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Measuring and Comparing Well-Being in South American Countries Using Equivalent Incomes

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Abstract

The purpose of this dissertation is to measure well-being in South American countries based on equivalent incomes. This measure of well-being has a multidimensional approach, and it respects preferences between individuals. We calculate equivalent incomes of individuals, using the Gallup World Poll in 2007 for six countries: Argentina, Brazil, Bolivia, Chile, Colombia and Peru. Additionally, we aggregate by country equivalent incomes as well as incomes and life satisfaction level, through a specific social welfare index with different grades of inequality aversion. We find some differences between country rankings made by incomes and equivalent incomes in spite of their strong correlation at individual level; in addition, the results present no correlations between equivalent incomes and life satisfaction level, as expected. The greatest difference in rankings is presented by Chile, which changes from the first in per capita income ranking, to the fourth in equivalent incomes ranking. Adopting equivalent incomes (based in multiple life dimensions and individual preferences) and introducing different inequality aversion parameters in the analysis lead us to better understand the well-being in Latin America.

Keywords: *Equivalent Incomes, Well-being, Latin America, Preference Heterogeneity.*

JEL: I31, C25, D63

I. Introduction

In recent years, international institutions continuously make initiatives to create new measures of progress and well-being. Because of these initiatives, some measures have been developed, e.g. the Human Development Index (HDI) published by United Nations Development Programme (UNDP) which is basically an average of the GDP per capita, the heath expectancy and the education level in each country. Other institutions like European Commission developed the "Beyond GDP" initiative, with the purpose of developing indicators like GDP that are more inclusive of environmental and social aspects of progress. In Europe the "Better Life Initiative", which measures several life dimensions among OECD countries is very popular as well.

In Latin America, conventional measures of well-being and progress are still used by institutions and the initiatives to create new measures are less common. Some of these initiatives have been addressed especially by the Economic Commission for Latin America and the Caribbean (ECLAC) and the Inter-American Development Bank (IDB), which focus essentially in collecting and interpreting country indicators of quality of life.

Due to the lack of well-being measures alternatives to GDP and HDI in Latin America, the purpose of this thesis is to measure well-being in South American countries through an alternative approach. We specifically propose equivalent incomes as a measure of well-being, because it uses multiple objective variables related with quality of life and, unlike some measures like HDI, it respects individual preferences on what makes a good life.

Subjective measures of well-being as life satisfaction and happiness also respect what people think is a good life. Several authors such as Layard (2005) and Kahneman et al. (2004) consider these indicators as measures of social progress. In contrast, Sen (1985) discover two issues presented on these measures and he defines them as: "Physical-Condition Neglect" and "Valuation Neglect". The first factor refers to how people are influenced by their mental attitude and, the second refers to the impossibility of the mental activity for valuing one kind of life rather than another. Due to these influences, it might be impossible for individuals to make a statement of their own well-being based in a subjective judgment, and to compare these measures between individuals.

Furthermore, objective indicators such as income, labor status and health, in contrast with equivalent incomes, only measure one dimension of life quality. Additionally, more structured indicators as HDI take into account several life dimensions by adding all variables with an arithmetic average, but they do not

respect individual preferences.

Equivalent Incomes are calculated at individual level and they respect the preferences of each person. Moreover, using objective measures make equivalent incomes comparable between them and useful to elaborate public policy.

Finally, the purpose of calculating equivalent incomes is twofold: i) to make comparisons between countries and ii) to show differences between objective and subjective well-being indicators with the equivalent income approach. In this regard, this thesis tries to fill the gap in Latin American literature about alternative well-being measures, and to promote more structured surveys that contain objective and subjective measures of life quality, besides of demographic and social characteristics of people. We use the Gallup World Poll to estimate heterogeneity in preferences among individuals and to compute equivalent incomes in South American countries.

In this thesis, we present in section II the literature review. Section III presents the meaning of Equivalent Income and how to calculate it. In section IV, we present the model and data used in the analysis. Then, section V presents the main results in preferences estimations and aggregates equivalent incomes of individuals by country. Finally, in section VI we conclude the analysis with some final remarks and recommendations.

II. Literature Review

Literature on well-being measurement is generally divided into to broad categories: subjective and objective measures. The first category captures people's feelings, assessing well-being trough ordinal measures such as: happiness level or life satisfaction level. Studies related with the second category start using GDP as a well-being measure, forward they use multidimensional approaches, which take into account several aspects that influence the quality of life of a person.

One of these multidimensional approaches is the equivalent income, which uses relevant life dimensions and consider individual preferences to add them. In this sense, to find individual equivalent incomes is necessary to estimate the people's preferences and their heterogeneity. We review here three approaches in the literature to estimate preferences that use different methods and sources of information.

The first method uses revealed preferences to estimate heterogeneity in individ-

ual preferences. Some papers like Decoster and Haan (2014) and Bargain et al. (2013) use labor supply models based on consumption-leisure trade-off, and incorporate preference heterogeneity to calculate equivalent incomes. The first paper provides empirical evidence about the sensitivity of welfare orderings in different normative principles, while the second paper derives equivalent incomes from different reference values and compares the results between countries, finding differences in preferences between "work-loving countries" and "work-averse nations". One problem in this method is the impossibility to include more than two life dimensions.

The second method bases estimations in stated preferences. Fleurbaey et al. (2013) use this method in a pilot survey which contains questions about willingness to pay (WTP) in health care. The authors calculate equivalent incomes based on the WTP in health value, and it is used in the estimation of some distributional weights to make cost-benefit analysis of medical interventions. This paper uses WTP questions, to calculate equivalent incomes. The best way to capture individual preferences is using this method, however gathering the information in a survey is very difficult and no surveys in Latin America do it.

The third method to estimate individual preferences is through life satisfaction answers. The satisfaction method has been used to calculate equivalent incomes by Fleurbaey et al. (2009) and Schokkaert et al. (2011). The first paper uses a life satisfaction scale provided in a Russian survey to estimate individual preferences, and then to calculate equivalent incomes. Authors find strong differences between Equivalent Incomes and subjective measures of life satisfaction. The second paper uses equivalent incomes as an indicator to measure job quality. The authors find that the indicator used is better than objective measures of job quality, since it takes into account income and relevant job characteristics. Additionally, they argue that equivalent incomes correct the failure of subjective indexes in terms of aspirations, and it leads to an increased concern about lower skill individuals in more demanding jobs. In sum, equivalent incomes correct by personal aspirations in contrast with subjective indicators, and respect preferences in comparison with objective measures.

Fleurbaey and Gaulier (2009)[1] and Decancq and Schokkaert (2013) use equivalent incomes to make comparisons between countries. The first paper compares OECD countries with the World Development Report in 2006, and it corrects the GDP of each country by calculating marginal WTP for labor, health and risk of unemployment. The authors determine equivalent incomes for each country, and

[1]This paper extends the analysis of Becker et al. (2005), who measure quality of life taking into account per capita income and longevity.

they find substantial differences between equivalent incomes and GDP rankings. The second paper uses equivalent incomes to measure social progress between European countries. The authors adopt the European Social Survey (ESS) to estimate individual preferences assuming homogeneity between countries; then they compute the indicator and make comparisons among countries. Both papers use equivalent incomes as a multidimensional indicator, which have several differences with other indicators like HDI, and highlight its multidimensional approach and respect for preferences.

In Latin America there are no studies using equivalent incomes to measure and compare the well-being of countries. The closest research in this area is the book edited by Lora et al. (2010), which contains several studies that explore new methods of monitoring urban life quality in each of the six Latin American cities analyzed. In general, the authors use two methods to study the quality of life in the cities: hedonic prices and life satisfaction approaches. Each study uses different methodologies and data sources, and that fact precludes comparisons between the cities. Moreover, Battiston et al. (2013) make some comparisons between Latin American countries in poverty. This paper compares Latin American countries combining the unsatisfied basic needs and the income approach.

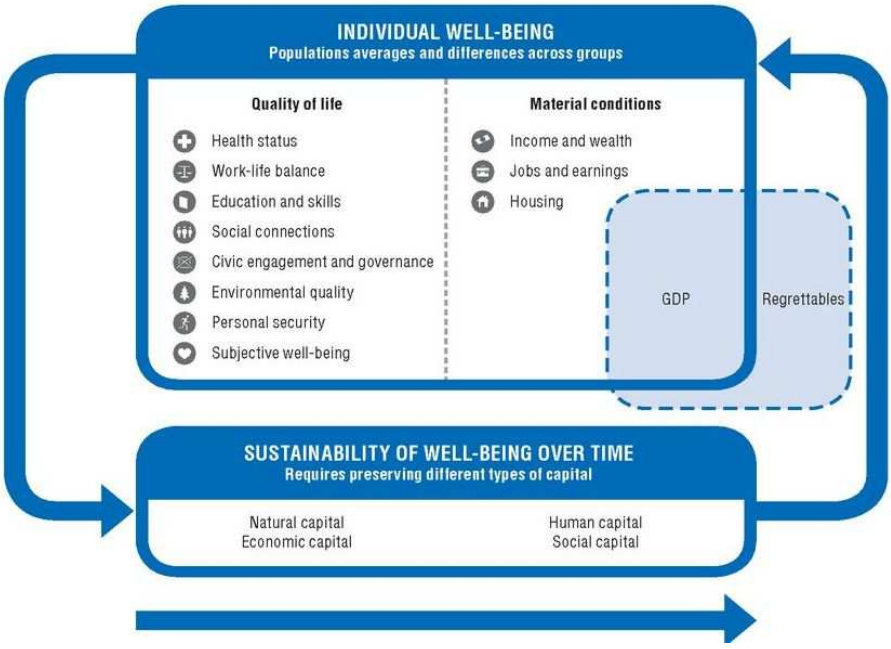
With the purpose of contributing to fill this gap in the literature for Latin America, this dissertation aims to measure well-being in six Latin American countries using equivalent incomes, and estimating the heterogeneity of preferences based on reported life satisfaction. Additionally, it attempts to create incentives to perform surveys in Latin American countries, which gather information about multiple life dimensions.

III. The Equivalent Income

Equivalent incomes have two aspects: a) they use relevant life dimensions and b) they respect individual preferences. The first aspect uses life dimensions that influence individual well-being; however, there is not a well-defined list of these dimensions. Still, it appears to be some consensus about which dimensions are important to have a good quality of life. Figure 1 illustrates some specific dimensions that influence individual well-being and can be used for practical applications.

In the same way, to describe how Equivalent Incomes respect individual preferences, we follow Decancq and Schokkaert (2013). Suppose two persons, Alice and Bruce, who have different preferences. Figure 2 represents the current sit-

Figure 1: List of OECD life dimensions



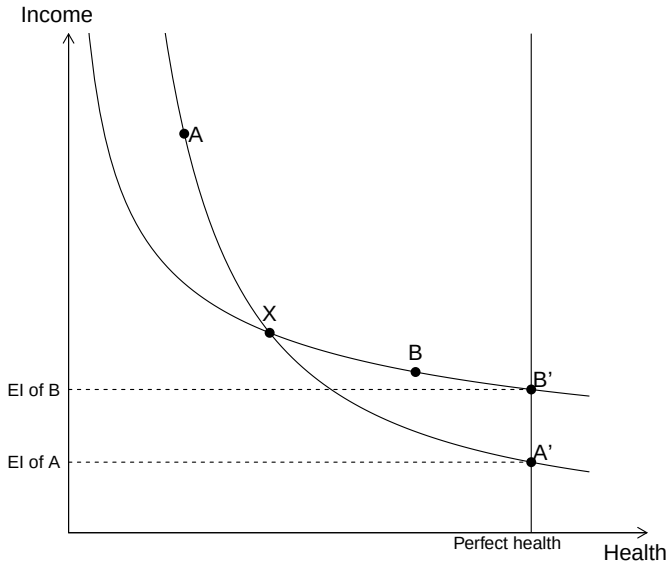
Source: OECD (2011).

uation of Alice in point A and Bruce in point B about health and income, and their indifference curves. It is possible to see that both individuals disagree about what is more important in life. Alice thinks that health is more important than income in comparison with Bruce; also Alice has a low level of health and a high income in regard to Bruce.

By definition, it is not possible to determine if Alice in situation A is better than Bruce in B or inversely, due to their indifference curves cross each other. If we could settle an equal level of health for both individuals, it would give a solution to determine the better situation by knowing who has the greatest income. But, what is the value of health level we need to have for each person? For example, if we move through the indifference curve of Bruce and we establish him at the Alice's health level,we clearly see in this situation that Alice would have more income than Bruce. However, she would be more worried about her health level, because she prefers more health than income in comparison with Bruce. In this case, we have to balance the differences in incomes and concerns about low health level; at that point, it gives no solution to the initial problem.

Now, if we assume that both individuals reached a perfect heath level, we could ensure that both individuals do not worry about this dimension. Removing health level from the equation, it is possible to compare the individual situa-

Figure 2: Equivalent Income Concept



Source: Decancq and Schokkaert (2013).

tions by their respective incomes alone. In Figure 2, situations A and A' give the same well-being to Alice, and situations B and B' give the same well-being to Bruce. Situations A' and B' have the same health level and then they can be compared by their incomes alone; these incomes are denoted in the figure 2 as "Equivalent income A" (for Alice) and "Equivalent income B" (for Bruce), which measure the well-being of each person in monetary levels. In this case, Bruce in B is better off than Alice in A despite the fact than Alice is richer than Bruce.

Based on the above, the equivalent income is then: "The hypothetical income that, if combined with the best possible value on all non-income dimensions, would place the individual in a situation that he/she finds equally good as his/her actual situation" (Decancq and Schokkaert, 2013).

To explain in a more formal way the procedure to calculate equivalent incomes, we follow chapter 4 of Fleurbaey and Blanchet (2013). Suppose an individual i who consumes a vector of market commodities $\mathbf{x}_i \in \mathbb{R}^l_+$, available at price $\mathbf{p} \in \mathbb{R}^l_{++}$, and enjoys non-market goods $\mathbf{y}_i \in Y \subset \mathbb{R}^m$. The utility of individual i is then represented by the function $u_i(\mathbf{x}_i, \mathbf{y}_i)$, and the respective indirect utility function is

$$v_i(\mathbf{p}, \mathbf{y}_i, m_i) = max\{u_i(\mathbf{x}_i, \mathbf{y}_i) | \mathbf{p}'\mathbf{x}_i \leq m_i\}$$

Where m_i is the actual rent of individual i. Then, if we fixed $\mathbf{p}$ at 1 and we assume

a reference value for all non-income dimensions $\tilde{\mathbf{y}}$,[2] the equivalent income is

$$m^* = e_i(\tilde{\mathbf{y}}, v_i(\mathbf{y}_i, m_i)) = min\{m | v_i(\tilde{\mathbf{p}}, \tilde{\mathbf{y}}_i, m_i^*) \geq v_i(\mathbf{y}_i, m_i)\} \tag{1}$$

Likewise, we can say that m^* is the solution of the equality

$$v_i(\tilde{\mathbf{y}}_i, m_i^*) = v_i(\mathbf{y}_i, m_i) \tag{2}$$

It is clear that the distinction between non-income dimensions when they have reached $\tilde{\mathbf{y}}_i$ is not important for individuals, and the only measure that remains to make comparisons is m_i^*. Equations (1) and (2) also make the concept of "Equivalent Income" intuitive. This is the level of income for individual i which, combined with reference parameters of non-income dimensions of life, would give to i the same satisfaction as the current situation.

Even though the equivalent income can be calculated with any value of $\tilde{\mathbf{y}}_i$,[3] the best choice is setting the most preferred value of $\mathbf{y}_i$.[4] Assuming that every person reaches the best possible value in all non-income dimensions, then they only care about the income they earn and it can be interpreted as a well-being measure.

IV. Model and Data

In order to calculate equivalent incomes, it is first necessary to gather information about all relevant individual life dimensions and personal characteristics. Second, individual preferences must be collected or estimated. In our analysis, the Life Satisfaction variable is discarded to be used as a non-income life dimension, due to the problems find by Sen (1985) and explained before in this dissertation. However, it is used to estimate preferences, using it as a measure of utility.

For estimating individual preferences, we assume that life satisfaction depends on three important variables: individual income m_i, a vector of non-income life dimensions $\mathbf{y}_i$, and a vector of personal characteristics $\mathbf{z}_i$. Following the model in Decancq and Schokkaert (2013), individual i's satisfaction can be written as:

$$S_i = \alpha + (\mu + \pi' \mathbf{z}_i) \ln(m_i) + (\beta + \gamma' \mathbf{z}_i)' \mathbf{y}_i + \delta' \mathbf{z}_i + \varepsilon_i \tag{3}$$

[2] This procedure can be performed, because prices could be seen as a form of public bad and the indirect utility function is monotone of zero degree over prices and rent.

[3] See, for example, Fleurbaey et al. (2009).

[4] See appendix A in Fleurbaey and Blanchet (2013), for more information about choosing reference values.

Where (α, μ, π, β, γ and δ) are coefficients to be estimated and ε_i is a disturbance term. The logarithm of income ($\ln(m_i)$) and the vector of non-income life dimensions ($\mathbf{y}_i$) affect directly the life satisfaction (S) of individuals. In the same way, the vector of personal characteristics directly affects the life satisfaction trough $\delta'\mathbf{z}_i$, and it captures aspirations and expectations of the individuals.

Additionally, heterogeneity in preferences is captured in the equation (3) through interactions between personal characteristics ($\mathbf{z}_i$) and life dimensions ($\ln(m_i)$ and $\mathbf{y}_i$).

Now, assuming all non-income dimensions are reached in their best possible value $\tilde{\mathbf{y}}_i$, the income which would place the individual in a situation that he or she finds equally good as his or her initial situation, could be called the equivalent income m_i^*. Using equations (2) and (3) we can derive the equivalent income from the equality

$$\begin{aligned} S_i &= \alpha + (\mu + \pi'\mathbf{z}_i)\ln(m_i) + (\beta + \gamma'\mathbf{z}_i)'\mathbf{y}_i + \delta'\mathbf{z}_i + \varepsilon_i \\ &= \alpha + (\mu + \pi'\mathbf{z}_i)\ln(m_i^*) + (\beta + \gamma'\mathbf{z}_i)'\tilde{\mathbf{y}}_i + \delta'\mathbf{z}_i + \varepsilon_i \end{aligned} \tag{4}$$

Rewriting the equation, it is possible to calculate the equivalent income as

$$m_i^* = m_i \exp\left[\left(\frac{(\beta + \gamma'\mathbf{z}_i)}{(\mu + \pi'\mathbf{z}_i)}\right)'(\mathbf{y}_i - \tilde{\mathbf{y}}_i)\right] \tag{5}$$

This solution is similar to equation (1), and the equivalent income (m_i^*) calculated will be the measure of individual well-being we are going to use in the analysis. As shown in equation (5), m_i^* does not directly depend neither on life satisfaction (S_i) nor on personal aspirations and expectations captured by $\delta'\mathbf{z}_i$ and the disturbance term ε_i. The indicator is calculated with the income (m_i) and the differences between the observed and the reference values of non-income life dimensions ($\mathbf{y}_i - \tilde{\mathbf{y}}_i$). Although $\mathbf{z}_i$ does not directly affect the equivalent income, it does indirectly influence it. This indirect influence is captured by the interactions of $\mathbf{z}_i$ with $\ln(m_i)$ and $\mathbf{y}_i$.[5]

Constructing the Social Welfare Index (SWI)

Assuming we have found a measure of individual well-being W_i (The individual well-being can be m_i^* or any other well-being measure), it is still necessary to figure out how to aggregate these values. In order to obtain an overall measure of

[5]Equation (5) is similar to equation (1). Both equations express the equivalent income in terms of income, and the actual and the reference value of all non-income dimensions

social welfare is important to take into account inequality, even if individuals do not care about others. To introduce the inequality in the SWI, firstly we calculate the average well-being (M) and then, we adjust this average by a measure of inequality (I_ρ). In sum, we can write the SWI as

$$SWI = M(1 - I_\rho) \tag{6}$$

The inequality measure I_p is calculated from the S-Gini family of inequality measures showed in Donaldson and Weymark (1980), which can be defined as a weighted average of the ratios of W_i and M for each individual:

$$I_\rho = 1 - \sum_{i=1}^{n} \left[\left(\frac{n-i+1}{n} \right)^\rho - \left(\frac{n-i}{n} \right)^\rho \right] \frac{W_i}{M} \tag{7}$$

In equation (7) all individuals are ranked from the worst-off to the better-off, and the expression between square brackets gives the weight for each individual. ρ is a parameter that shape the distribution of the variable. If $\rho = 1$, the same weight is assigned to each individual and $I_\rho = 0$ in equation (7), producing a SWI equal to M in equation (6). If ρ goes to infinity, the expression between square brackets in equation (7) gives only a weight equal to one to the worst-off of individuals, giving a result of $SWI = W_1$ in equation (6). Finally, if $\rho = 2$, equation (7) calculates the Gini coefficient of W_i.

Data

We use data from Gallup World Poll conducted in 2007. This poll uses a sample of people over more than 130 countries and it is nationally representative of individuals aged 15 and older. The typical World Poll survey in a country consists of 1,000 completed questionnaires and it includes urban and rural areas. Additionally, these surveys are conducted face-to-face or via telephone.[6]
The Poll uses a standard set of questions around the world, and it also includes some specific questions by region. This fact provides us an unique opportunity to perform cross-country comparisons, and it has been used numerous times to estimate life satisfaction and happiness regressions. Deaton (2007) and Helliwell et al. (2013) are some of the studies that have used the survey to perform analysis of life satisfaction and happiness, and compare the results among different countries.

[6]The telephone survey is conducted in countries where 80% or more of the population has landline phones. In countries where telephone interviewing is employed, Random-Digit-Dial (RDD) or a nationally representative list of phone numbers is used. Telephone methodology is typical in the United States, Canada, Western Europe, Japan, Australia, etc.

The Gallup World Poll conducts the survey in 10 South American countries; however, only Brazil, Argentina, Bolivia, Chile, Colombia and Peru contain enough information to perform the analysis. Although this is not the ideal survey to make the desired analysis, [7] it is the most complete existing survey, because it contains the life satisfaction, demographic questions, and some objective life dimensions.[8]

An important issue to consider is the fact that almost 20% of observations in the Poll do not contain information about household incomes. Therefore, the analysis is performed on a total of 4755 observations. Some statistical analysis were conducted to find the causes of missing information, but there is no evidence indicating that missing observations in household incomes are related with other household variables (For more details, see Appendix B).

Table 1 provides summary statistics of life satisfaction, life dimensions, and personal characteristics used in our analysis. The first column of Table 1 presents the average responses of life satisfaction question: "All things considered, how satisfied are you with your life as a whole these days?" Answers range from 0 (Very Dissatisfied) to 10 (Very Satisfied). Generally, all countries present high levels of life satisfaction. Brazil is the South American country with the highest average life satisfaction level, followed by Colombia and Argentina. Finally, Peru's score is the lowest in the poll.

Table 1: Summary Statistics

Country	Satisfaction	Life Dimensions			Personal Characteristics			
		Income	Health	Security	Female	Couple	Young	High Educ.
Brazil	7.46	12,094.10	7.94	37%	49%	55%	61%	9%
Argentina	7.14	17,179.06	7.53	44%	51%	53%	55%	8%
Bolivia	6.53	4,499.47	6.77	39%	48%	61%	63%	21%
Chile	6.22	17,319.39	6.87	38%	53%	51%	51%	19%
Colombia	7.29	9,837.09	7.79	54%	50%	52%	61%	16%
Peru	5.87	8,098.67	6.34	55%	50%	59%	62%	22%

Source: Gallup World Poll 2007.

Column 2 of Table 1 provides the average income of individuals calculated as the household income divided by the number of household's members. Also, it

[7] The desired survey must contain information about all life dimensions relevant for life quality, as well as demographic and satisfaction questions

[8] Other surveys like Latinobarometro and The Americas Barometer, only contain subjective questions. Moreover, quality of life surveys are only carried out at national level, and it precludes comparisons between countries

is standardized to coincide with the GDP per capita of each country (For more information, see Appendix A). This variable is one of the life dimensions considered in the model. In contrast with life satisfaction levels Argentina and Chile have the highest incomes, followed by Brazil. Finally, Bolivia has the lowest income of all countries in the study.

Columns 3 to 4 of Table 1 present the non-income life dimensions included in the model. Column 3 contains the average of health situation of the person, measured by their self-assessed heath, and it ranges from 0 (Worst State) to 10 (Best State). Finally, Column 4 presents the percentage of people who feel safety in each country. These 2 variables also appear in Figure 1, as relevant life dimensions to measure life quality.

Even though education is a life dimension included in Figure 1 as a determinant of individual well-being, it is also a variable that negatively affects the life satisfaction level, due to its influences in personal aspirations and expectations. In this way, a higher education is preferred for people, but at the same time it influences job aspirations, expected income earnings, among others. It is impossible to distinguish both effects of education in the specified model. For the reasons above, we decide to include education as a personal characteristic instead of as a life dimension.

The last four columns of Table 1 present personal characteristics as dummy variables: Being female, having a couple, being younger than 40 and having high education.[9] These variables are used to capture changes in aspirations and heterogeneity in preferences as shown in equation (3).

V. Results

In order to calculate Equivalent Incomes, we estimate preferences following equation (3). Life satisfaction is used as the dependent variable, and personal characteristics and life dimensions are included in regressions as independent variables. Additionally, we interact personal characteristics and country dummies with life dimensions to capture heterogeneity in preferences. In Table 2 we show the estimations of life dimensions coefficients over Life Satisfaction level. Since the dependent variable is ordinal, we employ an Ordered Logit specification at individual level.

[9]The dummy being younger than 40 was also used by Fleurbaey et al. (2009) in their analysis.

Table 2: Coefficients of life satisfaction regression

	Life satisfaction		
Age	-0.037	***	(0.009)
$Age^2/100$	0.039	***	(0.009)
High education	1.453	**	(0.62)
Argentina	-1.079		(0.9)
Bolivia	-1.653	**	(0.78)
Chile	-4.316	***	(0.887)
Colombia	0.067		(0.769)
Peru	-1.637	**	(0.738)
Log(Income)	0.247	***	(0.067)
Health	0.398	***	(0.016)
Security	0.338	***	(0.072)
Log(Income) x High educ.	-0.152	**	(0.066)
Health x Couple	0.029	***	(0.008)
Security x Young	-0.262	***	(0.094)
Log(Income) x Argentina	0.062		(0.098)
Log(Income) x Bolivia	0.134		(0.093)
Log(Income) x Chile	0.370	***	(0.097)
Log(Income) x Colombia	-0.016		(0.087)
Log(Income) x Peru	0.067		(0.084)
N	4755		
Pseudo R^2	0.080		

Standard Errors in parenthesis. * (p<0.10), ** (p<0.05) and *** (p<0.01). Results from Ordered Logit regressions.

We include as controls in the model: age, squared age, having high education, and country dummies. Other controls as being female were discarded due to the lack of significance. Dummy coefficients for Bolivia, Chile, and Peru are statistically significant and negative. These results are congruent with the averages presented in Table 1, where these countries were the lowest averages in life satisfaction. The effect of the variable age on life satisfaction shows us an expected U-shape similar to Argyle (1999) and Deaton (2007), reached the lowest average levels around 46 years old. Moreover, having high education indicates high satisfaction levels in average.

The effect of the logarithm of income on life satisfaction is positive and statistically significant. This effect is in line with findings of several studies such as Deaton (2007) and Layard (2005). Besides, the non-income life dimensions (health and security) also present positive and statistically significant coefficients, proving the direct relationship between these life dimensions and life satisfaction.

The significance of some interactions coefficients indicate the presence of heterogeneity in preferences. Specifically, we identify a significant difference in income preferences between individuals in Chile and other countries. These differences are captured by the interactions between the logarithm of income and the country dummies. We exclude the interactions between non-income life dimensions and country dummies, because none of the coefficients of interactions are statistically significant.

In order to test the parallel regression assumption, which is necessary to perform the ordered logit, we perform the Brant (1990) test (See appendix D) over the model, and we find no evidence that the proportionality assumption were violated by any relevant variable showed in Table 2.

Concluding the estimation process, we settle the reference values for life dimensions health and security as 10 and 1 respectively, based in their respective questions within the survey and the signs of non-income life dimensions coefficients showed in Table 2. We interpret the values above as the best possible state of health and security for each person.

With the estimations of heterogeneity in preferences and the reference values established, we proceed to calculate equivalent incomes at individual level using equation (5). Then, we use equation (6) to calculate the SWI of each country. Table 3 shows some rankings of SWIs by country using three different measures of individual well-being: life satisfaction, income and equivalent income. Furthermore, we use different parameters of ρ to change the inequality aversion as shown in equations (6) and (7).

Table 3: Ranking of Social Welfare Indexes by Country

Country	$\rho = 1$			$\rho = 2$		$\rho = 5$	
	Life Satisfaction	Income	Equivalent Income	Income	Equivalent Income	Income	Equivalent Income
Chile	6.22	17,319.38	1,668.97	7,722.73	162.06	3,930.91	6.27
Argentina	7.14	17,179.06	1,261.33	9,465.82	228.58	4,953.28	22.67
Brazil	7.46	12,094.10	2,273.12	5,856.95	353.70	2,964.58	30.62
Colombia	7.29	9,837.09	2,045.54	4,098.04	285.21	1,798.44	20.07
Peru	5.87	8,098.67	503.74	3,516.13	40.74	1,418.93	1.21
Bolivia	6.53	4,499.46	251.63	2,256.49	25.56	1,094.92	1.24

The first three columns of Table 3 present the SWIs for the three variables used

as individual well-being measures and taking $\rho = 1$. In this case, SWIs based on life satisfaction and income calculate the average found in Table 1. Otherwise, column 3 presents the average of equivalent incomes. Ranking of SWIs based on equivalent incomes present some differences with the SWIs based on income. This ranking presents Brazil as the country with the greatest value, followed by Colombia. Finally, Peru and Bolivia score the lowest values.

Changes in rankings of SWIs based on incomes and SWIs based on equivalent incomes, are due to the influence of health and security dimensions on equivalent incomes. We show in Table 1 that the highest values of health are presented by Brazil, Colombia and Argentina. Additionally; Colombia and Peru present the highest security perceptions in average. These values made Brazil and Colombia go up in the ranking of SWIs based on equivalent incomes, in comparison with the ranking of SWIs based on incomes.

Table 3 also calculates SWIs of equivalent incomes and income with $\rho = 2$, specifically it uses the Gini index coefficient as the inequality measure. SWIs of equivalent incomes set Argentina closest to Colombia, and it ranks Chile well below the first three countries. SWIs of income present little variations in rankings with respect to the SWIs with $\rho = 1$. Only Argentina change its score, this country places in the first position above Chile, because its very low inequality level (See Appendix E).

The last two columns of Table 3 contain values of SWIs with $\rho = 5$. SWI of equivalent incomes sets Argentina in second place above Colombia, and SWIs of income remain their rankings, but Brazil and Chile get closer. These incidents are due to the low and high inequality measures presented in Argentina and Chile respectively, when $\rho = 5$ (See Appendix E).

In summary, the health situation has a high influence in the value of equivalent incomes and therefore in SWIs of equivalent incomes. Moreover, High levels of inequality as presented by Chile and Colombia, produce falls in rankings as ρ increases.

Education as a life dimension

Figure 1 shows us the education as a life dimension of the individual well-being. As we explain in section IV, education affects life satisfaction in two ways, and the model we propose does not discriminate between them. If we assume that education only has a positive effect in life satisfaction, we could consider it as a life dimension. Since education is treated as a life dimension, we cannot interact it with the logarithm of income as shown in Table 2.

Table 4 shows the estimated coefficients assuming education as a non-income life dimension. Firstly, the coefficient of education is not statistically significant, which is expected, because this coefficient could also be capturing the negative effects, expressed by aspirations and expectations, of having high education on life satisfaction. In sum, if we assume education as a life dimension we cannot separate the two effects of this variable on life satisfaction, and therefore we cannot estimated the preferences of individuals in education with respect to income.

Table 4: Coefficients of life satisfaction regression with education as a life dimension

	Life satisfaction		
Age	-0.037	***	(0.009)
$Age^2/100$	0.040	***	(0.009)
Argentina	-1.002		(0.898)
Bolivia	-1.646	**	(0.78)
Chile	-3.900	***	(0.87)
Colombia	0.183		(0.766)
Peru	-1.466	**	(0.735)
Log(Income)	0.237	***	(0.067)
High education	0.030		(0.078)
Health	0.398	***	(0.016)
Security	0.333	***	(0.072)
Health x Couple	0.030	***	(0.008)
Security x Young	-0.257	***	(0.094)
Log(Income) x Argentina	0.053		(0.098)
Log(Income) x Bolivia	0.135		(0.093)
Log(Income) x Chile	0.324	***	(0.095)
Log(Income) x Colombia	-0.030		(0.087)
Log(Income) x Peru	0.047		(0.084)
N	4755		
Pseudo R^2	0.080		

Standard Errors in parenthesis. * (p<0.10), ** (p<0.05) and *** (p<0.01). Results from Ordered Logit regressions.

Additionally, we calculate the equivalent incomes assuming a reference value of having high education for variable education. We also perform the country rankings using the SWI function, the equivalent incomes, and different parameters of ρ. The ranking results were the same rankings of equivalent incomes presented in Table 3. We finally consider that having high education must be taken as a personal characteristic instead of a life dimension.

VI. Conclusions

Most rankings in Latin American countries are performed with GDP or HDI. These indicators are objective measures but do not respect individual preferences. Other rankings use subjective indicators as life satisfaction or happiness, but they cannot be compared due to the bias presented by personal aspirations and expectations.

We have argued that well-being measures must be calculated with objective variables that represent different dimensions of life and, for adding these dimensions in a synthetic index, we need to respect individual preferences. As a result, we use Equivalent Income as a measure of well-being, because it includes variables in different life dimensions, and these dimensions are added at individual level taking into account heterogeneity in preferences.

We consider the equivalent income as an attractive measure of well-being, even if we need to do dome assumptions in the choice of references values for non-income life dimensions. We then calculate equivalent incomes, taking into account the preferences of individuals by the different life dimensions, and the chosen references values. We also choose a specific function to calculate SWIs, using different degrees of inequality aversion. These SWIs give us different interpretations about how to rank well-being measures between countries and also give us a tool to perform sensitive analysis in this field, e.g. changing the value of ρ.

The results present an important change in rankings between SWIs of incomes and equivalent incomes, even if these measures are high correlated. Besides, SWIs of countries with remarkable differences in inequality measures present changes in rankings as ρ increase.

Clearly, we need to be careful with the information provided in the results, due to the selection of the method to estimate preferences and the lack of information in the survey. However, we show important results derived from the SWIs calculated with equivalent incomes. First, rankings of these SWIs are influenced by income and life dimensions in each country: e.g. Brazil ranks in first place, because of its high level of health and income. Second, we see that in presence of high differences in inequality, as presented between Argentina and Colombia, cause changes in the rankings as ρ increases.

Finally, we encourage throughout this study to perform more complete surveys both global and national level, including more questions about life dimensions, as seen in Figure 1. Besides, these surveys must include both objective and sub-

jective measures, to perform a better analysis of quality of life and well-being of countries.

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Appendix A. Procedure to calculate the income variable

The information about household income in the Gallup World Poll was obtained from the question "What is your total MONTHLY household income, before taxes? Please include income from wages and salaries, remittances from family members living elsewhere, farming and all other sources.". To answer the question, the respondents used a showcard with specific income intervals in local currency which varies depending on the country.

We take the midpoint of each interval, assuming an uniform distribution within each interval. After that, we divide the calculated household income on the number of members of each household to obtain the per capita income. To finishing, we standardized the average per capita income in each country to coincide with the respective GDP per capita corrected by PPP (Purchasing Power Parity) in 2007 provided by IMF in the "World Economic Outlook Database October 2014".[10] To standardize the per capita income, we multiply it with the GDP per capita of its country and divide by its arithmetic average calculated by country.

Comparing the Gini index calculated with the constructed income variable and the Gini index of the World Bank,[11] we show that the calculated Gini index for Bolivia and Brazil were underestimated. Final estimations and calculations were also performed with the World Bank Gini index and they yields the same results.

[10] http://www.imf.org/external/pubs/ft/weo/2014/02/weodata/weoselgr.aspx
[11] http://data.worldbank.org/indicator/SI.POV.GINI

Appendix B. Tests of missing values

About 20% of observations in the Poll were lost, due to missing data in household income variable. To probe that these missing data are not influenced by specific characteristics of individuals, we create a dummy variable (d) that takes the value of one if the observation does not report household income.

Table 5 presents the percentage of missing values presented by countries in the Poll, due to not reporting household income. The total percentage of missed observations is 18.4%, and its Standard deviation is 0.005, additionally Bolivia and Argentina are the countries with the most missing values in the Poll, with 27.6% and 25.1% respectively. Foregoing tell us, that missing data has no strong relation with the country, and it is possible to use the six countries in the analysis.

Table 5: Percentage of Missed Observations by Country

Country	**Mean**	**Standard. Dev**
Brazil	13.97%	(0.011)
Argentina	25.10%	(0.014)
Bolivia	27.60%	(0.014)
Chile	9.58%	(0.009)
Colombia	20.70%	(0.013)
Peru	13.80%	(0.011)
Total	18.40%	(0.005)

We also present in Table 6, the correlations between the Dummy variable d and the variables used in the regression of Table 2. d presents week correlation with some variables used in the analysis, but there is no reason to believe that these variables influence in the omission of household income.

Table 6: Cross Correlations

	Missed	Satisfaction	Female	Couple	Age	Educ.	Health	Security
Missed	1							
Satisfaction	0.031	1						
Female	0.037	-0.021	1					
Couple	-0.066	-0.014	0.010	1				
Age	-0.035	-0.072	0.015	0.208	1			
Education	-0.010	0.107	-0.053	-0.042	-0.242	1		
Health	0.038	0.456	-0.073	-0.070	-0.282	0.188	1	
Security	-0.006	0.038	-0.086	0.005	0.003	-0.033	0.043	1

For the reasons above, we can conclude that missing values in household income is not correlated or influence by any variable include in the analysis we performed. Furthermore, is possible to state that these missing data do not generate endogeneity problems in the regression presented in Table 2.

Appendix C. Cross correlations between individual well-being measures

	Equivalent Income	Income	Life Satisfaction
Equivalent Income	1		
Income	0.404	1	
Life Satisfaction	0.168	0.139	1

Appendix D. Brant (1990) Test of Parallel Regression Assumption

Variables	χ^2	p-value	df
All	408.35	0.000	171
Age	13.08	0.159	9
Age^2	15.24	0.085	9
High education	-22.88	-999.0	9
Argentina	9.52	0.391	9
Bolivia	10.66	0.300	9
Chile	14.94	0.093	9
Colombia	1.57	0.997	9
Peru	8.84	0.453	9
Log(Income)	14.3	0.112	9
Security	7.48	0.587	9
Health	11.27	0.258	9
Log(Income) x High educ.	14.28	0.113	9
Health x Couple	6.92	0.646	9
Security x Young	12.79	0.173	9
Log(Income) x Argentina	10.55	0.308	9
Log(Income) x Bolivia	8.28	0.506	9
Log(Income) x Chile	14.38	0.110	9
Log(Income) x Colombia	1.32	0.998	9
Log(Income) x Peru	9.21	0.419	9

Appendix E. Inequality measures by country

Country	$\rho = 2$		$\rho = 5$	
	Income	Equivalent Income	Income	Equivalent Income
Chile	0.55	0.90	0.77	1.00
Argentina	0.45	0.82	0.71	0.98
Brazil	0.52	0.84	0.75	0.99
Colombia	0.58	0.86	0.82	0.99
Peru	0.57	0.92	0.82	1.00
Bolivia	0.50	0.90	0.76	1.00