Improving the understanding of individual and household characteristics in the analysis of poverty in Bolivia

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University of the Basque Country UPV/EHU- Master in Economics:

Empirical Applications and Policies

2021/22

Abstract

This thesis aims to determine to what extent differences in individual and household characteristics within the same country affect the poverty of different areas of Bolivia or different social groups. The analysis is divided into two blocks; unidimensional poverty analysis where we focus on income and multidimensional poverty analysis focusing on other household characteristics. We find that when the head of the households are women, educated, living in an urban area, not belonging to the indigenous ethnicity, living in the department of Santa Cruz, single, employed and in a unipersonal household are less likely to be unidimensional poor. And for the multidimensional headcount ratio (H) we get that more than half of the population is multidimensional poor (having more than 25% of deprivations). Also, on average the multidimensional poor are deprived in almost 40% of deprivations (A).

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1 Introduction

In the present study we conduct an analysis on unidimensional and multidimensional poverty in Bolivia for 2019. Specific individual characteristics as well as household properties are taken into account for the mentioned analysis. We have opted for this year because it is the last one we could select due to availability in the dataset. And for the realization of the whole study we use data from INE Bolivia, which is publicly available. The main objective of the study is to understand how differences in individual and household characteristics within the same country affect the poverty of different areas of Bolivia or different social groups in a different way.

The concept of poverty has been one of the most studied topics over time due to the problem it represents for our society today, which is becoming more and more severe and it shows in the determination of the sustainable development goals (SDGs) where the reduction of the poverty is the first SDG. The revision of the measurement of poverty done by *Dominguez & Caraballo (2006)* mentioned studies done long ago related to poverty defining poverty by "a lack of those necessities which the custom of a country makes it indecent for both the well-to-do and the lower class to lack." *Smith (1776).* We can find a similar definition of poverty along all the literature regarding poverty, "an insufficiency of necessaries" or "an insufficient supply of those things which are requisite for an individual to maintain himself and those dependent upon him in health and vigour" *Godard (1892).*

However, the concept of poverty measurement as such was not introduced until late 19th century or 20th century. One of the first studies that attempted to make some sort of poverty measurement was done by combining sociology, urban studies, public administration, policy research, social surveys, demography and geography of the city of London *Booth (1892–1897)* "gathering and mapping living conditions" *Fearon,(2001).* Furthermore following *Sen (1976a)*, we have that poverty measurement analysis involves two distinct intertwined exercises. On the one hand, the identification of the poor using income as the sole attribute of welfare and specifying a "poverty line". And on the other hand, the aggregation of the existing information on the poor into a general indicator of poverty.

For the case of our thesis, we focus on relative measurement. This approach uses "current data to generate the poverty threshold with some notion of a standard of living for the income distribution, such as the mean, median, or some other quantile defining the cut-off as some percentage of this standard" *Foster (1998).*

We will also dive into a poverty analysis that measures poverty itself in more depth, multidimensional poverty. Recently, *Alkire & Foster (2011*) introduced an identification method that expands on conventional intersection and union approaches, and a class of poverty measures, which employs two forms of cut-offs: one within each dimension to assess whether a person is deprived in that dimension, and a second across dimensions that identifies the poor by "counting" the dimensions in which a person is deprived. As we will explain in more detail later, this concept is a branch of poverty analysis, taking into account different dimensions, such as the materials in a household or the assets that a family possesses. And this is where the deprivations that define a multidimensional poor person are drawn from.

But why is the reason behind looking at poverty from a multidimensional view? There are two approaches following *Chakravarty (2009)* that could clarify this. The basic-needs approach that defines poverty as the lack of basic needs, so poverty is in fact intrinsically multidimensional from this standpoint. Studies of both *Beccaria and Minujin (1985)* and *Kaztman (1989)*, who proposed an "integrated method" that crosses the UBN (Basic Needs) poor with the income poor in a contingency table, also called the two-dimensional method would be a part of this basic-needs approach. In addition the contribution of *Boltvinik (1992)*, of food poverty, did a good job concluding that the "distinction between the human need for food, from which the distinctions between food poverty and poor nutrition are derived". As for the second approach, the capability functioning approach, poverty is considered as a problem of capability failure. *Sen (1999)* explained that there are distinct types of freedom that helps to the general capability of functioning's of an individual and therefore capability failure captures the concept that is poverty. This approach focuses beyond the incapacity to own the highest income, but rather on the failure of obtaining a broad range of characteristics linked to living standards, like "education, access to health services, access to social security, shelter characteristics, access to basic services, access to food, and level of social cohesion" with the main goal of the study was to provide appropriate answers to questions arising from the identification (who is poor?) and aggregation (how much poverty is there?) *Foster, J. E. (2008)*.

The thesis is structured as follows. First we present in *section 2* we introduce the methodology used for the analysis of both unidimensional poverty and multidimensional poverty. In *section 3*, we present the data used for the two analysis of poverty as well as some descriptive statistics the population of households and individuals that we have in our data set of Bolivia in 2019. In *section 3.1*, the unidimensional poverty analysis focus on the FGT indices, TIP curves and some regressions in order to explain individual characteristics and the relation with poverty. And the second part, *section 3.2*, focusing on presenting both the multidimensional headcount and the adjusted headcount ratio (M_0) with some explanations done with the help of some curves that we compute. Finally *section 4* concludes the study.

2 Methodology

Regarding the methodology used in the study, we divide it into two blocks; the first one about the measurement of unidimensional poverty, and the second one being about the measurement of multidimensional poverty.

2.1 Unidimensional poverty

2.1.1. Indices and TIP curves

About the measurement of unidimensional poverty we start by with the Foster-Greer-Thorbecke index (hereinafter FGT index) *Foster et al. (1984)* and taking into account values of $\alpha \geq 0$ we have the following;

$$FGT_\alpha(y,z) = \frac{1}{N}\sum_{i=1}^{q}\left(\frac{z-y_i}{z}\right)^\alpha \qquad (1)$$

,where y_i the per capita income of the individuals, z would be the poverty line; $y = (y_1, y_2, \ldots, y_N)$ is a vector of per capita income; N the population size; $\max\{(z-y_i)/z, 0\}$ is the relative poverty gap of individual i and q is the number of poor individuals. It is important to mention that in order to compute the index, the population needs to be sorted in a non-decreasing way, that is $y_1 \leq y_2 \leq \cdots \leq y_N$. Then, the population of the poor is defined as $y_p = (y_1, y_2, \ldots, y_q)$.

This model weights by α which quantifies how unequal the segment of the poor is, but since the value of α is not predetermined, it can take on several values. The measure FGT_0 is simply the headcount ratio H, that is, the fraction of the population that lives below the poverty line, the proportion of poor individuals that only captures the incidence of the poor because it only takes into account the proportion and not how far the poverty gaps from the poverty line are. When $\alpha = 1$, we would get the FGT_1, which represents the average normalised poverty gap that captures the incidence and intensity of the poor, which shows the size of the income gap per individual in a given population, treating large and small poverty gaps in an equal way, and hence does not account for inequality amongst the poor. However, when $\alpha = 2$ we have FGT_2, which is the poverty severity index that describes the distribution of expenditure among poor people capturing the incidence, intensity and inequality of the poor putting more weight in those with higher income gap. We could say that the parameter α is a "measure of poverty aversion, which gives

greater emphasis to the poorest poor for higher α values" *Foster et al. (1984)*. This is, it gives more weight and importance the poorer the individual is.

In order to make the results on poverty analysis more robust and to have conclusive results for different alpha values, there are TIP curves (Three 'I's of poverty) *Jenkins & Lambert (1997)*, which make reference to the mentioned incidence, intensity and inequality of poverty. They are similar to the Lorenz curve in the poverty field and play a similar role giving robust and unambiguous results, meaning that the results shown by these curves should be on a par with other methods of measuring poverty, such as indices. If the TIP for a society lies above the TIP for another society then for any poverty index based on poverty gaps, the poverty level in the former society is higher than in the latter one

Figure 1 shows the TIP curve, it is obtained by ranking people from poorest to richest, cumulating their poverty gaps (or normalised poverty gaps), and plotting them. The incidence aspect of poverty is summarised by the length of the TIP curve's non-horizontal section, where we can also see the headcount ratio "*h*" that can be observed when the curve becomes completely horizontal. At this point, when the curve is totally horizontal, it means that we are accumulating the rich individuals, since the poverty gaps of the non-poor are equal to zero. The intensity dimension of poverty is summarised by the height of the TIP curve, which is the aggregate poverty gap averaged across all income-receiving units. And the inequality dimension of poverty is summarised by the degree of concavity of the non-horizontal section of the TIP curve. This is, if all poor individuals were to have equal incomes, their poverty gaps (z) would be equal and the curve would be a straight line with the slope being equal to the subtract between the poverty gap and the average income among the poor.

Let us define maximum poverty as the situation in which "each person in the population has zero income and thus a poverty gap of z, in which case the TIP curve is a straight line from the origin with slope z (and vertical intercept z at p=1)" *Jenkins & Lambert (1997)*. On the other end, when no person is poor, the TIP curve coincides with the horizontal axis.
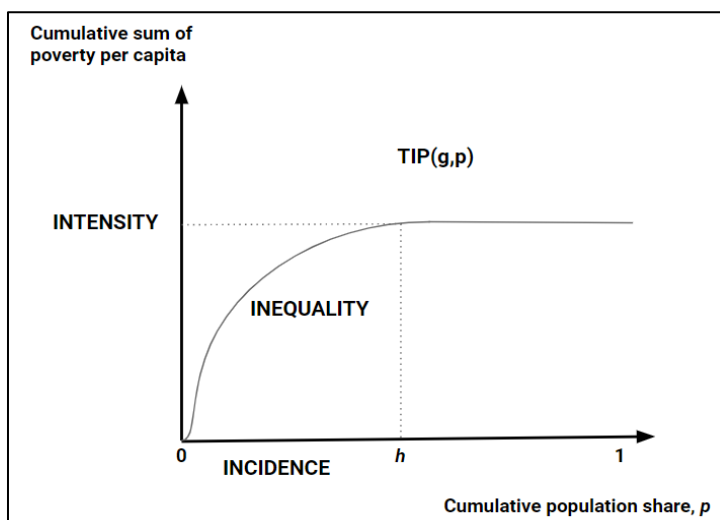

Figure 1: The TIP curves of Jenkins & Lambert (1997)

Following a similar line of research, we can extend the analysis of poverty measurement by focusing on further research on the incidence, intensity and inequality of the dimensions of poverty by ethnicity, departments and area of living of the individuals.

2.1.2. Regressions

When further analyzing the measurement of poverty, it would be useful to be able to identify the socioeconomic characteristics that determine the poverty status of a particular individual. Therefore, following the previous study by *Kyzyma (2020),* we will consider three different estimates to make the differentiation and identification of the observed covariates or individual characteristics that have been shown to be important predictors of poverty status. We make use of OLS with and without department fixed effects and also we compute a Logit estimation with department fixed effects to account for the probability of being poor. For the estimations we only take into account information on the variables referencing the head of the family, that overall represent the whole household. Department fixed effects are introduce in order to control for heterogeneity between the departments of Bolivia and to also consider omitted variable bias that could be present in the regression driven by the correlation of department-specific characteristics with individual or household/individual attributes according to the following equation.

$$pg_{ih} = \beta_0 + \beta X_{ih} + \varepsilon_{ih} \qquad (2)$$

To determine the degree to in which the interaction between individual characteristics and the size of poverty gaps differs across departments we estimate equation (2) above (without departmental fixed effects). Where pg_{ih} is the dependant variable representing the poverty gap of the individuals/ households; X_{ih} is a set of observed individual and household characteristics including the overall departments; β_0 is the constant of the estimation; β is a vector of parameters associated with X_{ih}; $\varepsilon_{ih} = u_i + \mu_h$ is the error term related to the individuals (head of the family) and households.

$$pg_{ihdep} = \beta_0 + \beta X_{ihdep} + \eta_{dep} + \varepsilon_{ihdep} \qquad (3)$$

Where X_{ihdep} is the set of observed individual and household characteristics taking into account department fixed effects; β_0 is the constant of the estimation; $\eta_{dep} = \sum_{dep=1}^{9} \gamma_{dep} D_{dep} = \gamma_1 D_1 + \cdots + \gamma_9 D_9$ is the vector of department fixed effects with $\gamma_{dep} D_{dep}$ being the variables accounting for the department dummies; $\varepsilon_{idep} = u_{idep} + \mu_{hdep}$ is the error term related to the individuals (head of the family) and households taking into account department fixed effects. OLS assures that the "sum of squared

predicted errors is minimized so that the error term has zero mean and with the important assumption that the characteristics to which they refer are exogenous, i.e., uncorrelated with the individual-specific error terms we would have a causal interpretation of the β parameters" *Kyzyma (2020)*. Since the design that we followed cannot guarantee that the unobserved characteristics of individuals do not interact with the observed characteristics included in the model according to Kyzyma itself, the estimates of β from equation (3) should also be interpreted in a non-causal way.

As for the logit estimation, we have the same equation as the one before but we estimate the following component that represents the cumulative distribution function (*cdf*) $\Lambda(\varepsilon) = \frac{exp(\varepsilon_{ihdep})}{1+exp(\varepsilon_{ihdep})}$

$$\text{Pr}(pg_{ihdep}) = \Lambda\big(\beta_0 + \beta X_{ihdep} + \eta_j\big) \qquad\qquad \textbf{(4)}$$

2.2. Multidimensional poverty

When measuring multidimensional poverty, the starting point of the process of analysis is to apply a counting poverty index, identifying this way the poor individuals. This identification step is usually done using two cut-offs. The first cut-off concerns the identification of the deprived individuals within each variable. The second cut-off establishes the minimum number of weighted deprived variables required for an individual to be considered a poor person. Therefore, a person is identified as poor if it is deprived in at least a given number of variables, a dual cut-off identification (*Alkire and Foster, 2011*).

When we get the poor individuals identified, we follow the counting approach, which is a methodology, which deals with dichotomous, ordinal and categorical variables focusing on the number of weighted variables in which an individual is deprived. For the variables, they take value 1 for the deprived households and 0 for the not deprived ones. Then, the variable value of each individual i is identified by a deprivation vector $g_i \in \{0, 1\}^k$, that is $g_i = (g_{i1}, g_{i2}, ..., g_{iD})$, where $g_{ij} = 1$ when individual i is deprived in attribute j and $g_{ij} = 0$ otherwise. Now let us define $w = (w_1, ..., w_D)$, where $\sum_j w_j = 1$. Furthermore we denote the poverty score of individual i, c_i, as the weighted sum of the dimensions in which person i is deprived, that is, $c_i = \sum_{j=1}^{D} w_j g_{ij}$; with D being the set of all admissible scores for c_i. Overall D is a discrete subset of [0, 1]. The value 0 corresponds to an individual who is non-deprived in any dimension and the value 1 is obtained when the person is deprived in all the dimensions.

The second step in measuring counting poverty is to identify the poor people. We may establish a cut-off in the number of variables k where $0 < k \leq 1$. Then, a person is identified as poor if the number of dimensions in which they are deprived is at least k, $c_i \geq k$, and non-poor otherwise, $c_i < k$.

To go further with the analysis, we introduce a poverty cut-off, which following the advice of *Santos & Villatoro (2018)* should be $k = 25\%$, accounting for the quarter of the total weighted parameters. Therefore in order to be labelled as a poor individual, the person needs to be deprived in a whole variable equivalent of a full dimension of housing, basic services, health care, living standard or education, plus some other parameter. This way, we can determine the multidimensional poor.

Now, with $k = 25\%$ defined, we create all the variables, but now taking into account the poverty cut-off in order to compute the multidimensional headcount ratio (H), the adjusted multidimensional headcount ratio (M_0) and the dimension of poverty (A) indices defined by *Alkire and Foster (2011)*. First we define the identification function $\rho_i^k(c_i)$ that has value 1 when the individual i with the vector of deprivations c_i is identified as poor, given the deprivation cut-off and the poverty cut-off k. We define also $c_i(k) = 1$ when $c_i \geq 0$ and $c_i(k) = 0$ otherwise.

Then, the multidimensional Headcount ratio is defines as follows:

$$H = \frac{1}{N}\sum_{i=1}^{N} \rho_i^k(c_i) = \frac{q}{N} \tag{5}$$

Where q is the number of poor individuals, and N the population size. The multidimensional headcount ratio only does a measurement of the incidence of poverty in the whole population. However, it "does not have the desirable property of increasing when a poor person becomes deprived in a new dimension" *Pacifico & Poege (2017)*. Therefore, we define the adjusted multidimensional headcount ratio (M_0) and the dimension of poverty (A):

$$A = \frac{1}{q}\sum_{i=1}^{N} c_i(k) \tag{6}$$

$$M_0 = H \cdot A = \frac{1}{N}\sum_{i=1}^{N} c_i(k) \tag{7}$$

A represents the ratio between the weighted sum of the deprived individuals by the number of poor individuals. The adjusted multidimensional headcount ratio (MPI) or (M_0) is the product of the multidimensional headcount ratio (*H*) by the dimension of poverty (*A*).

3 Data and Empirical applications: results

For the present study, we use data from the National Institute of Statistics (INE) and entities of the system of the official statistics of the Plurinational State of Bolivia" for the year 2019. We use microdata from the ANDA Catalogue (Central Data and Microdata Catalogue).

DATA FILES	OBSERVATIONS	VARIABLES	ANALYSIS
EH2019_INDIVIDUAL	39605	423	Unidimensional Poverty
EH2019_HOUSING	11869	67	Multidimensional Poverty
EH2019_EQUIPMENT	178035	11	Multidimensional Poverty
EH2019_FOOD SECURITY	11869	39	Multidimensional Poverty

Table 1: Description of the data base

Table 1 shows a description of the data base with the specific data files we will work with for the study and the particular use we will make of them (either poverty analysis or multidimensional poverty analysis). Individual data file contains information about the individual itself, housing data about characteristics of the household, equipment data about the goods that the household own and finally the food security data about the possible malnutrition of the household.
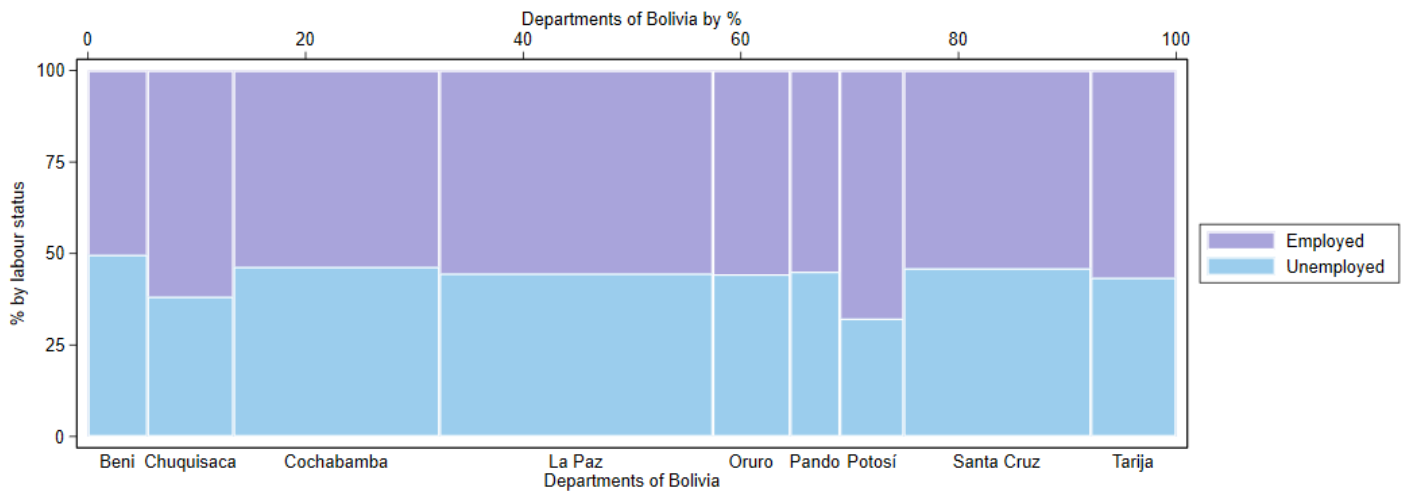

Figure 2: Distribution of departments by labour status

Area of living	Labour status			Ethnicity	Labour status		
	Unemployed	Employed	Total		Unemployed	Employed	Total
Rural	2174	5373	7547	Indigenous	2711	6072	8783
	28.81	71.19	100.00		30.87	69.13	100.00
Urban	12909	13746	26655	Not indigenous	12331	12997	25328
	48.43	51.57	100.00		48.69	51.31	100.00
				Not Bolivian	41	50	91
	15083	19119	34202		45.05	54.95	100.00
Total				Total	15083	19119	34202
	44.10	55.90	100.00		44.10	55.90	100.00

Table 2: Distribution of area of living and ethnicity by labour status

For a better understanding of the data and population of Bolivia, *Table 2* shows the distribution of the departments by labour status (taken from variable that considers people who during the week prior to the day of the survey, worked at least one hour in some economic activity, considering also people who during a period of time are temporarily not working due to vacations, leave or lack of materials). Employment is one of the most widely used characteristics to get an overall picture of the situation of a country. In the case of Bolivia we can observe that the biggest departments in terms of population are Cochabamba (6.220 million US$ of the GDP), La Paz (11.586 million US$ of the GDP) and Santa Cruz (12.185 million US$ of the GDP), which make sense because they were the biggest economic hubs in Bolivia accounting for more than 70% of the total GDP in 2019 which was 41.193 million US$ according to data from the INE. As for the percentage of employment, we get that it is pretty balance among all departments, except for Chuquisaca and Potosí where there are more individuals employed relative to their population.

With respect to the area of living, the most populated one is the urban area, accounting for 77.93% of the whole population, with 51.57% of individuals being employed. As for the rural area, 71.19% of the population living this area is considered as employed. For the ethnicity in Bolivia, 25% of the population in the data base is considered ad indigenous, with 69% of them being employed. The non-indigenous individuals account for the 74% of the whole population with more than 50% of them being employed, and lastly we have the non-Bolivian individuals accounting for only the 0.2% of the population with more than its half being employed.

3.1 Unidimensional poverty

Table 3 shows a description of the most relevant variables of the analysis. We can see that the database itself provides us with many variables related to poverty and extreme poverty, such as the poverty line, income poverty, income poverty gap and the magnitude of income poverty, very helpful in the posterior analysis of poverty and multidimensional poverty. Overall they are representing a population of 11.533.266 individuals in the year 2019.

VARIABLE	OBS	MEAN	STD. DV	MIN	MAX	VARIABLE LABEL
ID	39,605					Identification of the household
FACTOR	39,605	291.20	219.53	23.86	2181.60	Probability of selection that each individual has in a sample
DEPTO	39,605	4.92	2.39	1	9	Departments of Bolivia
AREA	39,605	1.77	0.41	1	2	Area of living
NRO	39,605	2.63	1.61	1	15	Number of the head of the household
GENDER	39,605	1.51	0.50	0	1	Gender of the individual
AGE	39,605	29.69	21.06	0	98	Age of the individual
YHOG	39,565	5,380	4,298	0	69,154	Household earnings per capita
Z	39,605					Poverty line
P0	39,565	0.37	0.48	0	1	Income poverty
P1	39,565	0.14	0.24	0	1	Income poverty gap
P2	39,565	0.08	0.17	0	1	Magnitude of poverty
LAB_STATUS	34,236	0.56	0.49	0	1	Labour status during the period asked
ETHN	39,565	1.76	0.43	1	3	Ethnicity of the individual
NIV_ED	39,565	5.47	2.17	1	8	Level of education
MRT_STATUS	39,565	2.60	1.19	1	6	Marital status
TIPOHOGAR	39,565	4.41	1.36	1	7	Type of household

Table 3: Description of the variables for the unidimensional poverty analysis

3.1.1 FGT indices and TIP curves

Therefore, with this information in mind, we proceed with the empirical results of the unidimensional poverty, starting with the analysis of the FGT indices.

Indices		FGT0	FGT1	FGT2
	Beni	0.37	0.13	0.08
	Chuquisaca	0.54	0.24	0.15
	Cochabamba	0.41	0.15	0.08
	La Paz	0.43	0.17	0.09
Departments	Oruro	0.35	0.14	0.08
	Pando	0.31	0.11	0.05
	Potosí	0.46	0.21	0.12
	Santa Cruz	0.25	0.08	0.04
	Tarija	0.38	0.14	0.07
Area	Rural	0.51	0.24	0.15
	Urban	0.31	0.10	0.05
	Indigenous	0.46	0.19	0.11
Ethnicity	Not indigenous	0.34	0.13	0.07
	Not Bolivian	0.16	0.05	0.03

Table 4: FGT indices by departments

Table 4 shows all three FGT indices by the nine departments of Bolivia, area of living and the ethnicity of the individuals. When looking at FGT_0, which is basically the proportion of the poor individuals (headcount ratio) as mentioned previously, we observe in *Figure 3* that for the departments of Bolivia, the values of the headcount ratio for all departments are relatively high, with Chuquisaca being the highest value among them, followed closely by Potosi. On the other side we have Santa Cruz, with the lowest proportion of poor individuals. In the case of the area of living, the rural area has by far a higher value of the headcount ratio. And the same happens if the ethnicity of the individual is indigenous, the proportion of the poor individuals for this ethnicity is far more high that for the not indigenous or the non-Bolivian. As for the average normalised poverty gap (FGT_1) and the poverty severity index (FGT_2), they follow the same positioning as the headcount ratio for the departments, area of living and ethnicity. Therefore, departments, area of living and ethnicity of the individuals with low/high poverty rates for the incidence of poverty also have relatively low measures of the intensity and inequality of poverty and the other way around.
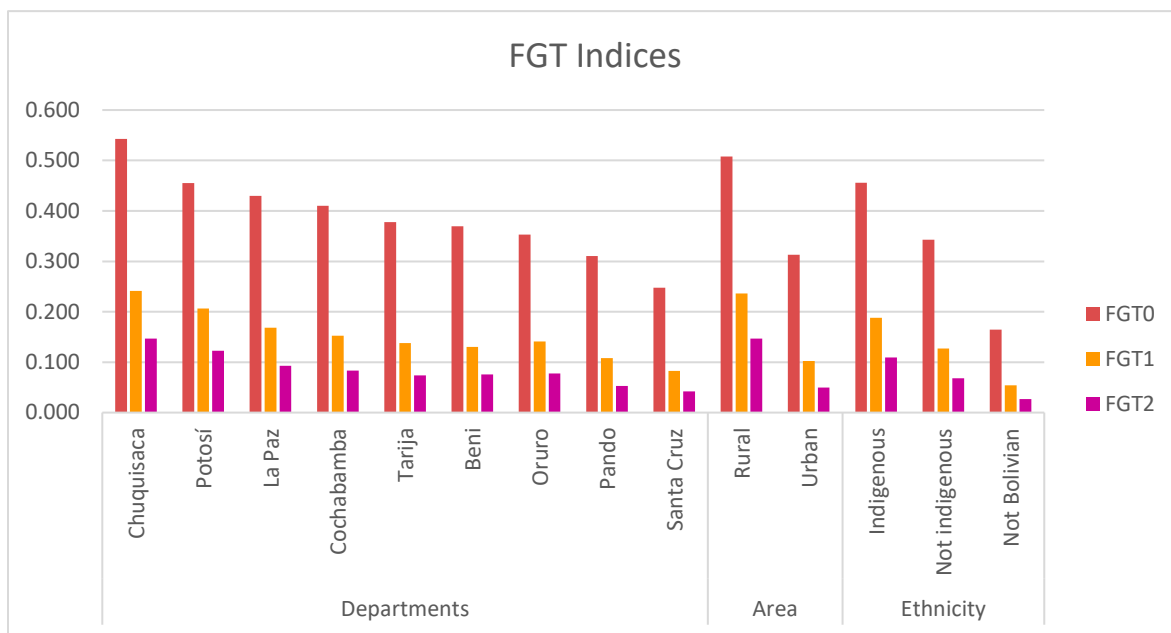
Figure 3: FGT indices by departments, area and ethnicity

To go further with the analysis of the incidence, intensity and inequality of poverty we presented the "TIP curves" *Jenkins & Lambert (1997)* that takes into account these three concepts of poverty and plots it accumulating the poverty gap of the individuals from the poorest to the not so poor, in our case we have compute different curves taking into consideration the departments, area of living and the ethnicity of the individuals. In terms of departments, in *Figure 4* we can observe that for most departments the curves cross each other, meaning that we cannot state anything about poverty relating the crossing curves. However, if we take into consideration a particular inflexion point in the percentile population; we can claim some statements for the analysis of poverty for some departments. Chuquisaca is the poorest department in Bolivia, followed by Potosí, where at the point where the curves become completely horizontal we observe the incidence rate (*h*) previously shown in *Figure 3*, which follows the same results we obtained in the curves, with Chuquisaca and Potosí being the departments with the highest incidence. On the other side we have Santa Cruz being the least poor department. A statement quite consistent with the importance of Santa Cruz being the first economic power among the departments. As for the other two economic hubs of Bolivia previously mentioned; Cochabamba and La Paz, taking into consideration the inflexion point of almost 0.2, we get that they are the following departments of Chuquisaca and Potosí in terms of poverty, even though their contribution to the economy is way larger than most departments.
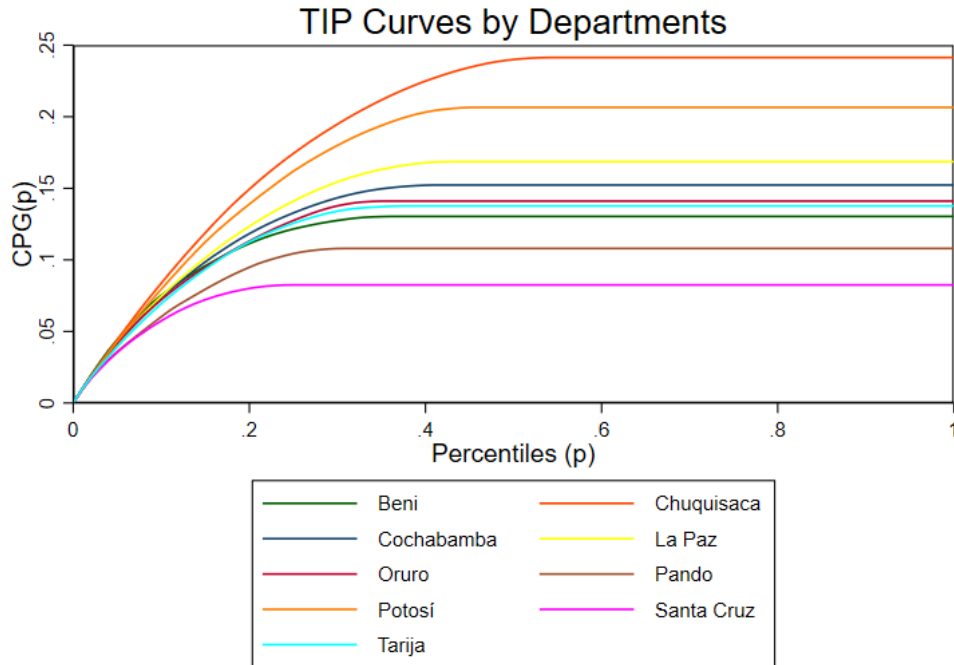
Figure 4: TIP Curves by departments
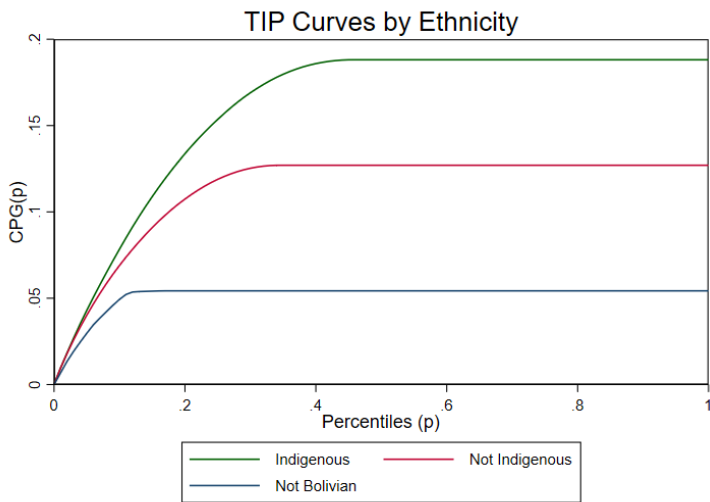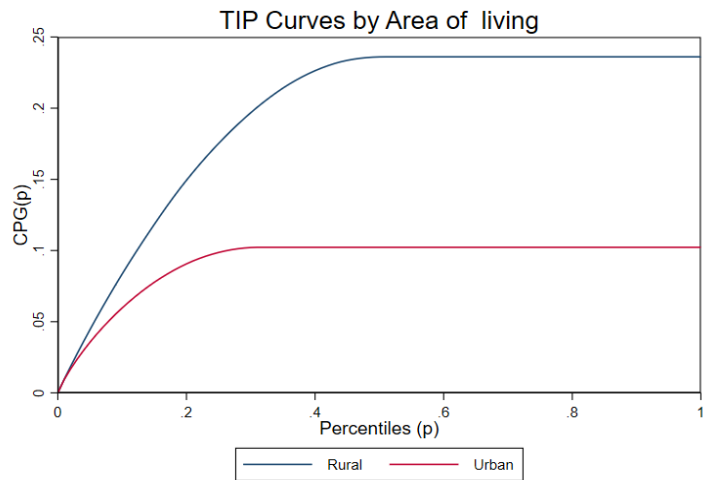

Figure 5: TIP Curves by ethnicity

Figure 6: TIP Curves by area of living

With respect to the ethnicity, we observe in *Figure 5* that the indigenous individuals compared to both the not indigenous and not Bolivian ones, have higher level of poverty regardless of the poverty index based on poverty gaps used, accounting for a higher amount of poor individuals. Regarding to the

area of living of the individuals shown in *Figure 6*, the poorest area would be the rural area, accounting for a higher incidence, intensity and inequality compared to the urban one.

3.1.2 Regressions

For the identification of the socioeconomic characteristics that determine the poverty status of a particular individual (considering as the individual the head of the family), which overall also represents its respective household, we take into account the previously presented variables in *Table 3* but for the head of the family (*hh*), and estimate the following estimations shown in *Table 5*.

VARIABLES	OLS (1)	OLS (2)	Logit (3)
age_hh	+0.00280***	+0.00312***	+0.0105
	(0.000604)	(0.000597)	(0.00665)
age_sq_hh	-5.14e-05***	-5.46e-05***	-0.000350***
	(6.03e-06)	(5.98e-06)	(6.92e-05)
Departments_hh (reference Beni)			
Chuquisaca_hh	—	+0.0687***	+0.562***
		(0.00816)	(0.0712)
Cochabamba_hh	—	+0.0140**	+0.183***
		(0.00635)	(0.0609)
LaPaz_hh	—	+0.0465***	+0.439***
		(0.00665)	(0.0603)
Oruro_hh	—	+0.0229***	+0.169**
		(0.00711)	(0.0704)
Pando_hh	—	-0.0401***	-0.354***
		(0.00718)	(0.0766)
Potosí_hh	—	+0.0364***	+0.186**
		(0.00830)	(0.0741)
Santa Cruz_hh	—	-0.0377***	-0.523***
		(0.00577)	(0.0596)
Tarija_hh	—	-0.00756	-0.0516
		(0.00781)	(0.0743)
Area of living_hh (reference Rural)			
Urban_hh	-0.0970***	-0.0897***	-0.392***
	(0.00450)	(0.00455)	(0.0385)
Gender_hh (reference Male)			
Women_hh	-0.0202***	-0.0205***	-0.0860*
	(0.00403)	(0.00400)	(0.0447)
Ethnicity_hh (reference Indigenous)			
Not_indigenous_hh	-0.0185***	-0.00789**	-0.140***
	(0.00353)	(0.00372)	(0.0323)
Not Bolivian_hh	-0.106***	-0.0779***	-1.239***
	(0.0149)	(0.0144)	(0.310)

Type of household_hh (reference Unipersonal household)			
Compound_household_hh	0.258***	0.265***	2.070***
	(0.0450)	(0.0457)	(0.275)
Extended household_hh	0.111***	0.112***	1.412***
	(0.00647)	(0.00652)	(0.0960)
Single parent household_hh	0.0897***	0.0895***	1.054***
	(0.00629)	(0.00631)	(0.0938)
Full-nuclear_hh	0.105***	0.103***	1.387***
	(0.00707)	(0.00712)	(0.0982)
Other_hh	0.0501***	0.0488***	0.743***
	(0.00826)	(0.00824)	(0.117)
Couple-nuclear_hh	0.0283***	0.0279***	0.553***
	(0.00791)	(0.00796)	(0.114)
Education_hh (reference no education)			
Other _hh	-0.178***	-0.169***	-2.116***
	(0.0151)	*(0.0153)*	*(0.193)*
Complete-elementary_hh	-0.0926***	-0.0901***	-1.055***
	(0.0104)	*(0.0103)*	*(0.0907)*
Incomplete-elementary_hh	-0.0551***	-0.0523***	-0.729***
	(0.0101)	*(0.00999)*	*(0.0874)*
Complete-secondary_hh	-0.151***	-0.151***	-1.481***
	(0.0102)	*(0.0101)*	*(0.0910)*
Incomplete-secondary_hh	-0.126***	-0.122***	-1.235***
	(0.0102)	*(0.0101)*	*(0.0894)*
Superior_hh	-0.189***	-0.189***	-2.332***
	(0.00982)	*(0.00977)*	*(0.0906)*
Labour Status_hh (reference unemployed)			
Employed_hh	-0.0555***	-0.0591***	-0.377***
	(0.00509)	*(0.00506)*	*(0.0531)*
Marital status_hh (reference single)			
Married_hh	-0.0114*	-0.0158**	-0.106
	(0.00690)	*(0.00689)*	*(0.0773)*
Parther_hh	-0.0176**	-0.00938	+0.0446
	(0.00709)	*(0.00708)*	*(0.0792)*
Separated_hh	+0.0233***	+0.0222***	+0.362***
	(0.00750)	*(0.00744)*	*(0.0810)*
Divorced_hh	-0.000651	-0.00190	+0.0351
	(0.00889)	*(0.00890)*	*(0.113)*
Widow_hh	-0.0293***	-0.0380***	-0.255***
	(0.00692)	*(0.00694)*	*(0.0855)*
Departments_hh	-0.00967***		
	(0.000573)		
Constant	+0.621***	+0.550***	+2.679***
	(0.0479)	*(0.0489)*	*(0.326)*
Observations	39,565	39,565	39,565
R-squared	0.143	0.153	0.1201

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 5: OLS and Logit estimations

Table 5 shows the results of the three estimations previously explained; the first one OLS (1) which is an OLS estimation without taking into account department fixed effects, this is, we take into account all departments all together, but we do control for individual/household characteristics. We notice that the first column and second column reveal substantial differences in the estimates of the coefficients on the determinants of income poverty gaps. This implies that there is a significant connection between the observed characteristics of the poor and the specific department context (economic conditions, institutional characteristics, public policies), which must be taken into consideration when estimating the relationships between individual characteristics and the size of the poverty gaps in Bolivia. On the contrary, in terms of the sign, the two first estimations are consistent across all variables with the size of the coefficients varies for the most part, and the significance level only varies in the marital status.

In the second column of *Table 5*, we have the results of the OLS (2) estimation controlling for department fixed effects, as well as for other individual/household characteristics. For this first column we get almost all coefficients significant for all p values. Showing the values of the department fixed effect estimates, which with Beni as the department of reference, the only departments that are better off, are Santa Cruz and Pando, results that we have already seen in the FGT indices analysis and also in the TIP curves analysis. We follow with, the other characteristics being equal, the older the individual is, the larger poverty gaps they have compared to young individuals, but the positive effect of age in the poverty gaps decreases as individuals gets older and turns into a slight negative effect up to certain point, which makes sense because the older they get the more stable their income they have. Moreover, an individual living in an urban area decreases its income poverty gap by 0.0897 point compared to an individual living in a rural area, results that we have already saw in the previous results of the FGT indices and the TIP curves. For gender, even thought is a controversial variable to take into account due to the redundancy of taking into account the gender role of the head of the family, we get than being a woman decreases the income poverty gap by 0.0205 points compared to being male. This is maybe due to the relation between being a male head of the family and taking labour intensive works (mining for example) that on average are linked to more rural and poor areas. As for the ethnicity, we see that the individuals who are not indigenous or not Bolivian are better off than those who are indeed indigenous. This could be related to the connection of the indigenous individuals with the rural area of living. Furthermore, households which are nuclear couple households (comprised of the head of household and his/her spouse without children), single parent households (comprised of the head of household without spouse and children), full nuclear households (comprised of the head of household, spouse and children), extended households (made up of the nuclear household and other family members), compound households (comprised of the nuclear or

extended household plus other non-relatives (other non-relatives)) and other type of households are worse off than the unipersonal households, meaning that the financial helps that the Bolivia government could give to couples or to households with children are not relevant enough to not affect negatively the poverty status of the individuals. Regarding the education characteristics, we can state that the individuals with any type of education have smaller poverty gaps compared to the ones with no education. Furthermore, we can observe that the value of the coefficients are higher for the educations that are complete, this may be due to the acquisition of any type of legal paper that states the finishing of the grade. And the values for the superior educations and other type of educations (a master for example) are the highest value coefficients accounting for the decrease of the poverty gap. Concerning the labour status, as expected, employed individuals are significantly better off than the unemployed ones, as the lack of a salary is an important aspect affecting negatively the income poverty gap. Lastly we have the marital status, where we only have three variables with significance coefficients; and from one side we can state that an individual which is married or is widowed has lower poverty gap than a single person. This is somewhat contradictory to what was previously said of the type of household, however, we can observe that the most significant variable is the one about being a widow; this could be a unipersonal household but now with the benefits of the widow´s benefit from the government. From the other side Table 4 shows that being divorced increases the poverty gap compared to being single, which could be due to not being able dissolve the marriage bond, which means that the spouses cannot remarry.

In the last column, we would have the logit estimates for the probability of being poor with the department fixed effects, Logit (3) providing further interesting results, allowing the analysis to determine whether correlates of the size of poverty gaps include the same individual/household characteristics which are related with a higher probability of being poor. We observe that; older individuals, individuals living in Santa Cruz or Pando, those living in an urban area, women, individuals with an ethnicity of non-indigenous or not Bolivian, the ones with any type of education and those employed and widowed are, on average, less likely to be found among the poor than their counterparts (younger individuals, those living in Beni, the ones living in a rural area, men, indigenous, individuals with no education, unemployed and single). On the other side, we have individuals living in any department except for Santa Cruz and Pando, those in a household that is not a unipersonal household and individuals that are separated are more prone to poverty than their counterparts (individuals living in Beni, those with unipersonal household and single)

3.2 Multidimensional poverty

Moving on to the measurement of the multidimensional poverty, the first step to the analysis is to define the dimensions that we are going to take into account. In our case we follow the dimensions presented in the study of *Santos & Villatoro (2018)* which proposed 13 variables grouped into six dimensions; "housing", "basic services", "living standards", "education" and "employment and social protection". However, in our study add one more dimension, "Heath care" to the analysis following the advice of the authors that mentioned that "given the importance of health for wellbeing, improving data collection in this dimension should constitute a priority". For the creation of the 6th dimension we make use of the short survey modules in view of the development agenda post-2015 done by the Multidimensional Poverty Peer Network and the Oxford Poverty and Human Development Initiative (OPHI) (2014).

DIMENSIONS	VARIABLES	DEPRIVATION INDICATORS	WEIGHTS (%)
HOUSING			18.18
HOUSING MATERIALS (hs_1)	*Materials of construction of the household wall* *Materials of construction of the household´s roof* *Materials of construction of the household´s floor*	Households with dirt floor or precarious roof or wall materials (cane, palm, straw, other materials).	6.06
ROOMS IN THE HOUSEHOLD (hs_2)	*Average number of rooms used for sleeping*	Households with less average rooms than the overall average	6.06
HOUSING TENURE (hs_3)	*Household tenure (rented, owned…)*	Households which live in in a ceded or borrowed house	6.06
BASIC SERVICES			18.18
IMPROVED SOURCES-WATER (bs_1)	*Water Providence* *Days a week of water service*	Household water comes from a river, delivery wagon, rain harvest, well, spring Households with 5 days of water service or less	6.06

IMPROVED SANITATIONS-HYGIENE (bs_2)	*Household have clean water* *Household have soup* *Household have clean towel* *Type of bathroom, toilet, or latrine in the household* *Number of household that shares the bathroom*	Households with some of the following: -dirty water -lack of soup -lack of clean towel - no toilet facility (bush/field) -shared toilet facility	6.06
ENERGY (bs_3)	*Household have electricity to light the house*	Households with no electricity to light the house	6.06
HEALTH CARE			18.18
ACTIVITY LIMITATIONS (hc_1)	*Difficulty to see* *Difficulty to hear* *Difficulty to speak* *Difficulty to walk* *Difficulty to focus*	Households with at least one individual with difficulties to see, hear, speak, walk or focus	6.06
DISABILITY (hc_2)	*Type of disability*	Households with at least one individual with any type of disability	6.06
MALNUTRITION (hc_3)	*Child Malnutrition (height, wt) (g)* *Adult Malnutrition (height, wt) (g)*	Households with at least one individual (child or adult) who had any type of eating malnutrition	6.06
LIVING STANDARD			18.18
MONETARY RESOURCES (ls_1)	*poor individuals*	Households with at least one individual considered poor	12.12
DURABLE GOODS (ls_2)	*list of possible items* *Household possesses x item* *How many items possesses the household*	Households who do not own one of the following items; car, refrigerator, washing machine, kitchen, bed	6.06

EDUCATION			18.18
CHILDREN OR ADOLESCENT SCHOOLING STATUS (ed_1)	*This year the individual have been matriculated at any educational institution*	Households with at least one child/adolescent not in school	6.06
CHILD OR ADOLESCENT SCHOOLING GAP (ed_2)	*Current course or grade of young individuals*	Households with at least one child/adolescent with schooling gap	6.06
ADULT SCHOOLING GAP (ed_3)	*current course or grade of adults*	Households with at least one adult with a schooling gap	6.06
EMPLOYMENT AND SOCIAL PROTECTION			9.09
EMPLOYMENT (esp_1)	*Employed individuals*	Households with at least one individual unemployed	6.06
SOCIAL PROTECTION (esp_2)	*Health insurance* *Pension income*	Households with at least one individual that do not own any health insurance or pension income	3.03

Table 6: Dimensions, Variables and Deprivation Indicators and Weights

Table 6 presents the dimensions, the variables and the deprivation indicators we have chosen jointly with their associated weights. We have adjusted the information of the parameters of the dimensions with the information on the variables provided by the database. It is because of this, that our *Table 6* deviates somewhat from the *Santos & Villatoro (2018)* proposal. The housing dimension makes reference to the deprivations of some housing characteristics; materials, room per household and house tenure. The first parameter, housing materials, in our case we take into account three different variables to compute it, giving a value of 1 (deprived) if the household has any of the following deprivations; households with dirt floor, straw/ cane/ palm/ mud roof or cane, palm, straw, other materials wall materials. As for the rooms per household, this parameter originally was "People per room", however, our data base did not have any variable accounting for the number of individuals per room, so in our case we

took into account the rooms per house and divide it by the maximum number of individuals in the household and considered as deprived the households who did have equal or less than the half of the overall average. For "House tenure" deprivation we just have in mind the households that did not own the house itself, and have it borrowed or ceded.

The basic services dimension makes reference to the deprivations of some essential facilities; water, hygiene and energy. In our case, for water and hygiene we are not going to make the difference between urban and rural areas because in the case of Bolivia, almost all rural areas do not satisfy the requirements of no deprivation, so it would be redundant to make the mentioned difference. The "water" parameter is comprised of three variables, and has a value 1 (deprived) if the household´s water comes from either a river, delivery cart, public pool, rainwater harvesting, well or a spring and household have less/equal than 5 days of water service in their home. As for the "hygiene" parameter, we have into consideration a household as deprived if their do not have clean water, soup or a clean towel, and own a well, ecological bath or bush toilet. Lastly with the "energy" parameter we consider as deprived those households that do not have electricity to light their house.

Concerning the health care dimension, it is obtain by taking into account activity limitations, disability status and malnutrition status. As mentioned earlier, this dimension was not included in the original table of dimensions due to lack of indicators of "health functioning in Latin American surveys, such as anthropometric indicators, infant mortality, chronic illnesses, or inability to perform daily activities autonomously" *Santos & Villatoro (2018).* But in our case we did have variables concerning the health status of the households, and following the short survey module previously mentioned we have gather up the three variables shown in the table. We can define a state of deprivation in this section as; any household that has at least one individual with limitations to see, hear, speak, walk and focus, with also any type of disability and malnutrition.

"Living standards" dimension is comprised by the monetary resources and the durable goods parameter. The inclusion of both parameters of "monetary resources" and non-monetary ones has been a controversy in the study of multidimensional poverty, however, *Laderchi (1997)* justify the inclusion of both parameters by discussing the role of income using Chilean data, both in terms of its direct impact on a set of welfare indicators and as a measure of the relevant factors that affect them, having as a result that the analysis of poverty is highly conditioned by the indicators chosen and that the approach should be as broad as possible to better capture the multidimensional nature of such a complex phenomenon. Therefore, our monetary resources is defined by the poverty headcount, so if there is a household with at least one

individual poor, is considered deprived. As for the durable goods we have created this variable taking into account the items, if they have the item mentioned before and how many items they own. A household is deprived in this case if they do not own any of the following; car, refrigerator, washing machine, kitchen or bed.

With respect to the "education" dimension, we take into account children/adolescent schooling status, children/adolescent schooling gap and adult schooling gap. For the schooling gap of both children/adolescent and adults, we first take into consideration as children/adolescent individuals with an age range of 0-19 and adults as individuals with more than 20 years. Then we compare the age with the education that should correspond them in that age, and if it doesn't match being in a lower educational course, it is consider deprived.

Lastly we would have the "employment and social protection" dimension that incorporates both the employment and social protection parameters. Having a household deprived if it has at least one individual unemployed, without health insurance or without a pension income.

Once we have all dimensions and parameters well-defined, we have to determine the weights of each parameter and dimension. We have opted to follow the structure of weighting done by *Santos & Villatoro (2018)* with some modifications due to the inclusion of one more dimension. Dimensions "Housing", "Basic services", "Education" and "Health care" have each a weight of 18.18%, distributing the weight equally among the 3 parameters of each one. As for the living standards it also has 18.18% but we weight more the monetary resources with 12.12% because income is a synthetic indicator, as it summarizes several deprivations in just one. Additionally, we have "Employment and Social protection" that accounts for half weighting compared to the others, this is because the deprivations included in this dimension go far beyond the conventional understanding of poverty in the region and also taking into account that the observation of deprivation for these parameters are more common compared to the others, so having the same weight as the other parameter (with weights corresponding respectively to the *Table 5* previously presented) would have over weighted this dimension.

Moving on to the results of the multidimensional poverty, first we are going to present the multidimensional poverty curves by departments, area of living and ethnicity. We have taken all dimensions, and variables taking into account their weighting structure and we have plotted the weighted sum of the variables.
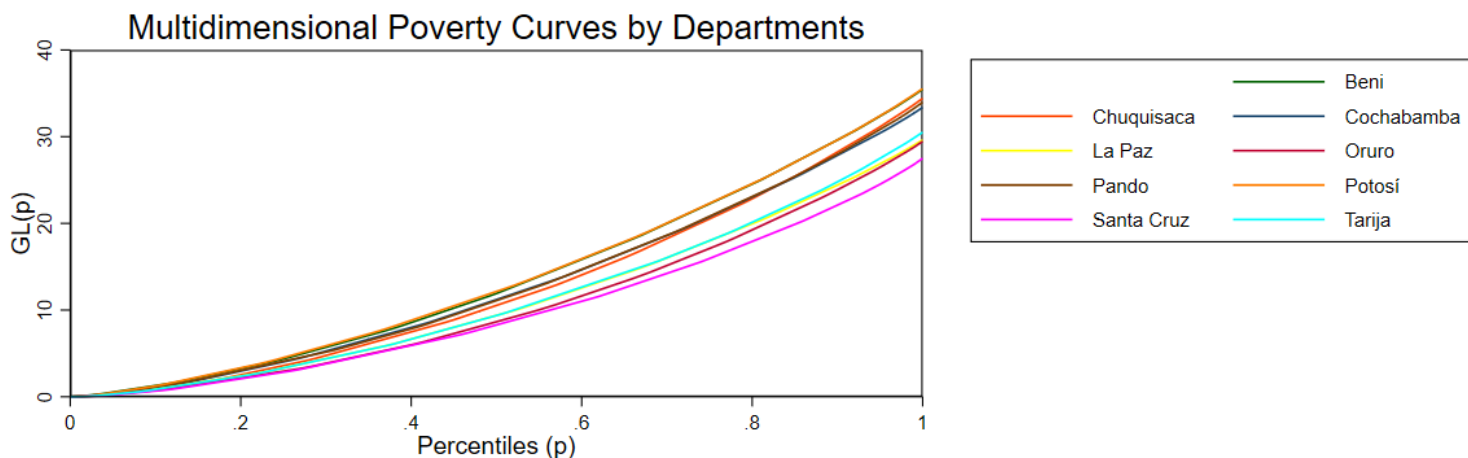
Figure 7: Multidimensional curves by departments

Figure 7 shows that most of the curves cross each other, making them impossible to interpreter. However, taking a particular point of inflexion in the population which in our case would be 0.6, we can state somethings about some of the curves. These curves are just a generalized Lorenz curves but as mentioned previously, taking into account the weighted sum of the deprivations. So, we can state that Santa Cruz is the least multidimensional poor department in all Bolivia, followed by Oruro. Compared to the previous results shown by the TIP curves, our results for Santa Cruz coincide with them, but for Oruro we couldn't state nothing before but now we see that take the second place of the non-poor departments.
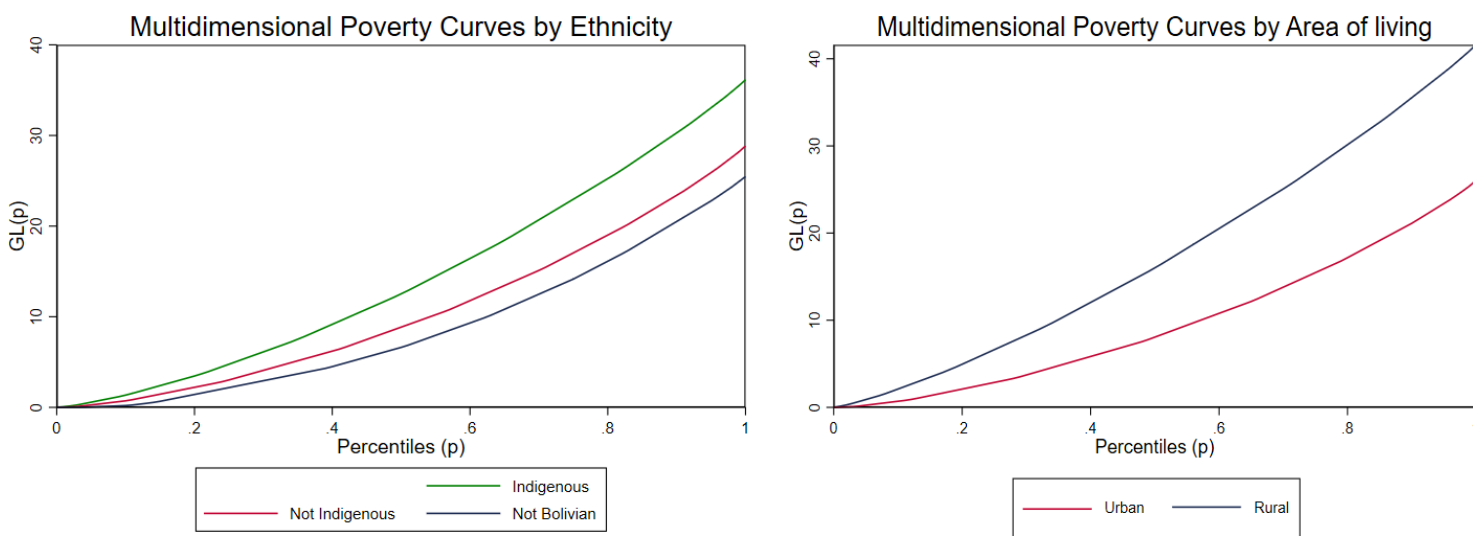

Figure 8: Multidimensional curves by ethnicity and area

In *Figure 8* we observe that in this case, the curves do not face the problem as before in *Figure 7* as they do not cross each other and we can give a statement about the multidimensional poverty. Regarding the ethnicity, an individual which is not indigenous, nor Bolivian is better off than an indigenous individual in terms of multidimensional poverty. And as for the area of living, individuals living in a rural area are more multidimensional poor compared to the ones living in an urban area.

Furthermore, when we do take into consideration the poverty cut-off $k=25\%$, we get the following results for the multidimensional headcount (H) , the average proportion of deprivations suffered by the poor population (A) and the adjusted headcount ratio (M_0)

	COEFFICIENT	*STD. ERR.*	*[95% CONF. INTERVAL]*	
H	0.634	0.003	0.629	0.640
M0	0.248	0.001	0.246	0.251
A	0.392	0.001	0.390	0.393

Table 7: Multidimensional poverty results with k=25%

Table 7 shows the results for the AF poverty measures, taking into account the entirely of Bolivia with the mentioned poverty cut-off. We see that the value of the multidimensional headcount accounts for 63.4%, meaning that more than half of the population in Bolivia it's considered poor as well. We also see that on average the poor population are deprived of almost 40% of the deprivations. As for the adjusted headcount ratio (M_0) we have a value of 0.248, which means that the proportion of weighted deprivations the poor experience in a society is 24,8% out of the total number of deprivations this society could experience if all people were poor and were deprived in all dimensions.

ETHNICITY	*Indigenous*	*Not indigenous*	*Not Bolivian*	*Total*
H	0.782	0.583	0.495	0.634
M0	0.323	0.222	0.187	0.248
Pop share	0.260	0.737	0.003	1.000

Table 8: Multidimensional poverty results with k=25% by ethnicity

If we compute the AF measures by ethnicity, we are able to see the differences the different ethnicities of Bolivia in *Table 8*. We observe that the ethnicity with the highest value for both the headcount ratio (76.2%) and adjusted headcount ratio (32.2%) is the indigenous individuals, followed by the not indigenous ones and the not Bolivians. Therefore we can say that indigenous individuals in Bolivia are poorer and account for more proportion of weighted deprivations among poor. Which is a statement that follows previous analysis already presented.

AREA	*Rural*	*Urban*	*Total*
H	0.917	0.512	0.634
M0	0.400	0.222	0.248
Pop share	0.302	0.698	1.000

Table 9: Multidimensional poverty results with k=25% by area of living

Table 9 shows that by far, any individual living in an urban area is less likely to be poor, with this particular area having a 51.2% of proportion of the poor, compared to the alarming 91.7% of the rural area. In terms of the adjusted headcount ratio, it also has higher values for the rural area, accounting for almost the double value of the urban adjusted headcount ratio.

Departments	*Beni*	*Chuquisaca*	*Cochabamba*	*La Paz*	*Oruro*	*Pando*	*Potosí*	*Santa Cruz*	*Tarija*	*Total*
H	0.749	0.712	0.725	0.619	0.582	0.689	0.762	0.536	0.619	0.634
M0	0.311	0.300	0.288	0.235	0.230	0.286	0.314	0.202	0.244	0.248
Pop. share	0.041	0.055	0.174	0.253	0.047	0.013	0.078	0.288	0.050	1.000

Table 10: Multidimensional poverty results with k=25% by departments

As for the departments *Table 10* shows high values for all multidimensional headcounts exhibiting values above 50% for all departments, with Potosí being the highest value and Santa Cruz the lowest one. This is consistent with what we stated before in the analysis for Santa Cruz. As for Potosí, even thought is not one of the three economic hubs, it does represent an important department for the economy (2,507 million US$) and especially for the mining sector of the economy. However, they have one of the lowest

per capita incomes in Bolivia despite living in one of the most resource-rich departments in the country and even thought being the main protagonist of the mining sector (in 2014 it generated 59% of the royalties from mining exploitation), which is the second productive activity in the country, after gas extraction, contributing to the known "Potosí paradox" *Smink (2015).*

The adjusted headcount ratio follows the same explanations as before, as Potosí has the highest value of M_0 and Santa Cruz the lowest one. This means that the proportion of weighted deprivations that are experienced by the poor in Potosí is 31.4% and 20.2% in Santa Cruz, of the total number of deprivations that this two department would experience if all people were poor and deprived in all dimensions.
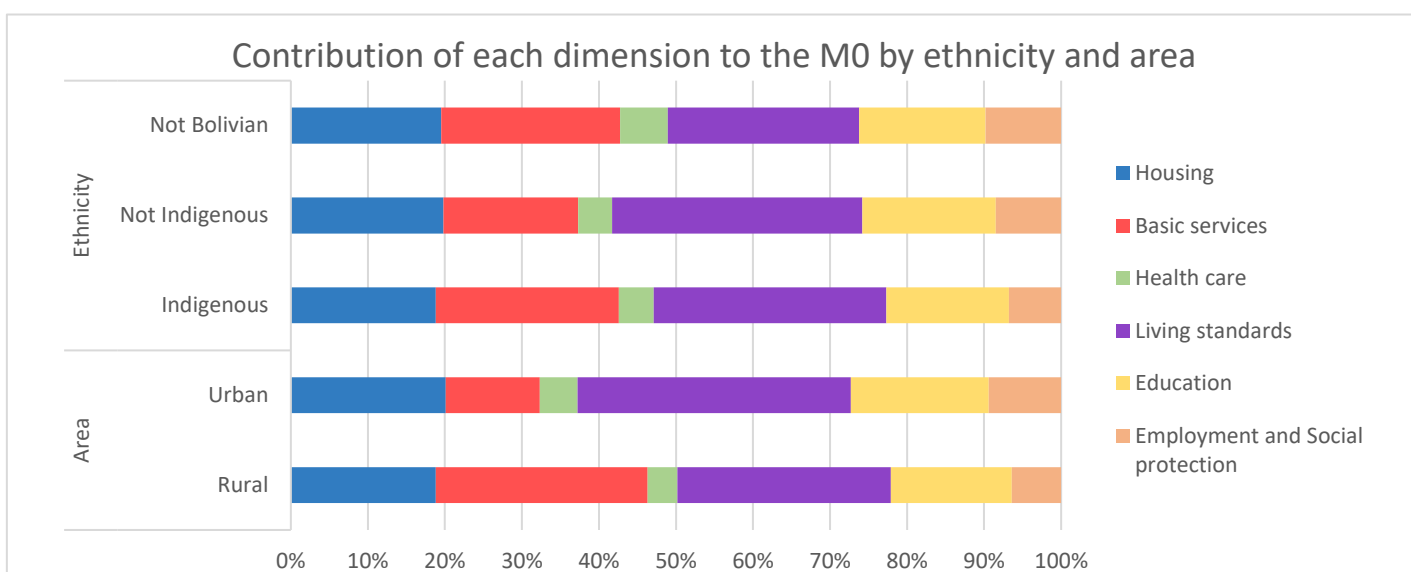

Figure 9: Contribution of dimensions to M0 by ethnicity and area

Figure 9 shows the contribution of the six dimensions of deprivation to the adjusted headcount ratio (M_0) by area of living and ethnicity of the individuals. We observe that for all ethnicities the biggest contribution to the adjusted headcount ratio is the dimension of living standards, which make sense because the mentioned dimension takes into account both income poverty and the deprivation of durable goods which are variables with a lot of relevance in terms of measuring poverty which in Bolivia play a huge role because of its economic state, that although the last few decades have seen a fairly high growth rate, this has not been able to translate into better living conditions for Bolivia's workers. We can state the same when we look at the area of living, which in general is related to the ethnicity because rural areas are in its majority comprised of indigenous individuals. But for the case of rural areas, the dimensions of housing and basic services also contribute quite a lot, compared to the urban area, this is due to the

limitations of living in rural areas where they are considered more isolated in terms of basic services and housing standards.
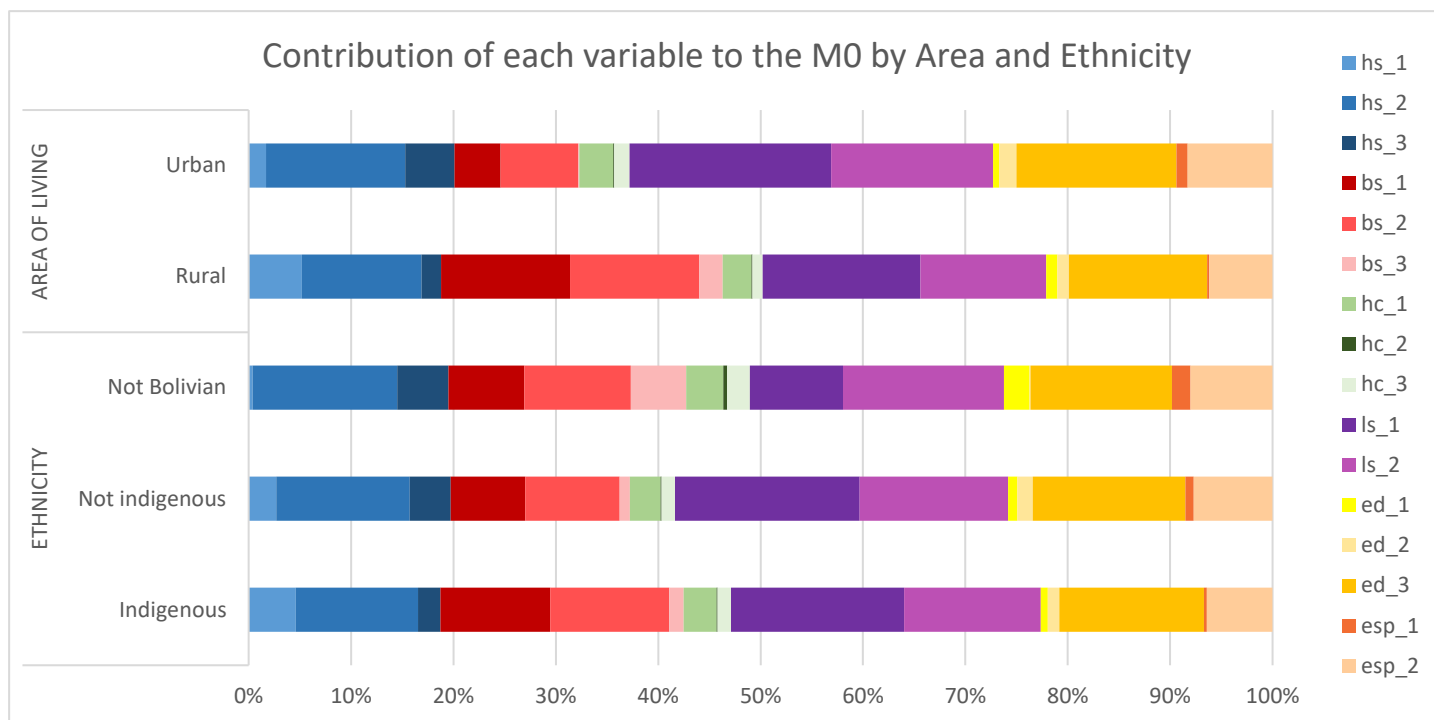

Figure 10: Contribution of each variable to M0 by ethnicity and area

When further analysing the contributions of the dimensions, in *Figure 10* we can focus on the different variables specific to each dimension to identify the true source of the dimension's relevance, where in *Table 12* of the Appendix we can observe specific values for the contribution. For the housing dimension we observe that for all ethnicities and areas of living the variable "rooms per household" is the most relevant one, meaning that the problem of overcrowding is important for all areas or ethnicities. As for the basic services, water and hygiene deprivations are the variables than contribute the most to the dimension, and furthermore in the case of the urban areas there is almost no contribution to the dimension, due to better electrical network connections of the cities. The health care dimension´s biggest contributor would be "activity limitations", whereas disability is almost not seen in *Figure 10*, the reason behind this could be that the concept of individuals with activity limitations is more wider (limitations to see, speak, walk…) than just being disabled or not. With regard to the living standards, for all ethnicities and areas of living the variable monetary resources is the main contributor, except for the not Bolivian individuals, due to the comparative advantage that they have in the labour market, raising this way their salaries. For

the education dimension, the schooling gap of the adults is the biggest contributing variable among all ethnicities and areas. And finally for the employment and social protection, without doubt the biggest variable is the social protection one. This is perhaps due to the difficulties in obtaining insurance because it is considered an extra expense that not many individuals can afford.
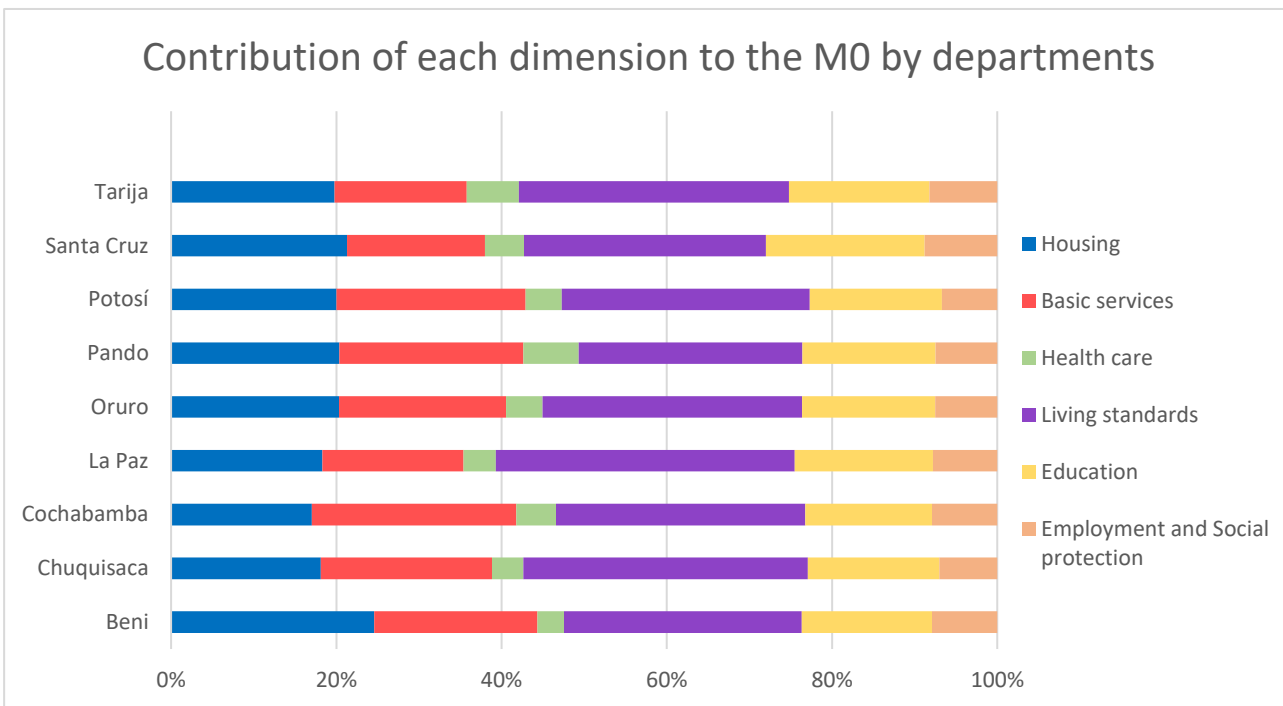

Figure 11: Contribution of dimensions to M0 by department

When analysing the contributions of the dimensions to the adjusted headcount ratio by departments shown in *Figure 11*, we observe a similar pattern as the ones previously mentioned. The dimension living standard is the biggest contributor of the whole adjusted headcount ratio, where in La Paz has their biggest value. La Paz, despite being the second populated department in Bolivia and having the administrative capital with the same name, it has a huge population of poor individuals as we have been seeing in the analysis, and this has a huge impact on the living standards which take into account monetary resources. We also observe that housing, basic services and education has a significant contribution in all departments with no big deviations from each other except for housing in Beni, which makes sense because this department is mostly made up of the Amazon rainforest making difficult to have proper housing characteristics.
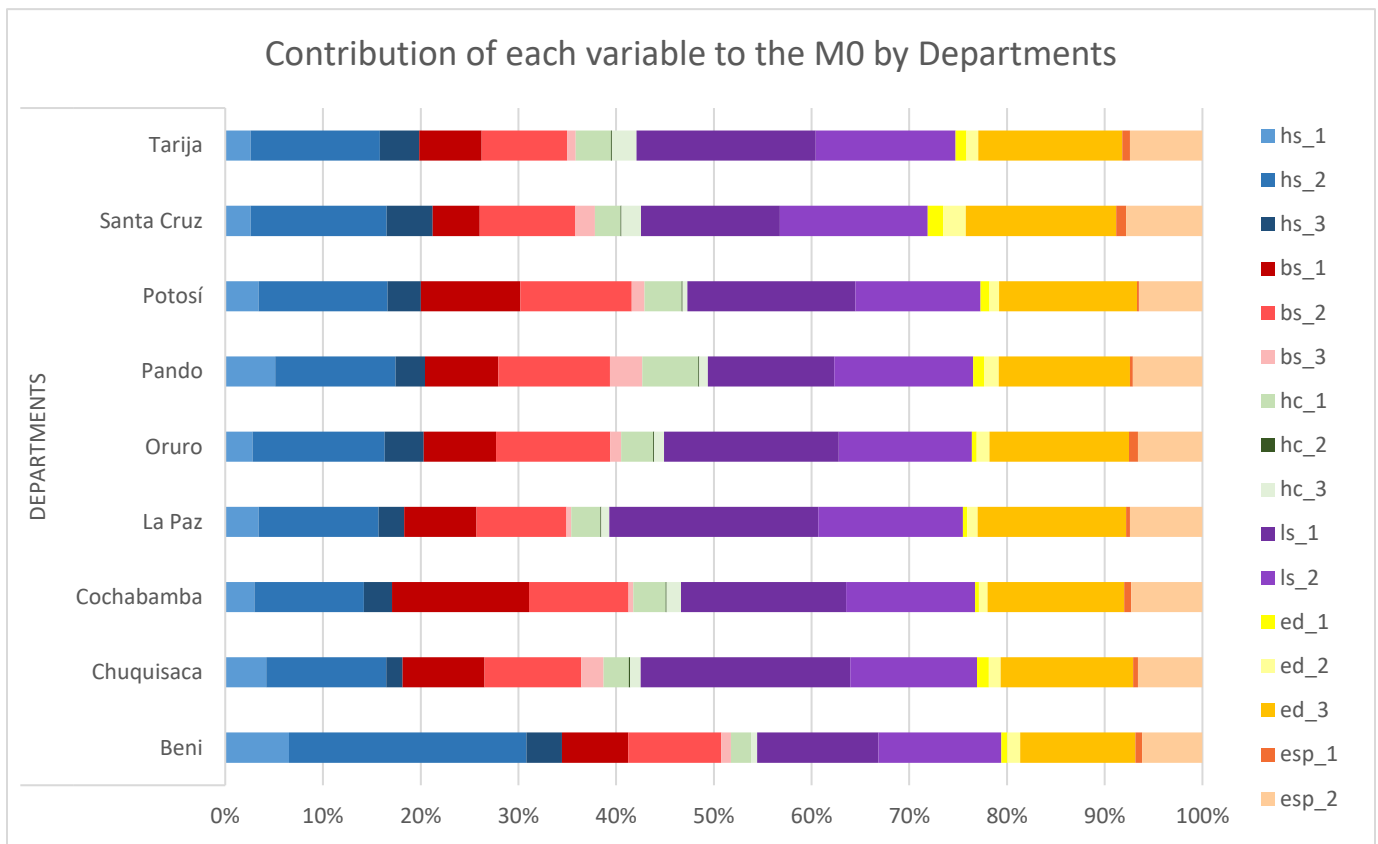
Figure 12: Contribution of each variable to M0 by department

Regarding the further analysis of the contributions of the dimensions, *Figure 12* shows the disaggregation of the dimension into their respective variables. For housing the variable of rooms in the household is still the highest contributor to the dimension, with a big significance contribution of 0.28 for the department of Beni (see Appendix *Table 11* for the contribution values). With respect to the basic services, water and hygiene deprivations are the variables than contribute the most to the dimension, and moreover in the case of La Paz there is almost no contribution to the dimension, due to importance of this department that forces to have better electrical network connections of the administrative city of La Paz. The health care dimension´s biggest contributor would be "activity limitations", whereas disability is almost not seen in *Figure 12* because there is fewer people identifying as disable compared to identifying with any type of limitation (limitations to see, speak, walk…). As for the living standards, for all departments the variable monetary resources is the main contributor, but it is worth to mention that for the department of Santa Cruz the contribution of monetary resources deprivations is almost equal to the contributions of durable goods, meaning that in this department there is better conditions in the variable of monetary resources, which coincides with what we have seen in previous results of the TIP curves,

FGT indices, multidimensional poverty curves and the AF measures. In the education dimension, the schooling gap of the adults is still the biggest contributing variable among all ethnicities and areas. And finally for the employment and social protection, undoubtedly social protection is the biggest variable.

4 Conclusions and further research

As a conclusion to our study we will divide the concluding remarks into two blocks about unidimensional and multidimensional poverty analysis. Looking first at the results for unidimensional poverty that we have shown in the thesis, we can state that individuals with an indigenous ethnicity have more chances to be considered as poor, and the same happens if the individuals lives in a rural area. As for the departments of Bolivia, we could only have a statement for the extremes; the poorest department according to both the FGT indices and the TIP curves is Chuquisaca, and the richest one would be Santa Cruz. When looking into specific characteristics on the head of the households we conclude that women, educated, living in an urban area, not belonging to the indigenous ethnicity, living in Santa Cruz, single, employed and in a unipersonal household are less likely to be poor than their counterparts. We observe that there is coincidence in the statements among all the analysis.

For the multidimensional poverty analysis, we observe that the multidimensional poverty curves show a similar result for poverty as the TIP curves previously explained, they have many curves that cross each other, but taking into account a specific turning point we can say that Santa Cruz is the least multidimensional poor department in Bolivia and the poorest one, this time goes to the department of Potosí. The same goes for ethnicity and area of living, the indigenous ethnicity and the rural area are more multidimensional poor than the rest. When looking at the AF measures of poverty we can state that for all Bolivia the multidimensional headcount ratio (H) is quite high, accounting for more than half of the population being multidimensional poor (having more than 25% of deprivations). Also, on average the multidimensional poor are deprived in almost 40% of deprivations (A). If we look at the contributions to the adjusted headcount ratio (M_0), the dimension of "living standards" if the most relevant one among all departments, ethnicities and areas of living, with the variable "monetary resources" playing a huge role on identifying the multidimensional poor. The only exception would be the non-Bolivian individuals, which have more monetary facilities and the most significant variable is durable goods.

However, this thesis does not give specific information or analysis about the status of the energy poverty in Bolivia, which is another side of multidimensional poverty that could be analysed in more

depth thanks to the variables related to energy given by the data. It also does not take into consideration the effects that COVID-19 pandemic had in the poverty in Bolivia. Also, is worth to mention that our analysis is done by taking into account individual variables from the head of the household, so it could be interesting to add household variables aggregating the variables of the individuals. We will leave this questions for a future research.

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6 Appendix

			DEPARTMENTS								
			Beni	Chuquisaca	Cochabamba	La Paz	Oruro	Pando	Potosí	Santa Cruz	Tarija
DIMENSIONS	Housing	hs_1	0.08	0.04	0.03	0.03	0.03	0.05	0.03	0.03	0.03
		hs_2	0.28	0.12	0.11	0.12	0.14	0.12	0.13	0.14	0.13
		hs_3	0.04	0.02	0.03	0.03	0.04	0.03	0.03	0.05	0.04
	Basic services	bs_1	0.08	0.08	0.14	0.07	0.07	0.08	0.10	0.05	0.06
		bs_2	0.11	0.10	0.10	0.09	0.12	0.11	0.11	0.10	0.09
		bs_3	0.01	0.02	0.01	0.01	0.01	0.03	0.01	0.02	0.01
	Health care	hc_1	0.02	0.03	0.03	0.03	0.03	0.06	0.04	0.03	0.04
		hc_2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		hc_3	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.03
	Living standards	ls_1	0.14	0.22	0.17	0.21	0.18	0.13	0.17	0.14	0.18
		ls_2	0.15	0.13	0.13	0.15	0.14	0.14	0.13	0.15	0.14
	Education	ed_1	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.02	0.01
		ed_2	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.01
		ed_3	0.14	0.14	0.14	0.15	0.14	0.13	0.14	0.15	0.15
	Employment and Social protection	esp_1	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.01	0.01
		esp_2	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.07

Table 11: Contribution of each variable to M0 by department

			ETHNICITY			AREA OF LIVING	
			Indigenous	Not indigenous	Not Bolivian	Rural	Urban
DIMENSIONS	Housing	hs_1	0.046	0.027	0.004	0.052	0.017
		hs_2	0.119	0.130	0.141	0.117	0.136
		hs_3	0.022	0.040	0.050	0.019	0.048
	Basic services	bs_1	0.107	0.073	0.074	0.126	0.045
		bs_2	0.116	0.092	0.104	0.126	0.076
		bs_3	0.014	0.010	0.054	0.023	0.001
	Health care	hc_1	0.032	0.030	0.036	0.028	0.033
		hc_2	0.001	0.001	0.004	0.001	0.001
		hc_3	0.013	0.013	0.022	0.010	0.015
	Living standards	ls_1	0.169	0.180	0.091	0.154	0.197
		ls_2	0.133	0.145	0.157	0.123	0.158
	Education	ed_1	0.007	0.009	0.025	0.011	0.006
		ed_2	0.011	0.015	0.001	0.011	0.017
		ed_3	0.141	0.149	0.138	0.135	0.156
	Employment and Social protection	esp_1	0.003	0.008	0.018	0.002	0.011
		esp_2	0.064	0.077	0.080	0.062	0.083

Table 12: Contribution of each variable to M0 by ethnicity and area of living