How Sensitive is Regional Poverty Measurement in Latin America to the Value of the Poverty Line?

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How sensitive is regional poverty measurement in Latin America to the value of the poverty line?

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Abstract

This paper contributes to the methodological literature on the estimation of international poverty lines for Latin America based on the official poverty lines chosen by the Latin American governments and commonly used in the public debate. The paper exploits a comprehensive data set of 86 up-to-date official extreme and total urban poverty lines across 18 countries in Latin America, as well as the recently updated values of the national purchasing power parity conversion factors from the 2011 International Comparison Program, and a set of harmonized household surveys. By using 3 and 6 US dollars per person a day at 2011 PPP as the extreme and total poverty lines for Latin America, this paper illustrates the sensitiveness of poverty rates to changes of the values of the poverty lines as a result of the recent update of the PPP values, the period of reference, and the relative cost of living across the countries in the region. The poverty lines with the 2011 PPP values lead to an increase in total poverty rates in Latin America when compared to the 2005 PPP values, while they leave the extreme poverty rate unaffected. In general, country-specific poverty rankings remain fairly stable to the values of the poverty lines selected.

JEL classification: I3, I32, D6, E31, F01

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1   Introduction

The international comparison of poverty measures is a central tool for development research. Comparing the performance of different countries in terms of poverty reduction is informative about the effect of structural characteristics, shocks, and policies on the well-being of the most vulnerable. Naturally, to carry out international comparisons, poverty should be measured consistently across countries. Unfortunately, at least for the purpose of research in international development, there is not a global protocol to measure poverty at the national level. In practice, poverty measurement differs from country to country in many respects, including: (i) the methodology to estimate the poverty line (e.g., relative vs. absolute lines, the minimum amount of calories, the choice of the reference group, or the procedure to go from extreme to total poverty lines); (ii) the choice of the individual welfare measure (e.g., income vs. consumption); (iii) the construction of the welfare aggregate (e.g., items included in the income or consumption variable or the treatment of implicit rent of own housing); (iv) the design of surveys (e.g., differences in questionnaire design); and (v) many other adjustments and considerations (e.g., adult equivalent scales vs. per capita values, economies of scale, and regional prices). Consequently, the comparison of official poverty estimates across countries is generally misleading. Thus, any attempt to generate meaningful poverty comparisons and to aggregate national poverty indicators into regional and global ones requires a standardized measure of household welfare and a common poverty line.

Ideally, the common poverty line should be constructed by agreeing on a bundle of goods, and computing the market price of that same bundle in all the countries. This undertaking however has proved difficult to materialize since it requires a high degree of international coordination. In Latin America, the United Nations, through its regional agency ECLAC, has made some inroads into that goal, but still countries in the region continue measuring poverty with substantial heterogeneity.

A body of research has proposed some alternative methods to obtain standardized measures of monetary poverty that are comparable across countries and independent of the official methodologies applied in each country. The most widespread accepted initiative is to define an international poverty line in US dollars and "translate" this value into local currency units using consumption purchasing power parity (PPP) exchange rates, computed by the International Comparison Program (ICP), a large project on price comparisons around the world.

The proposal requires setting a value in dollars for the international poverty line. To some extent this should not be an issue, since it is well known in the development literature that lines are arbitrary cultural constructions, given that there are not discontinuities in any well-being

indicator (Deaton 1997). A thorough poverty analysis should not be confined to a single line, but instead should consider a set of poverty lines, or better, check stochastic dominance conditions. However, it has proved useful in the policy debate, and in the development literature, to define some "focal" values for the poverty lines. These agreed values, although still arbitrary, are helpful to simplify the discussions.

The seminal work by Ravallion, Datt, and van de Walle (1991) proposed one of the first global extreme poverty lines at $1.01 (rounded to $1) per person per day at 1990 PPPs based on 1985 prices surveyed by the ICP.[1] This global extreme poverty line corresponded to the average of the poverty lines of the eight most deprived economies in the world and became the foundation for the United Nations' first Millennium Development Goals of halving the proportion of people with incomes lower than $1 a day between 1990 and 2015. This line was then revised by Chen and Ravallion (2001) to $1.08 per person per day at 1993 PPPs, and by Ravallion, Chen, and Sangraula (2009) to $1.25 per person per day at 2005 PPPs, the latter of which is known today as the Global Extreme Poverty Line and is computed as the average of the poverty lines of the 15 poorest countries in the world. Recently, Jolliffe and Prydz (2015) proposed an update of the Global Extreme Poverty Line which resulted in a poverty line of $1.92 per person per day in 2011 PPPs, while Ferreira et al. (2016) calculated it as $1.88 (rounded to 1.90) per person per day.

The Global Extreme Poverty Line frequently used for international poverty comparisons in the developing world was derived from poverty lines set in the poorest Sub-Sahara African countries; therefore, they have limited applicability in Latin America, a region composed mostly of urbanized middle-income economies. The share of the population under that line is lower than 5 percent in the region. Even the $2 per person per day poverty line, commonly used for middle-income countries, is "too low" compared with the lines officially chosen by the Latin American countries and used in the policy debate.[2] Consequently, these international lines fail to be "focal" and become irrelevant for all local discussions.

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[1] Ahluwalia, Carter, and Chenery (1979) used India's poverty line to estimate poverty at a global level based on the 1975 PPPs. This was the first attempt to measure global poverty, though it was based on income and consumption data from only 25 countries in the world (Ferreira et al. 2016).

[2] Most countries in the region officially use two poverty lines: an extreme (food) and a total (food and non-food) poverty line. Countries estimate their extreme poverty lines as the lack of per capita income required to access a basic food basket and expand them to non-food components using the Orshansky coefficient (Orshansky 1963).

Given this problem, many researchers and institutions like the World Bank, the Inter-American Development Bank (IADB), and ECLAC[3] use for Latin America an extreme and total poverty line of $2.5 and $4 per person per day in 2005 PPPs, respectively. Although there is not a formal document supporting this choice, Gasparini et al. (2013) report that these lines were close to the unweighted median of the poverty lines for the main urban areas of a sample of countries in 2005 (the sample excludes Brazil, the most populated country in the region).

In this paper, we provide inputs for deriving "focal" regional poverty lines by considering the US$ value of the extreme and total poverty lines officially chosen by the Latin American countries, and used in their own poverty and social policy debates. Besides providing a detailed description of the methodology, we improve the computations on several grounds. In particular, we exploit a unique data set of 86 official subnational urban poverty lines across 18 Latin American countries, as well as the recent 2011 PPPs from the ICP. We compute different weighted and unweighted statistics and carry out a robustness analysis of the results.

As far as we know, this study is the first one that explicitly documents the calculation of regional extreme and total poverty lines. Our proposal has some strengths compared to lines computed by other studies in the developing world. First, the proposed lines are based on a comprehensive list of all countries for which up-to-date data on official poverty lines are available (18 countries representing roughly 85.3 percent of Latin America's population in 2011 and almost all urban population of the region). As such, any existing bias in the estimation of the value of the regional poverty lines that results from excluding certain countries is likely to be relatively small.[4] Second, using up-to-date information from National Statistical Offices (NSO) in Latin America on poverty lines used to estimate official extreme and moderate poverty numbers in every country can be considered more transparent and easier to communicate to governments in the region. Third, the method proposed in this paper is relatively simple and easy to replicate, which is key to ensure credibility to the process (Ferreira et al. 2016). Fourth, this paper uses *subnational* official urban poverty lines when available, which accounts for regional disparities in the standard of living within countries and allows for the replication of countries' official poverty estimates. Finally, by using the most up-to-date poverty lines from NSOs in

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[3] López-Calva and Ortiz-Juarez (2014); Gasparini, Cicowiez, and Escudero (2013); Ferreira et al. (2012); World Bank (2015); World Bank (2014); World Bank (2013); World Bank (2011); Stampini et al. (2015), among others.

[4] Deaton (2010) argues that changes in the composition of the 15 countries used by Ravallion et al. (1991) result in significant changes in the value of the poverty line and the count of the poor worldwide (Jolliffe and Prydz 2015).

Latin America, our approach is less sensitive to changes in Consumer Price Index (CPI) data (Chen and Ravallion 2010; Jolliffe and Prydz 2015).

Depending on the specification chosen, the paper estimates the set of extreme and total poverty lines to be approximately $2.5 to $3.2, and $5.3 to $6.8 per person per day at 2011 PPP values, respectively. We then apply these lines to the distribution of household per capita income, which is standardized under the SEDLAC project, a joint initiative of the World Bank and the Center for Distributional Labor and Social Studies (CEDLAS) at Universidad Nacional de La Plata (UNLP) in Argentina,[5] in all Latin American countries for which microdata are available. Depending on the regional poverty line selected, we find that approximately 7 percent to 11 percent of individuals were extremely poor in 2013, while approximately 24 to 35 percent of the population were living with a per capita income lower than the total poverty line during the same year.

For the sake of illustration, we use the 3 and 6 US dollars per person a day at 2011 PPP as poverty lines for Latin America. Then, we estimate the sensitivity of the poverty rates to changes of the value of the regional poverty lines when changing the value of the PPP, the period of reference, and the relative cost of living across the countries in the region.

The rest of the document is organized as follows. Section 2 outlines the methodology and brings together the various sources of information used. Section 3 presents the results for the poverty lines, whereas section 4 reports the resulting headcount ratios. In section 5 we carry out a simulation exercise that quantifies the sources of differences between the poverty estimates under our proposal and those arising from the lines that are currently used by The World Bank and some researchers. Section 6 ends with some concluding remarks.

2   Methodology and data

Given the large heterogeneities across geographical areas, Latin American governments typically measure poverty by setting poverty lines at the subnational level. We propose to derive international aggregate poverty lines for Latin America from these subnational official poverty lines. Although the proposal is rather straightforward, some notation may clarify it. Define z_{rp} as the official poverty line for the subnational area r in country p expressed in a common currency.

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[5] CEDLAS and World Bank (2015).

As usual in the international studies, we express all lines in US dollars per person per day at purchasing power parity (PPP) values.

There are several ways to define an international line for a region comprised of several countries, such as Latin America. One possibility is to take the population weighted average of all the subnational poverty lines.

$$z_{AL}^1 = \sum_p \sum_{r \epsilon p} \alpha_r z_{rp} = \sum_p \alpha_p \left[\sum_{r \epsilon p} \alpha_{rp} z_{rp} \right] = \sum_p \alpha_p z_p \qquad [1]$$

where α_r (α_p) is the share of subnational area r (country p) in the population of Latin America, α_{rp} is the share of r in the population of country p and z_p is a population weighted average of the subnational poverty lines in country p.

Under this alternative, the international poverty line is strongly affected by the official lines set in highly-populated countries, such as Brazil and Mexico that include more than 55 percent of the Latin American population, and is almost unaffected by the official lines set in other less-populated nations, such as Uruguay with a share of the regional population of less than 0.6 percent. An alternative that avoids this feature and recognizes the special relevance of countries as political entities is to compute an unweighted mean of the country lines.

$$z_{AL}^2 = \frac{1}{P} \sum_p z_p = \frac{1}{P} \sum_p \left[\sum_{r \epsilon p} \alpha_{rp} z_{rp} \right] \qquad [2]$$

where P is the number of countries in Latin America. Finally, a third alternative could be to average out all the subnational lines ignoring any population weight.

$$z_{AL}^3 = \frac{1}{R} \sum_p \sum_{r \epsilon p} z_{rp} \qquad [3]$$

where R is the number of subnational units for which official poverty lines are computed. Unlike the poverty line in equation [1], the international poverty line in this case is not affected by the size of the population. However, this alternative is strongly affected by countries that consider a relatively large set of subnational official poverty lines (e.g., Colombia has more than 23 poverty lines, while Chile, Ecuador, Haiti, and Nicaragua have only one official poverty line).

Equations [1] to [3] illustrate the different alternatives with a measure of central tendency: the mean. In the empirical implementation, we also compute the *median* for each case, which has the convenient property of being less sensitive to extreme values.

To implement the methodology, we use three different data sets: (i) country-specific official poverty lines from National Statistical Offices, (ii) the PPPs from the 2011 ICP round, and (iii) household per capita income distribution from harmonized household surveys.

2.1   Country-specific official poverty lines

We make use of data on subnational official extreme and total poverty lines that correspond to closest to the last 2011 PPP round. These lines were obtained from NSOs or governmental agencies from 18 countries in Latin America: Argentina, Bolivia, Brazil,[6] Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, and Uruguay.[7] We collect more than 80 subnational urban[8] poverty lines, accounting for regional disparities within countries by capturing subnational heterogeneities in the standard of living.[9]

The level of subnational disaggregation varies from country to country. For some countries poverty lines are determined at the level of cities (e.g., Colombia), while for others they are determined at the regional level (e.g., Brazil). In some few cases, there is just one line at the national level (e.g., Nicaragua). Almost all poverty lines are in per capita terms; the only exceptions are Argentina where poverty lines also consider household composition and Uruguay where the non-food component of the poverty line accounts for economies of scale.

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[6] The Brazilian case is different from the rest; the country does not have an official poverty line. For the purpose of this paper, we use subnational poverty lines calculated by Institute for Applied Economic Research (IPEA, for its acronym in Portuguese) updated on a yearly bases based on the CPI (IPEA 2014).

[7] Cuba and Venezuela are not included in this study due to the lack of microdata from SEDLAC project in both countries and the lack of poverty lines in the case of Cuba. The estimation of the international poverty lines is robust to the inclusion of Venezuela.

[8] See section 2.3 for the reason we restrict the analysis to urban poverty lines.

[9] The pioneering work of Ravallion, Datt, and van de Walle (1991) gathered a compilation of 33 non-official national poverty lines for the whole world, while Ravallion, Chen, and Sangraula (2009) used data on 88 poverty lines extracted from the World Bank's program of country Poverty Assessments that have been carried out since 1990 worldwide. In a recent paper Jolliffe and Prydz (2016) compute implicit national poverty lines from combining official poverty headcounts, as reported in World Bank Poverty Assessments, with the corresponding consumption and income distributions from the World Bank's PovcalNet database. One caveat of this exercise is that the combination of official poverty rates with unofficial harmonized micro-data sets from PovcalNet may result in poverty lines that deviate from the official ones, which is the case for Latin American countries.

2.2 Purchasing power parity exchange rates

In order to compare the standard of living of households across countries in Latin America, household welfare needs to be expressed in common units. Pursuing that purpose, the ICP launched in May 2014 an update of its PPP data based on information of goods and services for almost every country in the world.[10] The updated PPP data allow for the comparison of household welfare across countries by providing a real exchange rate from local currency to US dollar in a particular year—2011 in this case.[11] The 2011 update of PPPs increased its coverage, collecting prices from 199 countries in the world, up from 146 in the previous update, and included several methodological and operational improvements with respect to 2005.[12]

Why not use exchange rates to express welfare measures in common units across countries? The main difference between the PPP data and the nominal exchange rate is that the former is created as an index of prices of the same basket of goods in the same period, whereas the latter is the price of a local currency in terms of a foreign one (i.e., the rate by which both currencies are exchanged). The nominal exchange rate reflects prices of only tradable goods and, hence, a significant proportion of goods and services consumed by the population are not taken into account (Ferreira et al. 2016). Thus, the exchange rate is not appropriate to compare levels or changes over time of any economic indicator, as it does not express the current cost of living of an economy based on the prices of a fixed basket of commonly purchased goods and services.

2.3 The problem of rural areas

The methodology outlined so far ignores one relevant limitation: the 2011 ICP round collected prices in Latin America only for urban areas (World Bank 2014a; Ravallion 2018).[13] Given this limitation, the deflation of rural poverty lines using an urban PPP factor would underestimate the value of the regional poverty line, since the cost of living tends to be higher in urban areas than in rural areas. Therefore, the inclusion of rural lines in the calculation of the Latin American aggregate line creates a downward bias; the size of that bias is a function of the differences in

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[10] The ICP includes nearly 200 countries. Some countries did not participate in the program. As stated in the official report, Afghanistan, Argentina, Lebanon, Libya, South Sudan, and the Syrian Arab Republic are the only large economies that did not take part in the 2011 ICP round.

[11] One of the new features of the 2011 ICP round is the availability of global PPP values in addition to USD PPP. For this paper, we still consider the USD PPP values.

[12] See Ferreira et al. (2016) for a detailed description of the 2011 PPP data.

[13] According to the meta data from ICP, about 29 percent of the 189 countries in the ICP and only one country in Latin America included rural areas in the price surveys (Ravallion 2018).

prices between rural and urban areas. Given that bias of unknown size, we decided to ignore all rural official poverty lines in our analysis, and therefore compute international *urban* poverty lines. Section 3 tests the robustness of our estimations to the inclusion of rural poverty lines.

2.4   Income distribution from harmonized household surveys

To estimate poverty measures that are comparable across countries, we need to increase the cross-country comparability of the welfare measures. To that aim we use the SEDLAC database as the primarily source of comparable welfare aggregates across the Latin American countries. SEDLAC is a harmonized database of LAC's households' surveys compiled by the poverty group at the World Bank in partnership with the Center for Distributive, Labor, and Social Studies (CEDLAS, for its acronym in Spanish) at the Universidad Nacional de La Plata in Argentina.[14] The main objective of this comprehensive data set of household surveys is to increase cross-country comparability of a range of socioeconomic measures, including household total income, from more than 300 household surveys within 18 countries in Latin America from the 1970s to the present. Following the practice of most countries in the region, in this paper we measure poverty based on household per capita income at the individual level.[15]

3   Regional poverty lines

Figure 1 shows the relationship between official per capita extreme (panel a) and total (panel b) poverty lines and per-capita household income from harmonized household surveys in the SEDLAC database in 2011.[16] The figure reports the nominal value of poverty lines – at 2011 PPP values[17] – for 18 countries in Latin America at the highest possible level of geographical

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[14] Bourguignon (2015) presents a detailed evaluation of the SEDLAC data set.

[15] NSO's statistics and SEDLAC figures serve different purposes. The first ones are the best possible representation of individual countries, while the second ones represent regional comparable indicators. Therefore, poverty estimates presented in this paper should not be interpreted as a claim of methodological superiority over official poverty estimates.

[16] The existing relationship in the graph may be considered spurious if poverty lines were calculated based on the same household surveys used in the graph. This is not the case for the countries covered in this paper; all poverty lines have been computed in different household surveys from the ones used in the figure.

[17] For those cases for which the poverty lines were not reported at 2011 PPP values, we deflated the closest value using national CPIs. Although countries have already published lines for more recent years, we prefer to use the figures corresponding to the nearest year as the last 2011 PPP round.

disaggregation.[18] Unlike some studies for the developing world,[19] Figure 1 suggests that in Latin America there is not a significant correlation between the value of the poverty line and the level of per capita income. This result is valid for different regression specifications (seeTable **1**) using poverty lines both at the subnational, as well as at the national (i.e., population-weighted average of subnational lines) level. Given this result, we decided to consider all available information to compute regional poverty lines, rather than only data from the poorest economies, as done by Ravallion, Chen, and Sangraula (2009).

Table 2 presents population-weighted averages of extreme and total urban official poverty lines for all countries in Latin America in 2011, and Figure 2 shows the density function of all subnational official poverty lines. Extreme poverty lines fall within a limited range between $2 and $4.4 per person per day, while total poverty lines are more disperse, ranging from $4 to $12.2 per person per day. This implies that the total poverty lines of some countries are lower in PPP terms than the extreme poverty line of other countries. For instance, the population-weighted average extreme poverty line of Paraguay ($4.4 a day) is slightly higher than the population-weighted average total poverty lines of Nicaragua, Ecuador, and Brazil.

The relatively large dispersion of the total poverty lines is also evident in Figure 3, which presents the cumulative distribution function (CDF) of the total number of official extreme and total urban poverty lines at the subnational level. The figure shows that the rank of the subnational regions based on the extreme official poverty lines is different from the rank based on total official poverty lines, suggesting a large variation of the Orshansky coefficients in Latin America. Additionally, the slope of the CDF based on extreme poverty lines is steeper than the one based on total poverty lines, which suggest that there is more heterogeneity in the normative cost of living when non-food items are added to the overall household consumption bundle.

Additional key messages emerge from Figure 3. First, there is a substantial overlap between subnational poverty lines – both extreme and total – across countries in Latin America. Taking Brazil as an example, Leste-Urban Area has the lowest total poverty line ($3.5 per person per day) in Latin America, which is considerably lower than the total poverty line of Region Pampeana in Argentina ($4.8 per person per day). By contrast, the metropolitan Area of Porto Alegre in Brazil has a total poverty line of $5.5 per person per day, which is above the median total poverty line in Latin America ($5.3 per person per day) and considerably higher than total

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[18] For the case of Chile, Ecuador, Haiti, and Nicaragua, the official poverty lines are published at the national level and there is no distinction between urban and rural areas or subnational regions.

[19] Ravallion et al. (2009), Ferreira et al. (2016), Jolliffe and Prydz (2016).

poverty lines in subnational areas of Argentina. Second, there is large heterogeneity in terms of the number of subnational poverty lines by countries. For instance, Colombia has 23 regional poverty lines, whereas Chile, Ecuador, Haiti, and Nicaragua have only one national poverty line. Finally, there are some extreme values of national poverty lines that could substantially increase the mean value of the regional poverty lines. For instance, Montevideo-Uruguay's total poverty line is $14.9 per person per day, which is considerably higher than the rest of the total poverty lines in Latin America.

Panel A of Table 3 presents the mean and median of the extreme and total urban poverty lines in Latin America in US dollars a day per person at PPP, using different weights according to equations [1] to [3] above. The first row (z_{AL}^1) shows a population-weighted mean (or median) of all the subnational official urban poverty lines in Latin America; the second row (z_{AL}^2) shows the unweighted mean (median) of the country lines, computed as population-weighted means of the subnational lines, whereas the third one (z_{AL}^3) is an unweighted mean (median) of all the available subnational official lines.

Regional extreme poverty lines based on the most up-to-date official extreme poverty lines are approximately $3 per person per day on average, while regional total poverty lines are approximately $6 per person per day on average. However, there is variation across different specifications in the table. Extreme and total regional poverty lines based on mean values of the official poverty lines are higher than those based on median values, which provides evidence of the impact that outliers have on regional averages of poverty lines. Similarly, unweighted poverty lines are higher than the population-weighted poverty lines, which is evidence of the existing heterogeneity in terms of the size of the subnational population and the number of poverty lines by country.

Panel B of Table 3 test the robustness of the estimates to the inclusion of rural poverty lines. Since the 2011 ICP round collected prices in Latin America only for urban areas, the rural poverty lines are deflated using an urban PPP factor in panel B of the table. Results remain fairly stable. However, the deflation of rural poverty lines using an urban PPP factor underestimates the value of the regional poverty line if they are not adjusted by urban prices first. Therefore, we prefer to avoid the use of rural poverty lines in our estimates.

As discussed above, although poverty lines are social constructions and poverty analysis could be carried out without reference to a given line, in practice it has proved useful to define a sensitive "focal" value for the poverty line that helps to simplify the discussions. In that sense, and given the results in Table 3, we propose the use of the poverty lines of 3 and 6 US dollars per person per day at 2011 PPP as focal regional lines for poverty comparison in Latin America.

Based on these two lines, we then illustrate the sensitivity of the poverty rates to the value of the poverty lines when changing the PPP values, the period of reference, and the relative cost of living across countries.

4 Poverty estimates

In this section, we compute poverty headcount ratios based on the regional poverty lines suggested in Table 3. As discussed above, and given the lack of rural data for the PPP adjustments, the regional lines are only urban. However, in this section we decided to report *national* poverty estimates, since national statistics are the ones usually considered in the policy debates. As a rough approximation to consider lower consumption prices in rural areas we follow Deaton and Dupriez (2011) and Chen and Ravallion (2010) and multiply all rural incomes by the ratio between urban to rural poverty lines.[20]

Using the set of extreme poverty lines shown in Table 3 (between $2.5 and $3.2 per person per day), the extreme poverty rate would have ranged from 7 to 11 percent in 2013. Similarly, using the total poverty lines (between $5.3 and $6.8 per person per day), the total poverty rate would have varied from 24 to 35 percent in the same year.

As we showed above, the difference in the number of subnational poverty lines by country, the presence of outliers, and the size of the subnational population affect the value of the poverty line. For the sake of simplicity, the following analysis uses $3 and $6 per person per day as the values for the extreme and total poverty lines, respectively. When rounded, these values result from averaging each column of Table 3.

Table 4 presents the country-specific poverty estimates in 2013 based on these selected extreme and total poverty lines and the 2011 PPPs. Poverty headcounts vary considerably across countries in Latin America. For instance, Uruguay has the lowest extreme and total poverty rate in Latin America, with approximately 1.8 and 9.8 percent of the population living with a per capita income lower than $3 and $6 per person per day in 2013, respectively. On the other extreme Haiti has the highest extreme and total poverty rate; approximately 67.2 and 85.7 percent of the population live with a per capita income lower than $3 and $6 per person per day, respectively.

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[20] We use the average value of all the country specific urban to rural poverty lines ratios for countries that have only one poverty line.

The last row of Table 4 shows the extreme and total poverty rates in Latin America as a whole based on the $3 and $6 per person per day poverty lines and the 2011 PPPs. By 2013, approximately 9.8 percent of the population lived with a per capita household income lower than $3 per person per day in 2011 PPPs. Similarly, approximately one in three Latin Americans qualified as poor in 2013, living with a per capita household income lower than $6 per person per day.

5   Comparison with other lines

As commented above, and given the lack of a study on regional poverty lines, researchers and The World Bank have been using the lines of $2.5 and $4 at 2005 PPP. It is interesting to analyze whether the poverty rates computed with these lines substantially differ from the ones under our proposal. To explore this issue, Figure 4 presents the comparison between country-specific extreme and total poverty rankings based on the $3 and $6 per person per day poverty lines and the 2011 PPPs with the corresponding estimates based on the $2.5 and $4 per person per day poverty lines and the 2005 PPPs. Any deviation from the 45-degree line denotes differences between the poverty rankings. The figure shows that, with few exceptions, most notably the Dominican Republican and Mexico, country-specific extreme and total poverty rankings are generally stable to the value of the poverty lines.

Poverty headcounts calculated using 2011 PPP values differ from those calculated using 2005 PPP values, not only because the value of the poverty lines is different, but also because the base year (i.e., 2005 or 2011) and the relative costs of living between countries (i.e., 2011 PPP round or 2005 PPP round) are different. For instance, an extreme poverty line of $2.5 per person per day in 2005 PPP values is different from an extreme poverty line of $2.5 per person per day in 2011 PPP values. As explained above, the $2.5 per person per day poverty line at 2011 PPP values is lower, in real terms, than a $2.5 per person per day poverty line at 2005 PPP values. The difference between the headcounts calculated with both poverty lines is due not only to the general inflation in prices that all the countries experienced, but also to the fact that (i) the relative prices between countries – reflected in the PPP values – changed from 2005 and 2011, and (ii) the set of underlying official poverty lines used to calculate the regional lines also changed. In this case, to obtain the same poverty rate of the $2.5 line at 2005 PPP values in 2011 PPP values, it is necessary to set the poverty lines at $3.2 per person per day.

Thus, the difference between the poverty headcounts using both the poverty lines in 2005 PPP values and the ones in 2011 PPP values can be decomposed into three components. The first

component is the change of the level of the nominal value of the poverty line. In the case of the extreme poverty line, the nominal value of the line in our example changed from $2.5 to $3 per person per day and from $4 to $6 per person per day for the case of the total poverty line. The second component is the effect of changing the base period from 2005 PPP values to 2011 PPP values. That is, the welfare aggregate of each country is deflated to either 2005 or 2011 PPP values using its corresponding CPI. As the CPI of each country evolved differently over time, the welfare distribution of the Latin American region as a whole would differ depending on whether the base year is 2005 or 2011. Finally, the third component is the effect of changing the spatial deflator (i.e., relative prices) from 2005 PPP to 2011 PPP. Most of the countries in Latin America—except for Guatemala, Panama, Peru, and El Salvador—experienced a depreciation of their currencies as the 2011 PPP values are higher than the 2005 PPP values.

To understand the effect of each component mentioned above, we estimate the Shapley value of the marginal effect of each component in the change of poverty headcount. That is, by leaving two of the components constant, we change one of the components from its corresponding value in 2005 PPP values to its value in 2011 PPP values. Then, we repeat this process five more times until we have calculated all the possible combinations.[21]

Figure 5 shows the results of the Shapley decomposition for the changes in both extreme and total poverty using the welfare aggregate of the closest household survey of each country to 2013. In the case of total poverty, the decomposition shows a substantial poverty-increasing effect of 14.9 percentage points from changing the nominal value of the poverty line and leaving unchanged the other two components. However, the currently-used $4 per person per day poverty line at 2005 PPP values and the $6 per person per day poverty line at 2011 PPP values are expressed in different spatial and temporal units. With respect to the PPP effect (i.e., the spatial adjustment effect), poverty headcount would increase by 3.2 percentage points, everything else constant, and the base period effect (i.e., the temporal adjustment effect), would reduce poverty by 11.3 percentage points, counterbalancing the significant positive effect of changing the nominal value of the poverty line. The net change is approximately 6.8 percentage points in 2013. On the other hand, the base period effect offsets the positive contribution of the PPP and the nominal value effects to the extreme poverty rate, leaving the proportion of extreme poor unchanged in 2013.

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[21] The number of possible combinations is equal to the factorial (n!) of the number of components. See the annex for more technical details.

Unlike the majority of countries in Africa and South Asia, where the changes in poverty measurement using the 2011 PPP values reinforced poverty reduction (Dykstra, Kenny, and Sandefur 2014), the poverty measurement with the 2011 PPP values leads to an increase in total poverty in Latin America and does not affect the extreme poverty.

6   Concluding remarks

Most countries monitor their own citizens' welfare and measure their living conditions on a regular basis. However, poverty measurement methodologies vary considerably across countries, which makes cross-country comparison and aggregations into regional and global trends difficult. To assess the world population's welfare, international organizations and researchers have promoted standardized methods to determine comparable cross-country poverty estimates by harmonizing a spatially-deflated welfare aggregate and by estimating a unique poverty line. At the regional level, $2.5 and $4 per person per day at 2005 PPP values have become the poverty lines widely used in Latin America. Using these lines, 12 percent of the population in the region qualified as extremely poor in 2013, while 24 percent qualified as poor during the same year.

This paper provides inputs to guide the update of regional extreme and total poverty lines for measuring poverty in Latin America as a whole, and it is the first attempt to explicitly propose and document these inputs in the region. The recently released 2011 PPPs represent an excellent opportunity to estimate regional extreme and total poverty lines in Latin America. To achieve this objective, we collected the most comprehensive and up-to-date available information on extreme and total official urban poverty lines combined with the standardized microdata available under the SEDLAC project. Unlike previous global estimates, we do not find a strong relationship between per capita income and the value of the poverty line. Therefore, we did not exclude any countries from regional estimates in LAC.

This paper sets regional extreme and total poverty lines ranging from $2.5 to $3.2 and from $5 to $6.8 per person per day, respectively. Depending on the regional poverty line selected, we find that approximately 7 to 11 percent of Latin America's population qualified as extremely poor in 2013, while approximately 24 to 35 percent of the population qualified as poor. To illustrate the sensitiveness of the poverty rate to the value of the poverty line, we compare the results of using $3 and $6 US dollars per person per day at 2011 PPP with the $2.5 and $4 dollars per person per day at 2005 PPP. The poverty lines with the 2011 PPP values lead to an increase in total poverty rates in Latin America with respect to the 2005 PPP values, while

they leave the extreme poverty rate unaffected. We believe that the approach described in this paper, together with the results and underlying data, could serve as valuable inputs for guiding the regional debate on poverty measurement in Latin America.

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Annex A. Shapley decomposition of change in regional poverty methodology from PPP 2005 to PPP 2011

A poverty rate P_s could be defined as non-linear function φ with components s—poverty line, CPI, and PPP. There are two possible values for: $\{a, r\}$, where a and r refer to the proper set of components used to estimate the poverty headcount using either alternative (a) or currently-used (r) poverty lines. Thus, the poverty rate is defined as $P_s = \varphi(y_s, z_s)$; where z_s represents the poverty line of the set of components s, while $y_s^t = \pi(y, cpi_s, ppp_s)$ is a vector of household incomes in time t that has been deflated using the set of components s.

Under this framework, equation (1) shows that the difference between P_a and P_r is not wholly due to changes in the poverty line, but also to spatial and temporal deflation using PPP and CPI, respectively.

$$P_a - P_r = \varphi(y_a, z_a) - \varphi(y_r, z_r) \tag{1}$$

Given that the differences between the two welfare distributions y_a and y_r are fully characterized by the use of different country specific CPI and PPP, equation (1) could be expressed as:

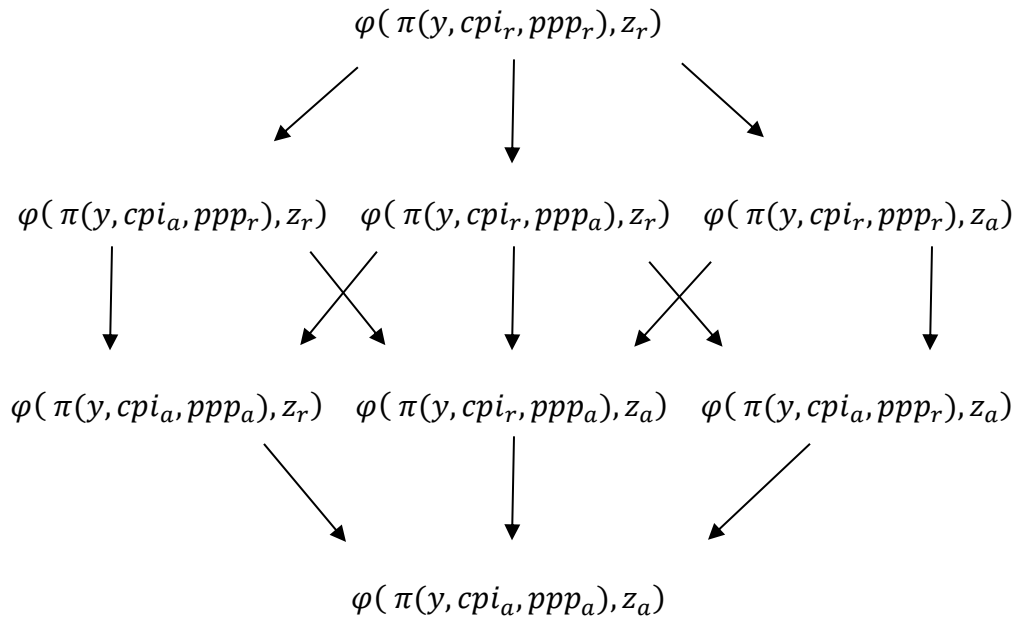$$P_a - P_r = \varphi(\pi(y, cpi_a, ppp_a), z_a) - \varphi(\pi(y, cpi_r, ppp_r), z_r) \tag{2}$$

Notice that the poverty headcount function φ is not additively separable among its components, which means that the sum of the marginal effects of all the components is not equal to the total change. Therefore, in order to understand the contribution of each of the components, a decomposition procedure for distributional analysis based on the Shapley value suggested by Shorrocks (2012) is applied to estimate the relative weight of each component of the difference in equation (2).

The Shapley-Shorrocks procedure consists of constructing a counterfactual headcount based on different combinations of components by substituting each component at a time. Then, the poverty headcount obtained by modifying only one component at a time, say the PPP component ($\varphi(\pi(y, cpi_a, ppp_b), z_a)$), would play the role of a counterfactual headcount of the PPP component, which can be interpreted as the poverty headcount obtained if the PPP had changed while the other components remained constant. Thus, the marginal contribution of the PPP would be the differences between the counterfactual headcount and the observed headcount, $\varphi(\pi(y, cpi_a, ppp_a), z_a)$. As explained above, given that the poverty headcount is a function of

three components, the procedure above is done six times to account for all possible combinations.[22]

Given that the marginal effects of each component do not sum up to the total change between the headcounts obtained with the currently-used and the alternative poverty lines, the decomposition suffers from path dependency. Additionally, the order in which each component is changed affects the marginal effects of each component. To solve that issue, the Shapley-Shorrocks value of a component is the average of all possible marginal effects that results for changing that particular component. The graph below shows each path that allows computing these marginal effects for the three components.

Figure A.1. Shapley Decomposition Paths

$$\varphi(\,\pi(y, cpi_r, ppp_r), z_r)$$

$$\varphi(\,\pi(y, cpi_a, ppp_r), z_r) \quad \varphi(\,\pi(y, cpi_r, ppp_a), z_r) \quad \varphi(\,\pi(y, cpi_r, ppp_r), z_a)$$

$$\varphi(\,\pi(y, cpi_a, ppp_a), z_r) \quad \varphi(\,\pi(y, cpi_r, ppp_a), z_a) \quad \varphi(\,\pi(y, cpi_a, ppp_r), z_a)$$

$$\varphi(\,\pi(y, cpi_a, ppp_a), z_a)$$

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[22] The number of changes is equal to n!, where n is the numbers of components.

For instance, in the case of the poverty line component, the Shapley value $\left(\frac{dP_{r,a}}{dz_{r,a}}\right)$ is the average of poverty headcount differences when just the poverty line switches from z_r to z_a for all the possible paths. Thus, the sum of each marginal effect is equal to total change in poverty headcounts. Algebraically,

$$\frac{dP_{ra}}{dz_{ra}} = \frac{2}{6}[\varphi(\pi(y, cpi_r, ppp_r), z_a) - \varphi(\pi(y, cpi_r, ppp_r), z_r)] \quad (3)$$

$$+ \frac{1}{6}[\varphi(\pi(y, cpi_a, ppp_r), z_a) - \varphi(\pi(y, cpi_a, ppp_r), z_r)]$$

$$+ \frac{1}{6}[\varphi(\pi(y, cpi_r, ppp_a), z_a) - \varphi(\pi(y, cpi_r, ppp_a), z_r)]$$

$$+ \frac{2}{6}[\varphi(\pi(y, cpi_a, ppp_a), z_a) - \varphi(\pi(y, cpi_a, ppp_a), z_r)]$$

Table 1. Parametric estimation of regional poverty lines in LAC, 2011

Coefficients	Extreme poverty lines			Total poverty lines		
	OLS		Q-reg p(50)	OLS		Q-reg p(50)
	Subnational	National	Subnational	Subnational	National	Subnational
	[1]	[2]	[3]	[4]	[5]	[6]
Log per capita income	0.002	0.534	-0.070	0.155	0.957	-0.160
	[0.235]	[0.541]	[0.126]	[0.493]	[1.278]	[0.220]
Constant	2.810*	-0.077	2.972***	4.980	0.741	6.821***
	[1.444]	[3.335]	[0.772]	[3.023]	[7.818]	[1.348]
Obs.	74	16	74	74	16	74
R-squared	0.000	0.065	-	0.001	0.039	-
Forecast for lowest income (Haiti)	2.82	2.41	2.49	5.70	5.19	5.71

Data source: Calculations based on official poverty lines from NSOs' in the region. Note: Standard errors between brackets. * Significant at 10%, ** significant at 5%, and *** significant at 1%. The table shows Ordinary Least Square (OLS) and Quantile Regressions (QR)—50th percentile—of poverty lines as dependent variable and log household per capita income as regressor. Columns 1 and 4 show the OLS regression of all subnational extreme and total poverty lines shown in Figure 3 while columns 2 and 5 are based on national averages of subnational poverty lines shown in Table 2. Columns 3 and 6 show QR of all subnational poverty lines. The last row shows the estimated value of the regression for Haiti, the poorest country in LAC. All regressions exclude outliers – i.e., the highest and lowest value of each poverty line. For instance, regressions for extreme poverty lines in columns 1 through 3 exclude Leste-urban in Brazil and Metropolitan Area in Paraguay (see Figure 3), as these values are the lowest and the highest, respectively.

Table 2. Population-weighted average of official urban poverty lines in LAC, 2011

Country	Poverty lines in 2011 PPPs ($/ per person per day)	
	Extreme	Total
	[1]	[2]
Argentina	2.33	5.04
Bolivia	4.02	7.62
Brazil	2.19	4.39
Chile	2.98	5.96
Colombia	2.52	5.91
Costa Rica	4.07	8.85
Dominican Republic	2.99	6.64
Ecuador	2.48	4.40
El Salvador	3.04	6.08
Guatemala	4.00	8.88
Haiti	2.01	3.95
Honduras	4.45	8.90
Mexico	3.78	8.11
Nicaragua	2.35	4.00
Panama	3.48	7.37
Paraguay	4.45	7.14
Peru	3.11	6.11
Uruguay	3.54	12.23
Venezuela, RB	3.45	6.90

Data source: Calculations based on official urban poverty lines from NSOs' in the region. Note: Poverty lines are population-weighted averages of subnational official extreme and total poverty lines. Chile, Ecuador, Haiti, and Nicaragua have only one national poverty line.

Table 3. Regional poverty lines in LAC, 2011

| Lines	Mean		Median	
	Extreme [1]	Total [2]	Extreme [3]	Total [4]
Panel A: Urban poverty lines alone				
z_{AL}^1	2.8	5.9	2.5	5.3
	(0.21)	(0.49)	(0.37)	(0.85)
z_{AL}^2	3.2	6.8	3.1	6.6
	(0.16)	(0.45)	(0.29)	(0.53)
z_{AL}^3	2.9	6.1	2.6	5.9
	(0.08)	(0.17)	(0.10)	(0.05)
Panel B: Urban and rural poverty lines				
z_{AL}^1	2.8	5.6	2.5	5.1
	(0.19)	(0.44)	(0.29)	(0.68)
z_{AL}^2	3.0	6.2	3.0	6.3
	(0.13)	(0.38)	(0.24)	(0.45)
z_{AL}^3	2.8	5.8	2.6	5.8
	(0.06)	(0.14)	(0.04)	(0.15)

Data source: own calculations based on NSOs' information. Note: The first row (z_{AL}^1) shows a population-weighted mean (or median) of all the subnational official urban poverty lines in Latin America; the second one (z_{AL}^2) is an unweighted mean (median) of the country lines (computed as weighted means of the subnational lines), whereas the third one (z_{AL}^3) is an unweighted mean (median) of all the available subnational official lines. Bootstrapped standard errors with 100 repetitions are between parenthesis.

Table 4. Extreme and total poverty rates in LAC using selected poverty lines in 2011 PPPs, 2013

| Country	Poverty Headcount (%)	
	Extreme ($3/day)	Total ($6/day)
	[1]	[2]
Argentina	3.4	12.2
Bolivia	12.0	30.5
Brazil	8.6	24.9
Chile	2.2	11.9
Colombia	12.6	34.9
Costa Rica	3.6	14.6
Dominican Rep.	9.2	36.5
Ecuador	9.7	35.3
El Salvador	7.7	34.4
Guatemala	17.2	48.5
Haiti	67.2	85.7
Honduras	31.4	59.7
Mexico	12.2	40.6
Panama	7.2	21.3
Paraguay	5.2	20.8
Peru	8.3	26.4
Uruguay	1.8	9.8
LAC	9.8	30.2

Source: Authors' own calculations based on SEDLAC (CEDLAS and the World Bank). Note: Poverty rates are based on $3 and $6 per person per day extreme and total poverty lines, respectively.

Figure 1. Official poverty lines and per capita household income in Latin America, 2011
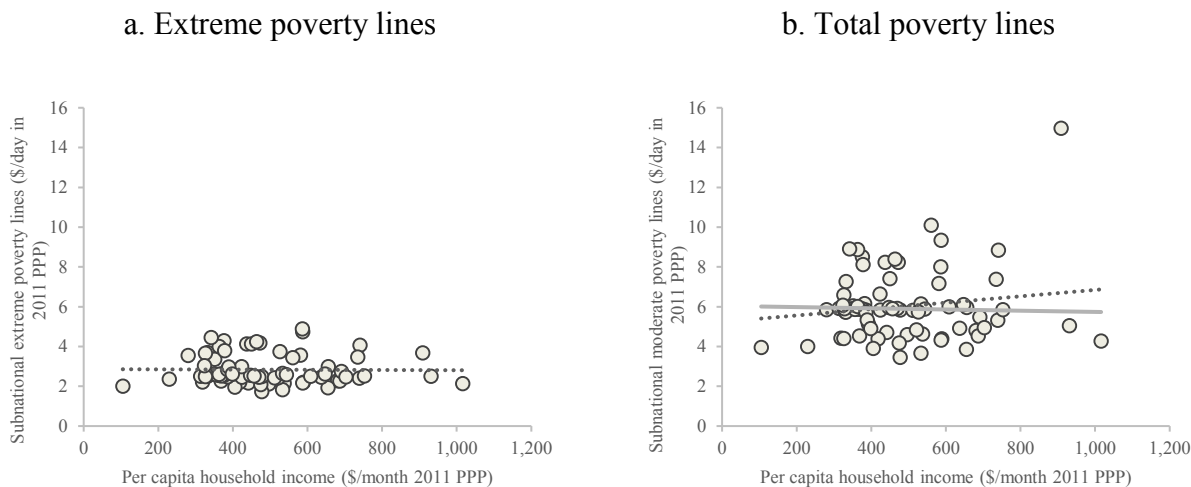
a. Extreme poverty lines
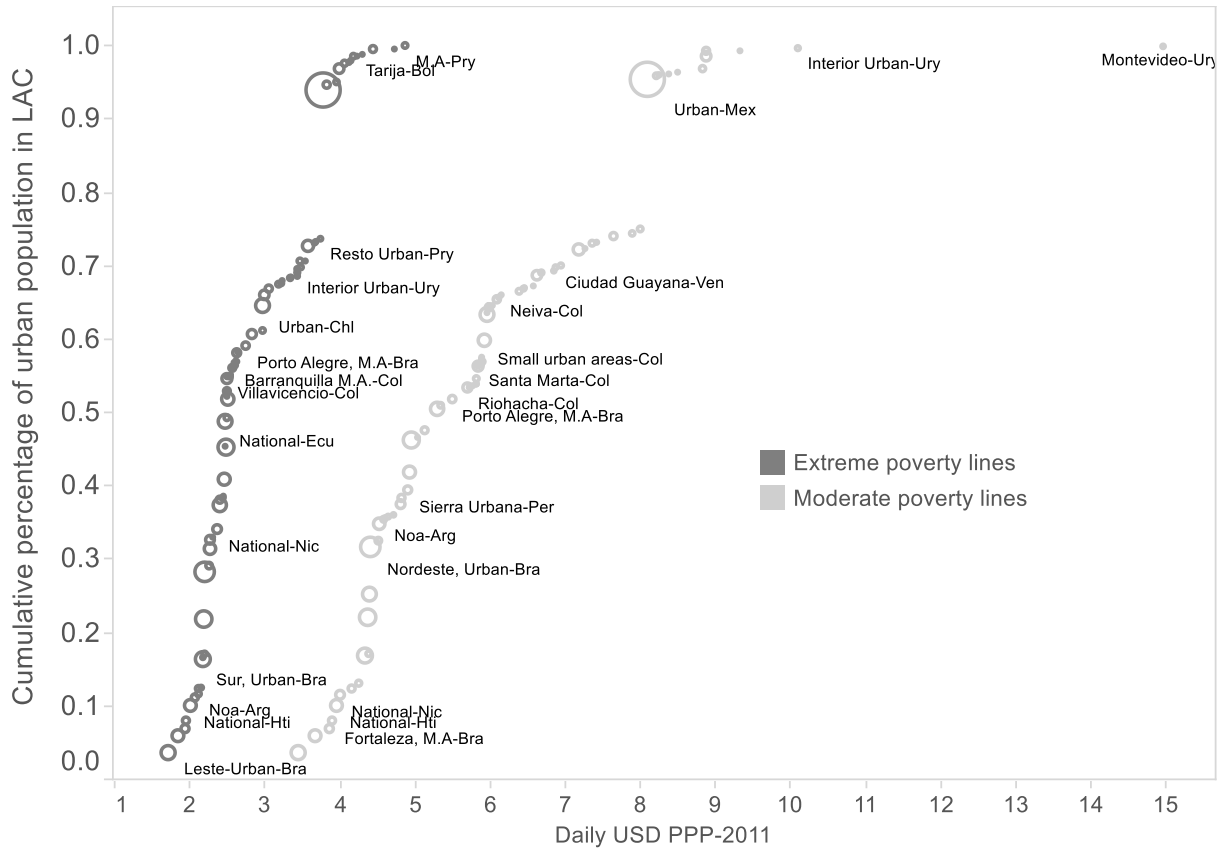
b. Total poverty lines

Data source: Calculation based on official extreme and total poverty lines from NSOs' in the region and SEDLAC (CEDLAS and the World Bank) data. Note: The dashed lines correspond to the unweighted OLS regression including all observations, while the solid gray line in panel b excludes outliers (i.e., Montevideo – Uruguay).

Figure 2. Density functions of official extreme and total poverty lines in LAC, 2011

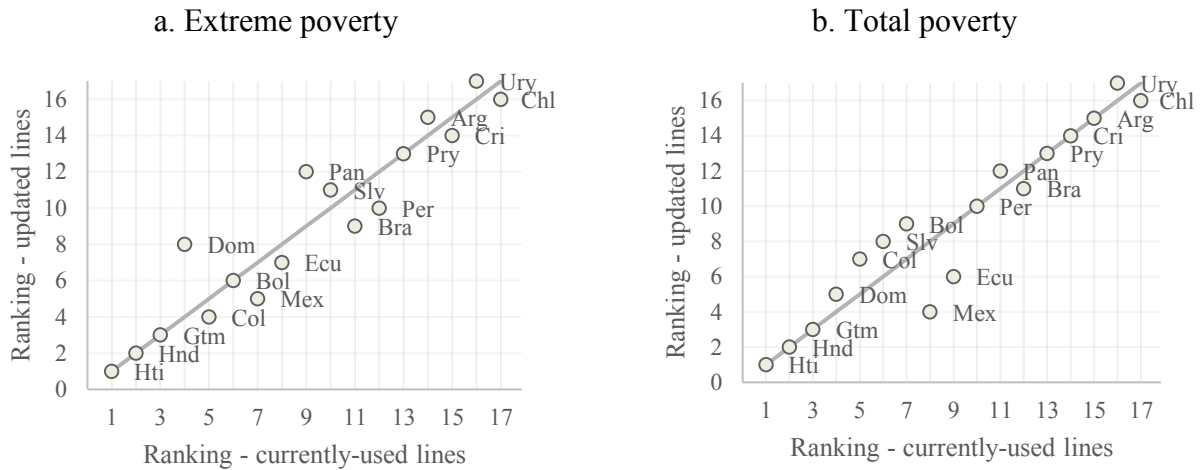Extreme official poverty lines — Moderate official poverty lines
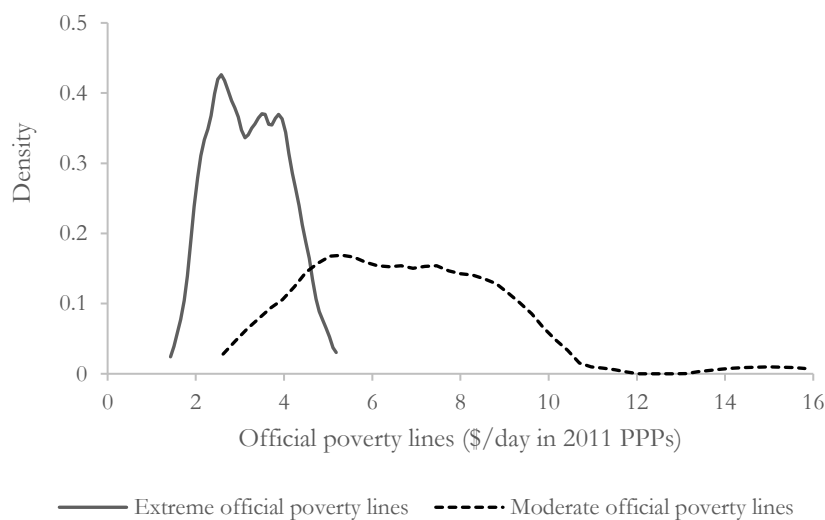
Data source: Calculations based on official poverty lines from NSOs' in the region. Note: The figure shows the density function of extreme and total official poverty lines in 2011 PPPs using Epanechnikov kernel.

Figure 3. Cumulative distribution of official extreme and total poverty lines in LAC, 2011
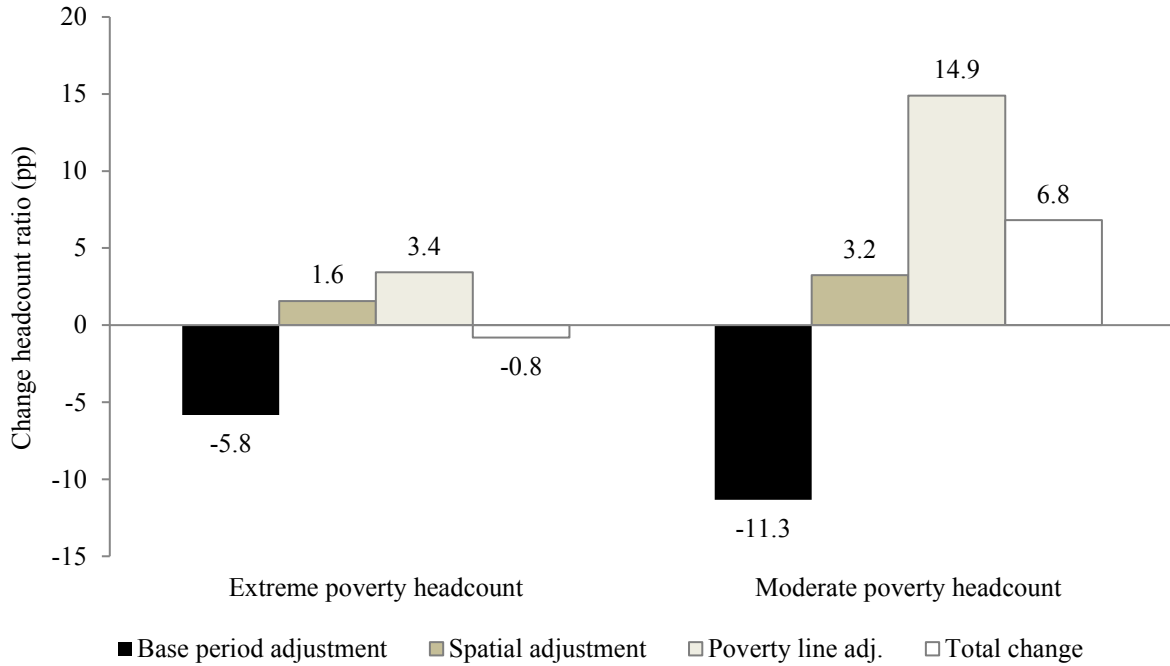

Data source: Calculations based on official poverty lines from NSOs' in the region. Note: Each circle represents a subnational region, with the diameter proportional to the subnational population.

Figure 4. Country-specific poverty rate rankings based on 2005 and 2011 PPPs, 2013

a. Extreme poverty

b. Total poverty

Data source: Calculation based on official extreme and total poverty lines from NSOs' in the region and SEDLAC (CEDLAS and the World Bank) data. Note: The horizontal axis is based on poverty rates using the $2.5 and $4 per person per day poverty lines in 2005 PPPs, while the vertical axis is based on poverty rates using the $3 and $6 per person per day poverty lines in 2011 PPPs, respectively (see Table 3).

Figure 5. Shapley decomposition of poverty headcounts differences using poverty lines based on 2005 PPPs and 2011 PPPS in LAC, 2013

Data source: Calculations based on official poverty lines from NSOs' in LAC and SEDLAC (CEDLAS and World Bank) data. Note: The figure shows the decomposition of the difference in the poverty rates from using 2011 PPPs and 2005 PPPs into three components. The first effect (i.e., "Base period adjustment"), is the effect of deflating the welfare aggregate from 2005 to 2011 PPP values. The second one (i.e., "Spatial adjustment."), is the effect of changing the spatial deflator (i.e., relative prices) from 2005 PPP to 2011 PPP. The third effect (i.e., "Poverty line adj."), is the change in the nominal value of the poverty line. The 2011 PPPs lines selected are $3 and $6 per person per day (see Table 3).