Income Mobility and Assessing Vulnerability to Consumption Between Aymaras, Quechuas and Chipayas

Movilidad del Ingreso y Vulnerabilidad entre Aymaras, Quechuas y Chipayas Medición econométrica sobre un panel de datos

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Resumen[2]

La investigación econométrica estudia la movilidad del ingreso y las características de la vulnerabilidad de tres grupos de indígenas (Aymaras, quechuas y Chipayas) en el área rural de Bolivia, haciendo uso de técnicas econométricas y a partir de un análisis empírico multivariante sobre el ingreso, consumo y bienestar de las familias en el área rural. La fuente de datos primarios para este estudio esta basado en un panel de datos recolectado el 2004 y 2005 en las áreas rurales de los departamentos de La Paz, Oruro, Potosí y Chuquisaca. La encuesta cubre 822 familias en cada ronda. Comunidades específicas en el área rural en Bolivia fueron identificadas para la elaboración de la encuesta con el objetivo de obtener información y percepciones sobre niveles dinámicos de pobreza crónica, vulnerabilidad, shocks y mecanismos para hacer frente a los shocks y disminuciones del ingreso.

En el estudio, la vulnerabilidad esta definida de dos maneras: En el primer caso, vulnerables son aquellas familias que experimentan una caída en su consumo per capita en el 2005 en comparación con su consumo per capita en el 2004. Por otro lado, se noto en el análisis econométrico que esta definición tiene una debilidad: clasifica a las familias de acuerdo a la caída en su nivel de consumo sin considerar el grado de caída del consumo per capita. Sin embargo, tomando en consideración el nivel de pobreza extrema que experimentan las familias estudiadas es un indicador interesante para medir la variación de los niveles en su consumo. En el Segundo caso, la idea de la definición fue la intensidad de la vulnerabilidad para medir el grado de descenso en el consumo que experimentan las familias. Por tanto, para validar la anterior definición no solamente medimos el descenso sino que también tomamos en cuenta el grado de descenso del consumo producto de un shock al ingreso. Así, vulnerabilidad es definida como el grado de descenso del consumo en el 2005 en comparación con el 2004. El radio del descenso es tomado es dividido por el consumo per capita en el 2004.

El análisis demostró que el 66 por ciento de las familias encuestadas que viven en pobreza extrema en el área de estudio han experimentado un descenso significativo en su nivel de bienestar y por lo tanto pueden ser considerados como un grupo vulnerable. La investigación mostró por otro lado, que la población indígena objetivo (Aymaras, Quechuas y Chipayas) en el área rural de Bolivia son altamente vulnerables a los shocks. Utilizando la metodología de Stefan Dercon de la Universidad de Oxford; la investigación confirmo que los más importantes shocks covariantes que afectan el bienestar de los grupos indígenas son principalmente sequías, heladas e inundaciones. Programas de bienestar social, mecanismos de manejo y gestión de riesgos en Bolivia son inexistentes en las áreas estudiadas, especialmente para gente de comunidades rurales. Los limitados activos de la gente indígena en donde los datos fueron recolectados hacen de ellos particularmente vulnerables al impacto de shocks adversos considerando la ausencia de mecanismos que puedan hacer frente a dichos shocks que afectan el bienestar de los campesinos.

Las estimaciones logit fueron aplicadas en la primera definición y un modelo tobit para el segundo caso. El análisis econométrico utilizando modelos probit y tobit demostraron que un alto nivel de educación del cabeza de familia, los títulos de propiedad de la tierra, familias que tienen un miembro que migro y la propiedad sobre el ganado incrementan su bienestar y por lo tanto la probabilidad de ser vulnerable se reduce.

El riesgo y la incertidumbre son características comunes de la vida de los indígenas en Bolivia. Las familias en el area rural de La Paz, Oruro, Potosí y Chuquisaca tienen cuatro formas de compensar su disminución del ingreso. Primero: trabajan más o incrementan sus días de trabajo (cambian de trabajo, y/o incrementan su participación en el mercado de trabajo). Esta categoría también incluye la migración en busca de trabajo; segundo: utilizan ahorros o empeñan bienes; tercero: venden animales y finalmente reciben ayuda de Organizaciones No Gubernamentales.

Palabras clave: Bolivia, gente indígena, pobreza extrema, pobreza crónica, vulnerabilidad, estrategias para hacer frente a shocks.

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Governments and donors cannot build effective social safety nets until they understand which people are most vulnerable to shocks and the nature of the socioeconomic risks they face.

The World Bank, 2003

1. Introduction

Bolivia is a county characterized by a high incidence of poverty, vulnerability and inadequate social risk management. Moreover, rural households in the Andean region of Bolivia where this study was conducted faces the risks of suffering from different types of covariate and idiosyncratic shocks, especially in the highland and central valley region.

While some shocks affect poor communities in the country as a whole[3], other shocks like natural disasters affect some regions specifically – for example periodic droughts and frost in the Altiplano of La Paz and Oruro and floods and frost in areas near Uyuni Salt Lake and Poopo Lake in Oruro and Potosi.

Other types of shocks such as a death or a loss of a job affect one or a few households[4]. Even though any household can be affected by such shocks, not all of them have the same probability of recovering from their consequences. Poor households that lack the necessary physical and human capital are less likely to recover from them.

This chapter presents an analysis of the incidence and impact of those shocks on the welfare of indigenous groups, taking into account that in Bolivia relatively little has been studied about vulnerability issues and the behaviour of consumption and welfare implications thereof.

2. Objective

The aim of this research is to identify vulnerable indigenous groups and using econometric techniques to find the determinants of vulnerability among indigenous groups in rural Bolivia.

3. Household data

The unit of observation is the rural household and detailed information was obtained for all members of the household. Primary data was therefore collected at a household level based on a structured questionnaire. The primary data source for this study is panel data sets for 2004 and 2005, which was collected in rural areas of Bolivia the first half of 2004 and first half of 2005. The survey covers 822 households in each round, with the intention to resurveying the same households in subsequent rounds. Specific communities in rural areas of Bolivia were identified for a household survey in order to obtain community perceptions on poverty, vulnerability, shocks and coping mechanisms. I used a quantitative data set derived from a household survey to develop indices of poverty, inequality and chronic poverty, and econometric techniques to explore linkages between welfare, chronic poverty, vulnerability and coping strategies at the household and community levels in the four rural regions.

4. Conceptual issues in vulnerability analysis

In literature on the subject there are diverse and quite a lot of approaches and definitions on vulnerability. Glewwe and Hall (1998) distinguish two types of vulnerability, one concerning specific changes in government programmes and another, a more general vulnerability concerning changes in socio-economic conditions, including inability to adapt to such changes. They call the first policy-induced vulnerability, and the second market-induced or 'robust' vulnerability.

Hoddinot and Quisumbing (2003a, 2003b), using large-scale household-level data sets, describe several alternative definitions and approaches to estimating vulnerability and distinguish between three forms of vulnerability:

1. As expected poverty (VEP) or an ex ante measure of vulnerability;
2. As expected low utility (VEU) or an ex post measure of vulnerability; and
3. As uninsured exposure to risk (VER).

As argued by Ligon and Shechter (2004) of the different approaches, in general two steps are involved in estimating vulnerability. First, one must estimate the distribution of future consumption expenditures for every household; second, one must construct a statistic from this estimated distribution, to capture the reduction in household welfare due to risk in household consumption expenditures.

[3] These are often referred to as covariate shocks.
[4] Idiosyncratic shocks

In other words, the first has to do with characterising consumption expenditures the second in summarising welfare consequences of this variation (Ligon and Shechter 2004, pp 2-3).

1. Vulnerability as expected poverty (VEP): This is defined as the probability that a household will fall into poverty in the future. Empirically Chaudhuri et al. (2002) estimate ex ante vulnerability by modelling a household consumption function for cross section data. Christiaensen and Subbarao (2001, 2004) also consider vulnerability as expected poverty and their study illustrates a methodology to empirically assess household vulnerability using pseudo panel data derived from repeated cross sections augmented with historical information on shocks using data from rural Kenya.

2. Vulnerability as low expected utility (VEU): Ligon and Schechter (2002, 2003) define vulnerability with reference to the difference between the utility derived from some level of certainty equivalent consumption, Z_{ce} at and above which the household would not be consider vulnerable[5] and the expected utility of consumption (Hoddinott and Quisumbing, 2003b p 16). In other words, they define vulnerability of a typical household as the difference between the utility from a certainty equivalent consumption sufficient to ensure that the household is not regarded as vulnerable and the expected value of the actual utility of the household from its (risky) stream of consumption. They then define vulnerability as the sum of three components: poverty (on average), aggregate risk and idiosyncratic risk. Minimisation of vulnerability is then tantamount to maximising expected utility (Raghbendra Jha, 2006 p 4).

   Vulnerability as uninsured exposure to risk (VER): This approach focuses on the response of household consumption expenditures to various observable shocks such as drought or idiosyncratic fluctuations of income. If household consumption expenditures co-vary with income shocks, then one may infer that a risk-averse household lacks the means to smooth or insure away these shocks to its expenditures (Ligon and Schechter (2004 p 3). In other words, when risks are not managed effectively shocks result in drops in consumption and hence welfare losses. To this extent what matters is the uninsured exposure to risk. VER is an ex post measure of vulnerability (Raghbendra Jha, 2006 p 5).

[5] Z_{ce} is analogous to a poverty line.

5. The concept of vulnerability

Vulnerability is the likelihood that at a given time in the future, an individual will have a level of welfare below some norm or benchmark. (Hoddinott and Quisumbing, 2003b p 9).

As argued by Dercon (2001 p 1-3) vulnerability must be defined relative to some benchmark. The natural benchmark would be vulnerability to poverty. Vulnerability is also forward-looking: it makes a statement about future poverty; it is therefore defined as ex-ante poverty, i.e. before one knows what the outcome of risk variables will be. A measure could try to count those that have a high probability of being poor in the next period or further in the future. It could also weigh of the extent of deprivation that is possible e.g. how deep below the poverty line one may fall. Using this definition, it is clear that not only poverty due to risk should be considered: measures of vulnerability should also include those not expected to move out of poverty, those that will move permanently into poverty and those falling into poverty due to predictable fluctuations, such as seasonality (Dercon, 2001 p 1-3).

Amin, Rai, and Topa (1999 p 2) consider that vulnerable households are those that are unable to smooth consumption in the face of fluctuations of income due to crop disease, floods, illness, and other idiosyncratic shocks to household resources. Vulnerability is therefore measured as fluctuations in consumption associated with inefficient risk sharing.

Shubham Chaudhuri et al. (2002 p 4) define vulnerability within the framework of poverty eradication, as the ex-ante risk that a household will, if currently non-poor, fall below the poverty line, or if currently poor, will remain in poverty.

Pritchett, Suryahadi and Sumarto (2000 p 3-4) define vulnerability as the risk a household will fall into poverty at least once in the next few years. This means that a household's vulnerability is measured as a probability; hence households have greater or lesser degrees of vulnerability. Since the future is uncertain, the magnitude of vulnerability rises

with the time horizon, so vulnerability over the next week will be quite low, over a year higher, and over several years the risk will be higher still.

6. Methodology

6.1. Vulnerability measurement

In this study, vulnerability is defined in two ways:

a. In the first case vulnerable are those households which experienced a fall in their per capita consumption in 2005 in comparison to the per capita consumption in 2004. A dummy value of 1 was assigned to a vulnerable household[6]: and 0 to otherwise (non-vulnerable household). On one hand, this definition has one weakness: it classifies all households that experience a fall as vulnerable irrespective of the degree of fall in the per capita consumption. On the other hand, taking into account the level of extreme poverty of the households this is a useful definition to classify and obtain an estimate of a household's variance of consumption expenditures.

b. In the second case, the idea of the definition was the intensity of vulnerability in order to measure the degree of fall in consumption. Therefore vulnerability is defined so as to take care of the flaws of the first measure, although it is not free from criticism. In this case vulnerability is defined as the degree of fall in consumption[7] in 2005 in comparison to 2004. The ratio is taken as the fall in per capita consumption divided by the per capita consumption in 2004.

Finally logit estimates were applied to ascertain the determinants of vulnerability in the first case and tobit model was used to find the determinants of vulnerability in the second case.

6.2. Vulnerability among indigenous people in Bolivia

Table 1 presents the resulting vulnerability profile as observed in 2004/2005; around 66 per cent of the indigenous households were classified as vulnerable as they experienced a fall in their per capita consumption.

[6] Households that experience a fall in consumption.

[7] Per capita consumption 2005 minus per capita consumption 2004 divided by per capita consumption in 2004 (the per capita consumption takes into account the equivalence of scales).

In other words, of the 97 per cent of indigenous people who are extremely poor and live below the extreme poverty line, 66 per cent experienced a decline in the level of welfare and can be taken as an extreme vulnerable group. Households in rural Bolivia are highly vulnerable and suffer from acute and extreme poverty, especially in rural areas of the highlands and valleys of the country. Furthermore, and according to the data shocks triggering the decline of welfare mainly are droughts, frost and floods among others.

Table 1: Percentage of the vulnerable households

Characteristic	Vulnerable HH	Non-vulnerable HH
Overall	66.04%	33.96%
By Gender		
Male-headed	65.17%	34.83%
Female–headed	71.56%	28.44%
By Region		
Rural La Paz	64.06%	35.94%
Rural Oruro	69.39%	30.61%
Rural Potosi	61.98%	38.02%
Rural Chuquisaca	68.91%	31.09%
By gender and region		
	Male-headed vulnerable HH	**Female-headed vulnerable HH**
Overall	65.17%	71.56%
Rural La Paz	64.74%	59.26%
Rural Oruro	69.46%	68.97%
Rural Potosi	62.94%	54.55%
Rural Chuquisaca	63.58%	96.77%

Source: Author's calculations
Note: HH = Households.

The limited assets of the indigenous poor in the regions where the data was collected, as discussed, also makes them particularly vulnerable to the impact of adverse shocks since they lack the means to be able to cope with them.

Turning to gender issues, indigenous female-headed households experienced higher levels of extreme poverty in 2004/05. 71.56 per cent of the female headed households are vulnerable. This is higher by 6.39 per cent compared to male-headed households suggesting, first, gender differences in terms of welfare and, second, in rural areas females are more likely to be vulnerable than males.

In comparing the different rural regions, rural Chuquisaca presents the highest level of vulnerability in comparison to other regions, with 96.77 per cent of the indigenous female-headed households are more likely to be vulnerable.

In general, the rural areas located in Oruro and Chuquisaca are among the most vulnerable regions with a 69.39 and 68.91 per cent respectively (Table 1). In other regions on 63 per cent of households are, on an average, likely to be vulnerable in La Paz and Potosi. Not only are these indigenous households vulnerable because of fall in consumption but also because of isolation, remoteness, low level of infrastructures and poor living conditions.

6.3. Household characteristics of vulnerable groups

This section describes the general characteristics of the indigenous groups. In the household questionnaire, respondents were asked about characteristics of their households, including access to electricity, source of drinking water, sanitation facilities, materials used in house-building, and land ownership among others. For example, only 17 per cent of the indigenous people had access to electricity in the survey area and the main source of lighting in rural areas is kerosene with around 75 per cent of the households using this source and 77 per cent of them are vulnerable (Table 2).

Table 2: Household characteristics

Principal material	Total HH	Vulnerable	Non-vulnerable
Roofing			
Metal sheets	24.19%	22.39%	27.68%
Tiles	21.68%	22.39%	20.30%
Straws	54.14%	55.22%	52.03%
Total	100.00%	100.00%	100.00%
Flooring			
Earthen bricks	6.27%	5.12%	8.49%
Concrete bricks	0.75%	0.95%	0.37%
Soil, earth or sand	92.98%	93.93%	91.14%
Total	100.00%	100.00%	100.00%
Lighting			
Electric power	17.17%	14.99%	22.22%
Gas	3.51%	4.17%	2.30%
Kerosene	75.81%	77.42%	75.48%
Candles	3.51%	3.42%	3.83%
Total	100.00%	100.00%	100.00%

Source: Author's calculations
Note: HH = Households.

Straws were the most common roofing material of the rural poor, accounting for 54 per cent of sampled households (55 per cent vulnerable). Only 24 per cent and 22 per cent of household had roofing of metal sheets and tiles respectively. In general, all households lived in structures with walls made of natural materials – basically straw and mud. Finally, the predominant material used for the flooring was soil, earth or sand, accounting for 93 per cent of the sampled households with 94 per cent of them are vulnerable.

6.4. Income quintiles and education

Table 3 presents expenditure quintiles and education distribution generated across rural areas for vulnerable and non vulnerable indigenous groups.

As expected, the distribution of the indigenous extremely poor across expenditure quintiles is balanced and almost uniform, showing low relative variation of welfare. In the first two quintiles those who are vulnerable account for about 45 per cent of the total indigenous population in rural areas.

Table 3:
Income quintiles and education (2005)

Quintiles	Total HH	Vulnerable HH	Non-vulnerable HH
1st Quintile	19.92%	21.06%	17.71%
2nd Quintile	20.18%	20.49%	19.56%
3rd Quintile	19.92%	20.68%	18.45%
4th Quintile	20.05%	18.79%	22.51%
5th Quintile	19.92%	18.98%	21.77%
Total	100.00%	100.00%	100.00%
By level of education			
No formal education	19.92%	19.92%	19.93%
Under primary	49.25%	51.61%	44.65%
Primary	19.17%	17.46%	22.51%
Intermediate	8.40%	7.40%	10.33%
High school	3.26%	3.61%	2.58%
Total	100.00%	100.00%	100.00%

Source: Author's calculations
Note: HH = Households.

The distribution of responses to the selected questions by household expenditure quintiles (using welfare levels) is shown in Table 3.
Respondents most frequently reported changes in their consumption patterns in response to harvest failures due to weather conditions. More than 41 per cent are vulnerable. About 62.23 per cent of respondents from the first three quintiles of the expenditure distribution had experienced a fall in consumption.

More than half of the respondents decreased their consumption in 2005/04 of which around 66 per cent were vulnerable (Table 1). Again, this decrease was not uniform. The highest proportion (about 42 per cent) of the

respondents who reported that they "cut down on meals" came from households in the lowest two quintiles of expenditure distribution. At the same time, only 20 per cent of the respondents from the highest expenditure quintile reported a decrease in consumption of food.

In rural Bolivia the indigenous poor continue to have few years of formal education. For instance, under primary was the most common level of education of the rural poor, accounting for 49 per cent of sampled households (where 52 per cent are vulnerable). In the first two quintiles 69 per cent of the households have low levels of education (under primary or no formal education).

6.5 Shocks faced by rural households in Bolivia (1984-2004)

The analysis of the incidence of shocks summarized in Tables 4 and 5 reveals serious, close to catastrophic, shocks in rural areas of La Paz, Oruro, Potosi and Chuquisaca. Basically the questionnaire went over a long list of possible events and shocks that could cause serious hardship. As explained by Dercon (1999 and 2001 p 52) the list of shocks was based on continuous surveys during 2004 using open ended questions and following the Dercon approach. Questionnaires asked whether the event caused very serious hardship in the last 20 years and to nominate the years in which it occurred, with simple landmark dates used to help dating during interviews.

Table 4: Shocks faced by rural households in rural Bolivia (1984-2004)

Type of shocks	Percentage of HH reporting to have been affected, by type of event in the last 20 years	Mode of the most recent serious event
Harvest failure	100.00%	2004
Oxen problems	13.99%	2003
Livestock problems	87.47%	2004
Land problems	37.71%	2004
Labour problems	55.72%	2002
Assets losses	31.39%	2002
Loss of income due to political event	18.86%	2003
Loss of income due to military event	55.11%	2004

Source: Author's calculations

Note: HH = Households.

Definitions: Adapted from Dercon (2001 p 53)

1. **Harvest failure:** Due to drought, too much rain and flood, pest and diseases, harvest losses in storage and frost and hailstorm.
2. **Oxen problems:** Due to livestock disease, theft, death due to drought, and distress sales due to drought.
3. **Livestock problems:** Due to livestock disease, theft, death due to drought, and distress sales due to drought.
4. **Land problems:** Due to peasant association reallocation, lost due to dispute and transfers among family members.
5. **Labour problems:** Due to death of husband, death of wife, other death, illness of husband, illness of wife, illness of other members, conscription, son leaving voluntarily, daughter leaving and divorce.
6. **Assets losses:** Due to destruction of house (fire, rains etc), theft of assets and villagisation **or vandalism**.
7. **Loss of income for political event:** Due to villagisation **or vandalism**.
8. **Loss of income for military event:** Due to disablement through social conflict or strike.

In this sense, Tables 4 and 5 respectively reveal that there is a large number of households that are affected by shocks., In the case of harvest failure and its related impact, the data shows that overall 100 per cent of the households reported to have been affected, and the most recent shock was reported when the survey were conducted in 2004.

Households affected by harvest failures, according to Table 5, were mostly due to droughts (29 per cent), too much rain and floods (26 per cent), and frost and hailstorm (27 per cent). It seems that the extremely poor in rural Bolivia who are not able to protect themselves against natural shocks are more exposed to droughts, floods and frost.

Those shocks caused losses in production of potatoes, which is the main staple food (potatoes provides important caloric consumption of the people of the Andean region), death of cattle, livestock diseases and food shortages among others. The data shows that losses of production are concentrated in communities in Oruro and Potosi.

Turning to oxen and livestock problems, respectively 14 per cent and 87 per cent of the households were affected. Most were affected by livestock diseases accounting for 53 and 59 percent of oxen and livestock problems respectively (Table 5). Other livestock essentially means llamas, goats and sheep. Death due drought, and distress sales due to drought were also very common.

Table 5: Shocks faced by rural households in rural Bolivia (1984-2004)

Type of shocks	Percentage of HH reporting to have been affected, by type of event in the last 20 years
Harvest failure	**100.00%**
Drought	29.04%
Too much rain and flood	26.12%
Pest and diseases	14.33%
Harvest losses in storage	3.51%
Frost and hailstorm	26.99%
Oxen problems	**100.00%**
Livestock disease	52.74%
Theft	15.07%
Death due drought	10.27%
Distress sales due to drought	21.92%
Livestock problems	**100.00%**
Livestock disease	59.47%
Theft	8.99%
Death due drought	28.54%
Distress sales due to drought	3.00%
Land problems	**100.00%**
Peasant association reallocation	55.96%
Lost a dispute	0.00%
Transfers among family members	44.04%
Labour problems	**100.00%**
Death of husband	9.08%
Death of wife	0.00%
Other death	20.31%
Illness of husband	26.28%
Illness of wife	17.80%
Illness of other members	10.75%
Conscription	0.00%
Son leaving voluntarily	10.51%
Daughter leaving	2.75%
Divorce	2.51%
Assets losses	**100.00%**
Destruction of house (fire, rains, etc)	76.98%
Theft of assets	7.17%
Villagisation	15.85%
Loss of income for political event	
Villagisation	18.86%
Loss of income for military event	
Disablement through social conflict or strike	30.78%

Source: Author's calculations

In the case of land problems and its related impact, the data shows that peasant association reallocation (56 per cent) and transfers among family members (44 per cent) were reported as the most common problems among rural communities.

According to Table 4, around 56 per cent of the households had experienced labour problems due to illness and death, especially of the head of the household. As discussed in the previous section straws were the most common roofing material of the rural poor, and in general all households lived in structures with walls made of natural materials, basically, straw and mud. Therefore destruction of house accounted for 77 per cent of assets losses, which had ben experienced by 31 per cent of households. (Tables 4 and 5).

In recent years the strength of indigenous mobilisation, strikes and other kinds of protests and violent demonstrations against the government were, among others, the most important reasons for loss of income due to political and military event.

6.6 Empirical analysis

In the following analysis, two main areas concerning rural vulnerability, characteristics and vulnerability determinants, are investigated econometrically.

First, an attempt was made to identify households which experienced a fall in their per capita consumption in 2005 in comparison to per capita consumption in 2004 using a probit estimation and to identify determinants of household vulnerability for the whole study area and separately for the four regions.

Second, the intensity of vulnerability in order to measure the degree of fall in consumption was identified. A tobit model was estimated to determine the factors and determinants of vulnerable indigenous households. In that sense, the tobit estimation was made for the whole region studied as well as separately for the four regions.

6.6.1 Dependent variables

a. In developing an empirical model using probit estimation for the first case, the dependent variable is discrete. The households were therefore divided into vulnerable and non-vulnerable groups. As discussed in Section 3.4.1 vulnerable are those households that experienced a fall in their per capita consumption in 2005 in comparison to the per capita consumption of the previous year. A dummy value of 1 was assigned to vulnerable household; and 0 to otherwise (non-vulnerable household).

b. Vulnerability was defined as the degree of fall in consumption in 2005 in comparison to 2004. The ratio of the fall in per capita consumption divided by the per capita consumption in 2004 was taken. In this case

the tobit model was used in order to find determinants of vulnerability.

6.6.2 Independent variables

The main principle in selecting potential determinants of vulnerability was exogeneity. The list of the variables is presented in brief below:

a. Highest educational level: This is the maximum years of school attended by a household member. In another model specification, the number of years of schooling was replaced with the literate dummy (if household head is literate =1, otherwise=0).

b. Gender: A dummy was created for the gender of household head. If the head is male then it is 1, otherwise 0.

c. Marital status: A dummy for the marital status was created. If the household head is married or cohabiting then it is 1, otherwise 0. In rural areas cohabiting is also considered as marriage.

d. Age of the head of the HH: The age of the household head is taken as it is very a important determinant of the income and earning capacity of the household.

e. Age squared: This is used to take care of the non-linearity of the age. With the increase in age of the household head, the earning capacity increases but after sometime, it decreases.

f. Household size: The household size is an important variable as it shows the effects of the family size on vulnerability.

g. Household size squared: This takes care of the non-linearity of family size and effects of income and welfare on vulnerability.

h. Dependency is measured in the first case as proportion of household members aged below 15 years and in the second case as proportion of household members aged above 65 years. This is because the number of dependent people in the household is likely to decrease income, increase poverty and make it more vulnerable.

i. Total livestock assets: Livestock is an important asset in rural households of Bolivia. An index of the livestock assets was created using the Taylor and Tunner method and used in the analysis. With increase in livestock, the household income is likely to increase and make it less poor and less vulnerable.

j. Migration: A dummy was created with migration equal to 1 if a member of the household migrates and 0 otherwise. A household that had its member migrating is supposed to be less poor and less vulnerable.

k. Land size: Land size is an important source of income and hence the determinants of poverty and vulnerability in rural areas. Landholding in hectares was used to measure the land assets available to the household.

l. Land entitlements: Generally, rural households have land but often do not have entitlements. A dummy was created for land entitlements to see if the entitlement affects vulnerability.

m. Remoteness: Remoteness also affects income, poverty and vulnerability. Remoteness was measures as time taken to reach facilities like school, hospital and markets.

n. Location: In order to see the effects of location, separate dummies were created for Oruro, Potosi, Chuquisaca and La Paz. But in the analysis, La Paz was used as the comparison group.

o. Ethinicity: Ethnicity is usually a determinant of household welfare, poverty and vulnerabiltity. Four dummies for ethnicity were created on the basis of the language households spoke (Aymara, Quechua, Aymara/Quechua and Chipaya).

6.6.3. Model results

6.6.3.1. Probit estimations

Table 6 shows the main results of applying the methodology specified in the Section 6 and 6.6.1 and presents the parameter estimates of the probit estimation model for the determinants of vulnerability in rural Bolivia. Additionally, with a few exceptions, the signs on the parameters are expected signs and many of them are highly significant. Also, alternative specifications show a high degree of robustness of the coefficients.

A higher level of education attained by the household head increases the welfare of the household and hence reduces the probability of becoming vulnerable. Therefore, the marginal effect of the level of education is significant at 10 per cent (Table 6) for rural households as a whole and for the rural

regions of La Paz and Oruro; in Potosi the variable in non-significant and in Chuquisaca is significant at 1 per cent.

Table 6
Determinants of vulnerability in rural areas of Bolivia (Probit model)

Variables	Overall	Rural La Paz	Rural Oruro	Rural Potosi	Rural Chuquisaca
Highest level of education attained					
Highest educational level	-0.0014 *	-0.0076 *	-0.0007 *	0.0031	-0.0512 ***
	(0.0064)	(0.0117)	(0.0128)	(0.0139)	(0.0155)
Socio-demographic characteristics					
Gender	-0.0049	0.2686 *	0.0142	0.2553 *	-0.3402 ***
	(0.0700)	(0.1657)	(0.1357)	(0.1779)	(0.0530)
Marital status	-0.1054 *	-0.3711 ***	-0.0221	-0.1341	-0.0044
	(0.0631)	(0.0686)	(0.1298)	(0.1363)	(0.1563)
Age of the head of the HH	0.0044	-0.0100	0.0121	0.0037	-0.0221
	(0.0096)	(0.0222)	(0.0169)	(0.0207)	(0.0252)
Age squared	0.0000	0.0000	-0.0001	0.0000	0.0002
	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0003)
Household size	0.0173	0.1167	-0.0476	0.0788	0.0731
	(0.0373)	(0.0899)	(0.0693)	(0.0845)	(0.0933)
Household size squared	0.0004	-0.0050	0.0070	-0.0100 *	-0.0020
	(0.0028)	(0.0076)	(0.0055)	(0.0066)	(0.0068)
Proportion of HH aged < 15	-0.0104	-0.0350	-0.0125	0.0312	-0.0682 *
	(0.0174)	(0.0421)	(0.0328)	(0.0354)	(0.0384)
Proportion of HH aged > 65	-0.0337	-0.0022	-0.0700	0.0122	-0.2688 ***
	(0.0344)	(0.0723)	(0.0706)	(0.0817)	(0.0882)
Assets and other characteristics					
HH with electricity	-0.1533 ***	-0.2028	-0.1770 *	-0.2458 **	-0.0423
	(0.0546)	(0.1486)	(0.1070)	(0.1206)	(0.1107)
Migration	-0.1041 ***	-0.2318 ***	-0.0278	-0.1924 *	-0.1953 ***
	(0.0415)	(0.0777)	(0.0763)	(0.0981)	(0.0673)
Land size	0.0158	-0.0215	0.0548 **	0.0033	-0.0188
	(0.0150)	(0.0356)	(0.0261)	(0.0304)	(0.0344)
Land entitlements	-0.1098 **	-0.2449 **	-0.0846	-0.2243 *	-0.1199
	(0.0542)	(0.1097)	(0.1155)	(0.1208)	(0.1273)
Total livestock assets	0.0061	0.0289 ***	0.0047	0.0039	0.0289 ***
	(0.0047)	(0.0113)	(0.0079)	(0.0098)	(0.0114)
Remoteness					
Remoteness – Hospital	-0.0096	-0.1564 ***	0.0625	0.0344	0.0970 *
	(0.0209)	(0.0407)	(0.0484)	(0.0389)	(0.0530)
Remoteness – School	0.0515 *	0.1463 ***	0.0236	-0.0495	-0.1133 *
	(0.0272)	(0.0582)	(0.0518)	(0.0724)	(0.0613)
Remoteness – Market	-0.0059	0.0456	-0.0340	0.0188	-0.0211
	(0.0119)	(0.0264)	(0.0283)	(0.0430)	(0.0198)
Location					
Rural Oruro	-0.0121				
	(0.0551)				
Rural Potosi	-0.0930 *				
	(0.0628)				
Rural Chuquisaca	-0.0135				
	(0.0713)				
Ethnicity					
Ethnicity Aymara	0.0421				
	(0.0906)				
Ethnicity Quechua	0.0585				
	(0.1081)				
Ethnicity Aymara/Quechua	-0.1665 *				
	(0.1180)				
Number of observations	798	217	196	192	193
Wal chi2 (23) (17) (17) (17) (17)	50.46	39.37	30.71	30.04	42.64
Prob > chi2	0.0008	0.0016	0.0216	0.0261	0.0005
Pseudo R-squared	0.0477	0.01663	0.1181	0.0966	0.2028

Source: Author's calculations
Notes:
a. Dependent variable: Vulnerable household = 1.
b. ***p < 0.001, **p<0.05, *p<0.1, indicate significance at the 1%, 5%, and 10% level.
c. Robust standard errors adjusted in parentheses.

In general, if the household head is literate then the household reduces the possibility of becoming vulnerable; hence, those who have higher level of education always get better opportunities and have a comparative advantage. The significance of the literate dummy as discussed in the previous sections can be explained by better awareness and higher productivity in households with literate heads compared to those with illiterate heads.

It seems that female-headed households do not appear to be at a disadvantage in the region as a whole, except in case of rural Chuquisaca, where the negative coefficient for female household head significant at 1 per cent level indicates that female-headed households are better off and non-vulnerable than those headed by a man, other things being equal. However, in Potosi and La Paz it is the opposite (significant at 10 per cent) as male-headed households are better off and non-vulnerable than those headed by a woman.

In general, other specifications showed that male-headed households are less vulnerable especially in La Paz and Potosi and explanations would require more specific research on gender issues. It was also found that if the households head is married or cohabiting, the household is less vulnerable with the marginal effect significant at 10 per cent (Table 6) for rural households as a whole, significant at 1 percent for La Paz, and for the other regions the variable remains non-significant.

In Bolivia, poor indigenous farmers play an important role as producers and providers of food and nutritional security for the household. Women play an especially significant role in household welfare as homemakers and as managers of natural resources. Nevertheless, most of the rural farmers in La Paz, Oruro, Potosi and Chuquisaca do not have land entitlements and equal access to land and property.

It is found that households with land entitlements are more likely to be less vulnerable in the region as a whole with significance at 5 per cent level. In La Paz and Potosi significance is 5 and 10 per cent respectively.

Livestock ownership variables are most significant for La Paz and Chuquisaca; the probit results show that households with higher livestock assets (mostly llamas and alpacas) are less vulnerable. The coefficient for large livestock is significant at 1 per cent level in La Paz. In Chuquisaca (mostly sheep and goats) it is significant at 1 per cent level. Hence, livestock ownership may increase a household's welfare, income or consumption through the sale or consumption of animals and animal products. Consequently, households are mostly at risk and more likely to be vulnerable if they have a small number of livestock.

A household that has a member migrating is less likely to experience a decline of its welfare and is less likely to be vulnerable. Thus, households that have a migrating member(s) are less vulnerable and the likelihood of becoming vulnerable decreased 10 percent overall at 1 per cent significance level, 23 per cent in La Paz and 20 per cent in Chuquisaca at 1 per cent significance level, and by 19 per cent in Potosi significant at 10 per cent level.

Finally, ethnic group speaking both Aymara and Quechua are less likely to be vulnerable compared to Chipaya communities (Pukina speakers).

6.6.3.2Tobit estimations

This section seeks to estimate the determinants of vulnerability in rural Bolivia by using the tobit model. Table 7 shows the main results of applying the methodology specified in Section 6 and 6.6.1 and presents the parameter estimates of the tobit regression model for the determinants of vulnerability in Bolivia.

As shown in Table 7, the level of education seems to be an important determinant of vulnerability with the marginal effect significant at 1 per cent in the region as a whole and the same level of significance in Potosi and Chuquisaca.

The number of years of schooling attended by the household head increases the welfare of the household and hence reduces the probability of becoming vulnerable. The reason is that education provides opportunities for generating higher income.

As discussed above, it seems that female-headed households do not appear to be at a disadvantage in the region as a whole, except in the case of rural Chuquisaca where the negative coefficient for female household head is significant at 5 per cent level. This indicates that female-headed households are better off and non-vulnerable compared to those headed

by a man, other things being equal. However, in Potosi significance at 1 per cent is the opposite with male-headed households better off than those headed by a woman.

Table 7
Determinants of vulnerability in rural areas of Bolivia (Tobit model)

Explanatory Variables	Overall	Rural La Paz	Rural Oruro	Rural Potosi	Rural Chuquisaca
Highest level of schooling attained					
Highest educational level	-0.0014***	-0.0005	-0.0008*	-0.0019***	-0.0030***
	(0.0002)	(0.0004)	(0.0005)	(0.0005)	(0.0005)
Socio-demographic characteristics					
Gender	0.0023	0.0070	-0.0005	0.0145***	-0.0103**
	(0.0025)	(0.0046)	(0.0054)	(0.0053)	(0.0047)
Marital status	-0.0042*	-0.0167***	0.0030	-0.0087*	0.0023
	(0.0026)	(0.0049)	(0.0054)	(0.0052)	(0.0051)
Age of the head of the HH	-0.0001	0.0000	-0.0002	-0.0005	-0.0001
	(0.0004)	(0.0008)	(0.0007)	(0.0007)	(0.0008)
Age squared	8.1E-07	-3.1E-06	4.5E-06	6.5E-06	-1.2E-06
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Household size	0.0009	0.0038	0.0007	0.0001	-0.0023
	(0.0014)	(0.0029)	(0.0026)	(0.0026)	(0.0030)
Household size squared	-0.0003***	-0.0004*	-0.0003	-0.0003*	0.0001
	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Proportion of HH aged < 15	-0.0002	-0.0005	-0.0003	0.0012	-0.0013
	(0.0007)	(0.0014)	(0.0013)	(0.0012)	(0.0013)
Proportion of HH aged > 65	-0.0014	0.0027	-0.0069***	0.0021	-0.0072**
	(0.0013)	(0.0025)	(0.0026)	(0.0026)	(0.0032)
Assets and other characteristics					
Land size	-0.0006	-0.0027***	0.0007	-0.0007	-0.0010
	(0.0005)	(0.0011)	(0.0010)	(0.0009)	(0.0011)
Total livestock assets	-0.0012***	-0.0005	-0.0011***	-0.0013***	-0.0010***
	(0.0002)	(0.0004)	(0.0003)	(0.0003)	(0.0004)
Remoteness					
Remoteness - Hospital	0.0009**	0.0052***	0.0014	0.0011	0.0011
	(0.0008)	(0.0014)	(0.0018)	(0.0013)	(0.0019)
Remoteness - School	0.0019**	0.0051***	-0.0002	-0.0008	-0.0009
	(0.0010)	(0.0020)	(0.0018)	(0.0023)	(0.0023)
Remoteness - Market	0.0001**	0.0017**	-0.0006	0.0009	-0.0009
	(0.0005)	(0.0008)	(0.0011)	(0.0013)	(0.0007)
Location					
Rural Oruro	0.0043**				
	(0.0020)				
Rural Potosi	0.0054***				
	(0.0022)				
Rural Chuquisaca	-0.0026				
	(0.0026)				
Etnicity					
Ethnicity Aymara	-0.0024				
	(0.0035)				
Ethnicity Quechua	-0.0014				
	(0.0041)				
Ethnicity Aymara/Quechua	-0.0074*				
	(0.0042)				
_cons	0.0461***	0.0361*	0.0318**	0.0375**	0.0684***
	(0.0096)	(0.0195)	(0.0163)	(0.0162)	(0.0214)
Number of Observations	798	217	196	192	193
LR chi2 (20) (14) (14) (14) (14)	253.51	60.89	94.47	85.63	89.58
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R-squared	-0.0655	-0.0566	-0.1045	-0.0932	-0.0952

Source: Author's calculations

Notes:

a. Dependent variable: Vulnerable household = 1.

b. ***p < 0.001, **p<0.05, *p<0.1, indicate significance at the 1%, 5%, and 10% level.

c. Robust standard errors adjusted in parentheses.

Turning to marital status, in general both specifications (definition I and II of vulnerability) showed that that if the household head is married or cohabiting the household is less vulnerable with the marginal effect significant at 10 per cent (Table 7) for rural households as a whole; significant at 1 per cent for La Paz and at 10 per cent for Potosi. For other regions the variable remains non-significant.

Households with larger family size are less likely to be vulnerable because they can use some of the family labour for productive income generating activities. In addition, there may be synergies from larger household size, both in production and in consumption. Working in groups can be more productive through improved supervision, pooling of tools and experience, or higher motivation.

The quadratic term of the household size is significant for the region as a whole and in La Paz and Potosí as well. This result confirms a general finding in poverty literature that there may be economies of scale of household welfare derived from increasing household size.

In terms of old age dependency, it seems that in Oruro and in Chuquisaca older people are likely to be non-vulnerable, signifying that individuals continue to work productively beyond 65 years of age and earn.

It seems that land size for rural La Paz is significant at 1 per cent level signifying that households with a significant size of land assets are more likely to be less vulnerable since land size and its productivity is an important source of income.

Livestock ownership variables are mostly significant for the region as a whole, Oruro and Chuquisaca at 1 per cent significance level. The estimation results show that livestock is a very important asset for rural households and reduces the probability of being vulnerable. Thus, households with larger livestock assets are less likely to be extremely poor and vulnerable.

The Oruro region has a 0.43 per cent (significant at 5 per cent) probability of being vulnerable compared to La Paz. Rural areas in Potosi have 0.54 per cent (significant at 1 per cent) probability of becoming vulnerable compared to rural households in La Paz. The result is in line with the poverty indices and supports past studies. The rural regions of Potosi and Oruro are the poorest and most vulnerable because of poor infrastructure, less resource endowments and low level of human capital.

Finally, the analysis indicated that in rural Bolivia, Aymara/Quechua households (significant at 10 per cent) are less vulnerable, compared to Chipaya communities.

7. Summary and conclusions

Bolivia is a county characterized by a high incidence of poverty, vulnerability and inadequate social risk management; rural households face risks of suffering from different types of covariate and idiosyncratic shocks, especially in the highland and central valley region. The analysis shows that 66 per cent of extremely poor households have experienced decline in the level of welfare between 2004 and 2005. These households are an extremely vulnerable group. According to the results, no other developing country in Latin America has such a vulnerable group.

Households in rural Bolivia are highly vulnerable and suffer from acute and extreme poverty, especially in rural areas of the highlands and the valleys of the country. Furthermore, and according to this study data, the shocks triggering the decline of welfare are mainly droughts, frost and floods among others.

The limited assets of the indigenous poor, in the regions where the data was collected, makes them particularly vulnerable to the impact of adverse shocks as they lack the means to be able to cope with them.

In terms of gender, 71.56 per cent of the female-headed households are vulnerable. This figure is higher by 6.39 per cent than in the case of male-headed households, suggesting, first, gender differences in terms of welfare and, second, in rural areas females are more likely to be vulnerable than males.

In general, rural areas in Oruro and Chuquisaca are among the most vulnerable. In the other regions, including La Paz and Potosi, on average 63 per cent are likely to be vulnerable. Not only are they vulnerable because of fall in consumption but also because of isolation, remoteness, low level of infrastructure and poor living conditions of the indigenous population.

The rural poor live in desperate conditions. Only 17 per cent of the indigenous population in the study area has access to electricity. The main source of lighting in rural areas is kerosene with 75 per cent of the people using this source and 77 per cent of them are vulnerable. Straw is the most common roofing material of the rural poor, accounting for 54 per cent of sampled households (55 per cent vulnerable). In general all of the households lived in structures with walls made of natural materials – basically straw and mud.

As expected, expenditure distribution among the indigenous extremely poor across expenditure quintiles is balanced and almost uniform across rural expenditure quintiles, showing low relative variation of welfare.

The indigenous poor continue to have fewer years of education. For instance under primary was the most common level of education of the rural poor, accounting for 49 per cent of sampled households (where 52 per cent are vulnerable), and in the first two quintiles 69 per cent of the households have low levels of education (under primary or no formal education).

The analysis reveals that there is a large number of households that are affected by shocks. In the case of harvest failure and its related impact, 100 per cent of the households over reported to have been affected, and the most recent shock was reported when the survey were conducted in 2004.

It seems that the extremely poor in rural Bolivia are not able to protect themselves against natural shocks and are very exposed to droughts, floods and frost.

These shocks caused loss of production of potatoes, which is the main staple food (potatoes provide important caloric consumption for the people of the Andean region), death of cattle, livestock diseases and food shortages among others. The loss in production is concentrated in communities of Oruro and Potosi.

In the case of oxen and livestock, diseases affected essentially llamas, goats and sheep. Deaths due to drought and distress sales due to drought were also very common.

Empirical analyses using a Probit and Tobit models show that a higher level of education attained by the household head increases the welfare of the household and hence reduces the probability of becoming vulnerable.

It was also found that if the household head being is married or cohabiting, the household is less vulnerable in the case of rural households as a whole and for La Paz. For other regions the variable remained non-significant.

In Bolivia, poor indigenous farmers play an important role as producers and providers of food and nutritional security for the household. Women play an especially significant role in household welfare as homemakers and as managers of natural resources.

However, most of the rural farmers in La Paz, Oruro, Potosi and Chuquisaca do not have land entitlements and equal access to land and property. It is found that households with land entitlements are less likely to be vulnerable in the region as a whole as well as in in La Paz and Potosi.

Livestock ownership variables are most significant for La Paz and Chuquisaca; the Probit and Tobit analyses show that households with higher livestock assets are less vulnerable. Hence, livestock ownership may increase a household's welfare, income or consumption through the sale or consumption of animals and animal products. Consequently households that experienced a shock are mostly at risk and more likely to be vulnerable if they have a small number of livestock.
A household with its member migrating is less likely to experience a decline in its welfare and is less likely to be vulnerable. Finally, the ethnic groups speaking Aymara and Quechua are less likely to be vulnerable compared to Chipaya communities (Pukina speakers).

8. Policy implications

A poverty and vulnerability reduction strategy should take into account building up assets for the poor. Social protection and social risk management programmes play an important role in building assets for the poor.

Considering that the main shocks that affect rural communities are related with harvest failures (mainly droughts, frost and floods among others), it is important to improve the weather forecast and early warning systems.

As Dercon (2001 p 55) argues, policies to reduce vulnerability will include standard poverty reduction policies aimed at improving levels and trends in well-being, but will need to be supplemented with policies focusing on risk and on fluctuations in well-being, such as those related to seasonality. These additional policies should address or compensate for imperfections in insurance and in consumer credit markets.

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