance	0.480	(0.46)	-0.646	(0.17)
<i>Location characteristics</i>				
Valles	11.480	(0.10)	9.979	(0.22)
Altiplano	-6.598	(0.44)	-3.704	(0.69)
Dispersed area	-33.200	(0.00)	-35.517	(0.00)
<hr/>				
Number of observations	1395		1966	
Wald χ^2 (15)	36.07		358.28	
Prob > χ^2	0.001		0.000	

5.2.3 Determinants of household incomes

In this section, the focus of the analysis will be the household. This analysis is done primarily to understand which characteristics are important in determining whether a household will obtain income from one sector versus another.

Five equations are estimated, these are: total income, agricultural income, self employment, agricultural wage income and nonagricultural wage income. Total income is defined as all earned income obtained from all four income sources. Agricultural

income is net income and it is the sum of crop and livestock net incomes. Self employment is also net income and it includes entrepreneurial activities in the agricultural processing sub sector, service provision and manufacturing. Agricultural wage income and nonagricultural wage income, which are incomes derived from remunerated activities, are all gross incomes. These dependent variables have censored data since many households do not participate in nonagricultural employment and therefore, did not obtain income derived from these activities.

As described previously, the results are estimated using OLS for total income, agricultural income and nonagricultural self employment, since all income is observed. The incomes derived from wage activities are estimated using a tobit model. Estimation results for all equations are reported in Table 11.

The importance of education is highlighted once again in this model, however, the results vary depending on the activity. For income earned from agricultural production activities, education has a positive effect, but then declines with additional years of education. Similarly for activities related to self employment (mostly services and manufacturing) having a basic level of education is an advantage, but additional years of education do not contribute to higher incomes. It is likely that basic literacy is important for carrying out activities that range from production to services and manufacturing. These findings are consistent with the literature, where it is found that higher levels of education will not contribute to increased earnings from agricultural wage employment (Escobal, 2001). On the other hand, for incomes obtained from wage activities, education

does play a more important role, especially for those activities in the nonagricultural wage sector. These activities are in construction, office employment, artisans, and technicians among others where additional years of education or specialized training may be required or is highly valued.

For all of the sources of income, having additional adult members in the household is a highly significant determinant for obtaining higher incomes, especially for nonagricultural wage employment. This implies that having a larger household, thereby having a greater labor force gives the household the flexibility to distribute work between the own farm, agricultural activities and also nonagricultural employment, and therefore have a higher capacity of diversification.

The distance variable measured by hours of distance to a nearest market shows that as distance increases, incomes from self employment activities decrease. This result is as expected and suggests that in less accessible rural areas, probably with a low population concentration, it is difficult to establish rural enterprises because of the lack of derived demand and the fact that productive linkages cannot be established. In terms of location, being from a dispersed area, as opposed to being from a more accessible populated center, significantly reduces total income, self employment income, and nonagricultural wage incomes. Both of these variables, distance to market and whether an individual lives in a populated center or dispersed rural area, reinforce the fact that in areas where there is more access to markets and where linkages are created, self enterprise initiatives and wage activities in the nonagricultural sector seem to flourish. Households located in

dispersed rural towns have positive incomes derived from agricultural wage activities, which is expected since those areas are more dedicated to agricultural production and have a higher demand for agricultural wage labor as peons, and likely to be non skilled labor.

The results show that households in the Altiplano and Valles regions, as compared to the Yungas, have significantly higher incomes obtained from nonagricultural wage activities. Also, the level of income obtained from agricultural wage activities is significantly lower than that obtained in the Yungas. This is expected, especially in the Altiplano since the rural economy in that region is disadvantaged and the agricultural sector suffers from low productivity (Pachecho and Ormachea, 2000, Morales 2000).

Table 11. Determinants of annual household income for 3,299 households: Results estimated using OLS and tobit regressions Agricultural Year 2001-2002

<i>Dependent Variables</i>	Total income		Agricultural Income		Self employment income		Agricultural wage income		Nonagricultural wage income	
	OLS		OLS		OLS		Tobit		Tobit	
<i>Household characteristics</i>	Parameter	P-val	Parameter	P-val	Parameter	P-val	Parameter	P-val	Parameter	P-val
hh_female	-399.374	(0.47)	-1076.954	(0.00)	494.666	(0.12)	-453.801	(0.18)	576.673	(0.31)
hh_age	42.846	(0.01)	23.210	(0.06)	10.129	(0.18)	-84.164	(0.00)	-109.659	(0.00)
hh_education	239.217	(0.33)	437.472	(0.02)	251.678	(0.02)	-420.140	(0.00)	-442.591	(0.03)
hh_education2	39.640	(0.04)	-29.581	(0.03)	-5.530	(0.50)	1.676	(0.83)	86.632	(0.00)
adults in hh	1687.231	(0.00)	400.746	(0.01)	427.134	(0.00)	647.406	(0.00)	1972.530	(0.00)
total_land	1.515	(0.26)	1.738	(0.33)	-0.066	(0.91)	-1.102	(0.60)	1.611	(0.43)
Livestock	0.235	(0.17)	0.252	(0.12)	0.024	(0.47)	0.021	(0.33)	-0.664	(0.04)
Distance	-39.522	(0.33)	43.038	(0.13)	-35.301	(0.02)	-22.342	(0.50)	-76.481	(0.18)
<i>Location characteristics</i>										
Valles	102.577	(0.92)	-500.223	(0.52)	-613.014	(0.42)	-3858.589	(0.00)	6294.438	(0.00)
Altiplano	-3184.086	(0.00)	-1697.663	(0.01)	-1247.392	(0.07)	-1150.251	(0.06)	6070.512	(0.00)
Dispersed area	-5344.278	(0.00)	-504.212	(0.65)	-2478.836	(0.00)	1405.348	(0.00)	-4499.990	(0.00)
cons	3716.603	(0.04)	635.480	(0.61)	1428.508	(0.21)	1559.519	(0.08)	-8296.767	(0.00)
Number of observations	3299		3299		3299		3299		3299	
F(11, 209)	22.22		4.88		8.92		9.97		15.84	
Prob > F	0.000		0.000		0.000		0.000		0.000	
R ²	0.126		0.019		0.070					

6. CONCLUSIONS AND RECOMMENDATIONS

This study contributes to understanding the rural economy in three different regions of Bolivia by addressing three research questions: i) What are the determinants of an individual's participation in non-farm employment? ii) What is the level of labor allocated to the different non-farm activities? iii) What are the determinants of household's rural non-farm incomes?

The findings highlight the importance of several factors. An individual's gender will have a significant influence on whether participation in non-farm activities occurs. Women's participation in non-farm employment is definitely limited, regardless of the region. These findings coincide with studies in other countries like Nicaragua (Corral and Reardon, 2001) who find that women mostly participate in self employment activities. As was mentioned previously, Carafa (1993) and Glick and Sahn (1997) recognize that this may be due to women's many roles in the household. In terms of policy interventions, focus should be on analyzing the reasons for this tendency in the case of Bolivia and whether women in the rural areas do not participate in non-farm activities because of limitations or by choice, or a combination of both. In any case, programs encouraging education or training at some level for women are critical in order to provide women with the tools required to enter other labor markets.

On this note, the importance of education is also highlighted from the findings. While it is undeniable that more education contributes positively to an individual's capacities, it was determined that each activity has different education level requirements.

Participation in nonagricultural self employment requires some level of education but tends to decline after a certain level of education is attained. Similar results can be observed for agricultural production, where there is a significant negative effect on income beyond three years of education. More education on the other hand, proved to be a determinant for participation in high skilled wage employment. Also, education is a determinant for obtaining higher incomes, especially in nonagricultural wage activities. These findings are similar to those described by Taylor and Yunez-Naude (2000) in Mexico where education was found to increase the likelihood of participation in wage work. The opposite occurs for agricultural production and self employment activities where additional years of education will probably not contribute to higher earnings for a household.

This thesis shows that education clearly contributes to higher earnings from nonagricultural wage income, although not so for agricultural wage income. Similarly, Yúñez-Naude and Taylor (2001) find that basic education has positive returns for income derived from maize production in rural Mexico and wage activities, although they do not disaggregate between agricultural wage employment and nonagricultural wage employment. But like this study, they conclude that education plays a very important role in the activity a household will be involved in.

This study finds that a significant share of total income in the three regions of Bolivia is derived from agriculture, but it also proves that incomes derived from nonagricultural activities are very important components of total household income. Of these activities,

the one that has the highest share of total income is nonagricultural wage employment, followed by nonagricultural self employment. From a policy perspective, it is important to take into account the high level and share of nonagricultural wage employment of total income in rural areas by region. An example of how to strengthen this sector would be by strengthening the already existing but neglected network of rural training centers, which currently do not match training programs with the actual demand. But it is also necessary to look at the importance of agricultural production, which is socially and economically important for rural households in Bolivia. Greater economic development impacts could be achieved by identifying strategic agricultural crops which have the potential to generate a derived demand of manufacturing and services, thereby creating upstream and downstream productive linkages. Regarding the significance of non-farm activities, the policies designed to reactivate the rural economy and promote the generation of sources of non-farm employment and income should incorporate self enterprise initiatives but also, acknowledge the importance of wage employment and the close link that exists between the two sectors. The design of intervention strategies that focus on skills obtained through training for example will allow for a greater participation and level of income derived from these two activities.

Likewise, interventions by the public or private sectors should acknowledge the heterogeneity of labor and income distribution in the three ecoregions. In the region of the Valles, for example, nonagricultural wage employment along with agricultural wage employment are important contributors to the household income. This region is diverse in terms of sources of income and the creation of small and medium enterprises could be

appropriate in order to promote and consolidate productive chains. Households in the Altiplano are also engaged in nonagricultural self employment, but given the harsh agroclimatic conditions which limit agricultural production, households have to look to other activities to control for the risk in order to guarantee a certain level of income. The focus in this region could be directed at providing training for individuals to obtain skills so they can access nonagricultural skilled jobs since agriculture is not a feasible alternative for many. Finally, the region of the Yungas shows the highest share of income obtained from agricultural wage employment and also agricultural and nonagricultural self employment. In this region households have alternatives to agricultural production and therefore have more opportunities to diversify. Interventions in this region supporting the creation of small enterprises and cooperatives or other forms of organization based on the agricultural potential of this region are appropriate, especially if they are aimed at creating linkages that will help create a sustainable local economic dynamic.

For future research it would be valuable to follow up the baseline survey used for this study in order to compare changes between periods (agricultural year 2001-2002 to future years) and to see the patterns of rural employment and incomes in the three regions over time. Also, it would also be interesting to analyze non-farm activities in the context of the governmental policies to decentralize municipalities and what the impacts have been. These policies gave rise to the development of local economies by giving accountability to the municipalities. Studying the impacts of nonagricultural employment and incomes

in this context could provide a richer interpretation of the dynamic of agricultural production, self employment and nonagricultural wage incomes of the rural economy.

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APPENDICES

TABLES

Table 12. T-tests of significance to compare means: for Table 4 in document.

Variables	Macro eco-region			
	Total	Valles- Altiplano	Valles- Yungas	Altiplano- Yungas
Number of households	3299	2010	915	374
Number of observations (household members)	10548	6703	2698	1147
Individual gender (% male)	50.0	0.02	0.07	0.00
Individual age (years)	34.3	0.00	0.13	0.00
Individual can read and write (% Yes)	80.7	0.49	0.00	0.00
Years of education completed (number)	5.0	0.17	0.00	0.00
Gender of household head (% Female)	10.0	0.24	0.15	0.61
Age of household head (years)	47.5	0.71	0.00	0.00
Household head can read and write (%)	0.8	0.00	0.00	0.02
Level of education of household head (years)	6.5	0.00	0.00	0.00
Number of members in household >12	4.0	0.00	0.00	0.00
Access to electricity (%)	43.0	0.00	0.00	0.00
Access to potable water (%)	64.0	0.00	0.00	0.00
Distance from household to nearest market (km.)	19.3	0.00	0.02	0.00
Total value of livestock per household (in Bs.)	4751.2	0.00	0.03	0.68
Household land size (in hectares)	1.5	0.11	0.01	0.69
Dispersed area (%)	78.0	0.00	0.00	0.00

Table 13. Coefficients of Variation for Income Strata, for Table 6

Source of income	Quartiles			
	Low	2nd	3rd	High
# of households	3,299			
Agricultural Income	(4.0)	(1.0)	(0.9)	(2.8)
Agricultural Wage Income	(1.0)	(0.8)	(0.8)	(1.1)
Nonagricultural Wage Income	(0.9)	(0.7)	(0.8)	(1.0)
Nonagricultural Self Employment	(2.1)	(1.7)	(1.6)	(1.9)
Unearned Income	(1.0)	(1.0)	(1.2)	(1.6)
Total Income	(1.3)	(0.2)	(0.2)	(1.1)

* Coefficients of variation are in parenthesis (standard deviation/mean)

Table 14. Average level of income of those who obtain income from non-farm activities, by income quartile in U.S. Dollars*

Source of income	Quartiles			
	Low	2nd	3rd	High
# of households	3,299			
Agricultural Income	60	249	408	1,222
Agricultural Wage Income	92	191	385	873
Nonagricultural Wage Income	159	380	749	2,146
Nonagricultural Self Employment	73	126	187	602
Unearned Income	37	76	192	1,156
Total Income	157	493	1,002	3,439

* Exchange rate as of December 2001 1US\$/6.83 Bs.

Table 15. Average level of income of those who obtain income from non-farm activities by ecoregion, in US Dollars*

Source of income	Region			
	Valles	Altiplano	Yungas	Total
Agricultural Income	513	292	613	461
Agricultural Wage Income	381	169	519	366
Nonagricultural Wage Income	1,247	871	950	1,125
Nonagricultural Self Employment	274	210	307	257
Unearned Income	401	197	896	389
Total Income	1,443	813	1,483	1,273

* Exchange rate as of December 2001 1US\$/6.83 Bs.

Table 16. Wage activities by ecoregion (percent of 10,548 individuals)

	<i>Macro region</i>			<i>Total</i>
	Valles	Altiplano	Yungas	
Agriculture peon	50%	33%	75%	50%
Livestock peon	1%	1%	0%	1%
Wood extraction peon	0%	0%	1%	0%
Construction worker	12%	18%	7%	12%
Fishing peon	0%	0%	0%	0%
Driver	4%	2%	4%	3%
Office employee	2%	2%	2%	2%
Machine operator	1%	0%	0%	1%
Artisan	5%	16%	2%	7%
Armed Forces/Police	0%	0%	0%	0%
Commerce/Sales	5%	6%	3%	5%
Non skilled wage peon	13%	16%	3%	13%
Technician or mid level professional	5%	4%	3%	5%
Professional	1%	0%	0%	1%
Director and Executive in Government or Private Sector	0%	0%	0%	0%
Total	100%	100%	100%	100%

Table 17. Employment by ecoregion (percentage of 10,548 individuals)

	<i>Macro region</i>			<i>Total</i>
	Valles	Altiplano	Yungas	
Agriculture	52%	34%	78%	51%
Livestock	1%	1%	0%	1%
Mining	0%	11%	0%	2%
Manufacture	3%	2%	1%	2%
Construction	13%	21%	5%	14%
Commerce	7%	7%	3%	6%
Services	9%	9%	4%	9%
Public Sector	6%	8%	6%	6%
Housework	4%	3%	1%	3%
Education	3%	3%	1%	3%
Hotels and Restaurants	1%	1%	2%	1%
Community Activities	0%	0%	0%	0%
Transport, Storage	1%	0%	1%	1%
Provision of gas and water	1%	0%	0%	0%
Financial Intermediary	0%	0%	0%	0%
Total	100%	100%	100%	100%

Table 18. Households participating in nonagricultural self employment by ecoregion (percent of 3,299 households)

Valles	67,60%
Altiplano	21,60%
Yungas	10,80%
Total	100,00%

Table 19. Sources of unearned income for the households who received unearned income. (Based on 1901 households from a sample of 3,300 in all three regions)

Unearned income	Percent
Rents	11%
Pensions	31%
Remittances	35%
NGOs or State money	11%
Other	12%
Total	100%

Table 20. Wage labor activities (percent of 3,338 wage laborers among 10,548 individuals)

Agricultural wage	Percent
Crop and livestock wage worker	52%
Nonagricultural wage	
Construction worker	13%
Artisan wage worker	7%
Commerce/sales wage worker	5%
Driver	3%
Technician	5%
Non skilled wage worker	13%
Other	2%
Total	100%

Table 21. Nonagricultural self employment activities for the household classified into two categories: food processing, and manufacturing and services

Food processing

Out of 3,300 households elaboration of by products of primary production

<i>Nonagricultural self employment</i>	<i>Percent</i>
Food processing*	73%
Total	73%

Manufacturing and services

Out of 973 participating households; secondary and tertiary activities performed by households

<i>Nonagricultural self employment</i>	<i>Percent</i>
Manufactured goods**	26%
Artisan	8%
Alcoholic beverages	7%
Carpentry	3%
Bread making	3%
Other	5%
Services	74%
Convenience store	26
Kiosk	24
Transport	6
Intermediary/Middlemen	5
Food pension	4
Others	9
Total	100%

**Households may obtain income from food processing, as well as manufacturing and services.

Table 22. Location of wage employment by ecoregion (10,548 individuals)

	Macro region						Total
	Valles	%	Altiplano	%	Yungas	%	
Non Local	5422	80	2383	88	867	76	8672
Local	1281	20	315	12	280	24	1876
Total	6703	100	2698	100	1147	100	10548

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