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Multidimensional Poverty in the Philippines, 2004-13: Do choices for weighting, identification and aggregation matter?

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Abstract:

Multidimensional poverty comparisons can be sensitive to the choice of welfare indicators, the weights assigned to the indicators, as well as the choice of the aggregate poverty measure. This paper examines the robustness of trends in multidimensional poverty in the Philippines to these choices by presenting estimates for three alternative weighting schemes and three alternative measures of multidimensional poverty. Using data from the Annual Poverty Indicators Survey for 2004-13, the paper finds evidence of a significant decline in multidimensional poverty that is robust to these alternatives, though the magnitude of the decline in, and especially the dimensional contributions to, aggregate multidimensional poverty are quite sensitive to the alternatives considered.

Keywords: multidimensional poverty; weighting; identification and aggregation; Philippines
JEL Codes: I3, I32, N35

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Multidimensional Poverty in the Philippines, 2004-13: Do choices for weighting, identification and aggregation matter?

1. Introduction

The multidimensional nature of poverty has been widely noted for a long time. Over the last decade or so, however, both the theory and practice of measurement of multidimensional poverty has made rapid advances. Indeed, one measure of the growing recognition of multidimensional poverty is the publication of Multidimensional Poverty Indices (MPI) for more than a 100 countries by the United Nations Development Program (UNDP) in its annual Human Development Report beginning with HDR 2010. Conceptually, the case for measuring multidimensional poverty over and above poverty measured in terms of consumption or income is straightforward. It is rooted in viewing poverty as "capability failure", the most notable exponent of this view being Sen (1980, 1985, 1999).[1] Viewed as such, multidimensional poverty then invites direct attention to a range of specific capabilities including those relating to health, education, shelter, and access to basic amenities. The key consideration then turns on the question whether consumption or income offers an adequate representation of an acceptable range of capabilities. If it did, there would really not be much of a case for a separate focus on multidimensional poverty.[2] Conversely, the case for a distinctive focus on multidimensional poverty rests in the proposition that there are many aspects of poverty which, for a variety of reasons, may not be adequately captured by income or consumption. It is presently not necessary to dwell on these reasons which for the most part have to do with market failures of one sort or another.[3] In addition, it is also worth noting that a focus on multidimensional poverty has the potential to draw attention to "government failures" too, especially in relation to provision of public goods and how markets function.

[1] Sen's writings on this subject are many; referenced here are only a few examples (including one of the early ones).

[2] Even from the welfarist perspective of consumption expenditure as a money-metric of utility, consumption may be inadequate as there are other arguments in individual utility functions for which either markets (and hence prices) may either not exist or if they exist may be distorted.

[3] Even in the absence of market failures, total consumption or income as a linear combination of prices and quantities of goods and services implies perfect substitutability between these goods and services – an assumption that is questionable from a non-welfarist or human rights perspective that insists on the essentiality of minimum levels of achievement across a range of dimensions.

While these conceptual arguments for an independent focus on measuring multidimensional poverty apply to all countries, there is also a significant framing issue that is especially relevant for the Philippines. During 2003-14, the Philippine economy grew at average rate of 5.4% per year. While there was fluctuation in growth over this period, per capita GDP grew by 48% and per capita consumption grew by 37% in real terms or at average annual growth rates of 3.5% and 2.9% respectively. However, the official (income) poverty estimates over this period largely indicate a flat line, changing little from 28% in 2003 to 26% in 2014 (see Figure 1).[4]

Why economic growth has not translated into significant income poverty reduction has been puzzling. This however begs the question of how non-income indicators of poverty – including those related to health, education, quality of housing and access to services – have progressed over this period. This has already initiated an investigation of trends in multidimensional poverty based on a range of non-monetary indicators of welfare. For instance, using data from three different sets of household surveys – the National Demographic and Health Survey (NDHS), Family Income and Expenditure Survey (FIES), and the Annual Poverty Indicators Survey (APIS), Balisacan (2015) constructs a series of multidimensional poverty indices. Defining poverty as deprivation in at least one-third of the chosen indicators, he finds that rates of multidimensional poverty reduction were higher than income poverty reduction during 1998-2011/12,[5] leading him to conclude that "aggregate poverty, seen from the lens of multidimensional deprivation, actually declined as the economy expanded during the past decade" (p. 463).

However, as is well-understood in the literature, multidimensional poverty comparisons are sensitive to assumptions in relation to the choice of indicators, the weights assigned to the indicators, the dimensional (deprivation) and the overall poverty cut-offs, as well as the choice of the aggregate poverty measure. For the Philippines, Balisacan (2015) already looks into some aspects of this robustness, for instance, variations in the choice of indicators across the three data sources, and

[4] These official estimates are based on per capita incomes from the first-semester Family Income and Expenditure Surveys (FIES) for 2003, 2006, 2009 and 2012, and the Annual Poverty Indicators Surveys (APIS) for 2013 and 2014. The APIS surveys are only conducted for the first semester of the survey year. Since 2013, the APIS has used the same income module as the FIES.

[5] Balisacan (2015) in fact presents estimates for a longer period for some of his data sources. In particular, the study uses FIES data for the years 1998, 1991, 1994, 1997, 2000, 2003, 2006, 2009 and 2012; NDHS for 1993, 1998, 2003 and 2008; and APIS data for 1998, 2002, 2004, 2007, 2008, 2010 and 2011.

sensitivity to alternative poverty cut-offs. However, the issues of alternative weighting schemes and poverty measures have remained underexplored.

Using data from six rounds of the Annual Poverty Indicators Survey (APIS) conducted by the Philippines Statistics Authority (previously, the National Statistics Office) over the period 2004-13, this paper complements Balisacan (2015) in further investigating the robustness of trends in multidimensional poverty to methodological choices for the Philippines. In particular, the paper focuses on the choice of alternative weighting schemes and aggregate poverty measures, empirical investigation of which is relatively limited even for other countries. In addition, the paper also explores the implications of including an employment-based dimension amongst welfare indicators. The analysis thus helps reassess evidence on the larger question of the changes in poverty in the past decade by examining whether the absence of a trend in income poverty is also mirrored in the trends of multidimensional poverty over this period. Our main finding is that there is evidence of a significant decline in multidimensional poverty measures in the country during 2004-13 that appears robust across a range of alternatives considered. Dimensional contributions to aggregate multidimensional poverty however vary enormously across alternatives.

The paper is organized as follows. Section 2 spells out the data and the methodology. In particular, it discusses the choice of dimensions and indicators, alternative approaches to setting weights for different indicators as well as alternatives for aggregate poverty measures, in particular, the use of "distribution-sensitive" measures. Section 3 presents the results of implementing these with the APIS data for 2004-13. It presents summary trends in individual indicators over this period, three sets of weighting schemes (two of which are estimated from APIS data for the initial year), and finally the estimates of multidimensional poverty measures as well as dimensional decompositions for the range of alternatives considered. Section 4 offers some concluding observations.

2. Data and methodology

There now exists a large literature on the measurement of multidimensional poverty offering a variety of measurement methodologies; see Alkire et al. (2015) for a recent survey. Cutting across these different approaches, however, there are broadly three sets of issues that need to be addressed in any measurement framework for multidimensional poverty. These relate to:

1) *Dimensions*? Which indicators should be included in a multidimensional poverty measure? What sort of dimensional cut-offs should be used to define deprivation in different dimensions?
2) *Weights*? How should the different dimensions be weighted?
3) *Identification and aggregation*? How should dimensional deprivations of individuals be aggregated into an overall measure of multidimensional poverty? This includes the issue of how should the multidimensionally-poor be identified, in particular the use of a cross-dimensional (or poverty) cut-off as for instance in the counting approach of Alkire and Foster (2011), as well as the issue of how should the multiple deprivations of those identified as poor be aggregated over the population (or a sub-population).

We discuss our approach to considering different options for each of these issues below, though, as mentioned in the Introduction, a key focus will be on alternative approaches to assigning weights to different dimensions and on the use of alternative poverty measures.[6]

2.1 Dimensions and indicators

Our choice of dimensions and indicators to be included in the measurement of multidimensional poverty is guided both by common empirical practice as well as particular data considerations for the Philippines. Since multidimensional poverty is concerned with the joint distribution of deprivations in different dimensions, a key data consideration is the ability to observe deprivations across these dimensions for the *same* set of households or individuals. This limits the range of data sources that can be used for such analysis, and conversely, a given data source may limit the set of includable dimensions to those that can be readily measured from that source. In this paper, we use data from six rounds of the Annual Poverty Indicators Survey (APIS). With the exception of anthropometric information which it does not have, the APIS is quite well-suited to the task of multidimensional poverty measurement. As noted before, data from two other sources – the National Demographic and Health Survey and the Family Income and Expenditure Survey – can also be used for constructing multidimensional poverty measures. However, their more limited frequency – once every five years for NDHS and once every three years for FIES – implies that only 2-3 rounds of these surveys are available every decade. By comparison, for the 2004-13 period covered by this study, we are able to use six rounds of APIS for the years 2004, 2007, 2008, 2010, 2011 and 2013.

[6] Most of the literature has concentrated on the identification and aggregation issues with the choice of dimensions and weights having remained relatively under-explored.

A notable benchmark in terms of empirical practice is the global Multidimensional Poverty Index (MPI) adopted by UNDP and now estimated for over 100 countries – including the Philippines. The UNDP's MPI is based on the counting approach proposed by Alkire and Foster (2011), and uses ten indicators covering three broad dimensions related to education, health and what is dubbed as the "standard of living". Education and health have two indicators each, and there are six indicators of the standard of living related to access to services (especially, electricity, water and sanitation) and asset ownership (see UNDP, 2014 for details).

The choice of indicators used in this paper broadly follows the global MPI. While the same three main dimensions of health, education and standard of living are identified as in the global MPI, the specific indicators under each had to be adapted to what could be implemented with the data available from the APIS surveys. In particular, this paper presents results using the set of indicators as shown in Table 1.

The two indicators for education deprivation – viz., if no one in the household has completed six years of schooling, and if any school-age child in the household is not attending school – are essentially the same as have been used in the global MPI, and do not require further explanation. In relation to health indicators, as noted above, APIS does not collect anthropometric information, nor information on child mortality. Instead, there are two other potential health indicators available from the APIS. First, as APIS has information on consumption, the adequacy of a household's per capita food consumption can be assessed relative to the official food poverty thresholds. The indicator we use ("*health1*" in Table 1) deploys a stringent criterion of nutritional deprivation defined as per capita food consumption of the household falling below 80% of the food poverty threshold.

The second potential health indicator ("*health2*" in Table 1) is defined in terms of past (self-reported) illness or injury of household members. There is however a data comparability issue related to this indicator due to a change in the reference period. In the APIS surveys up to the round for 2011, the reference period for this question was the "past month"; however, in the 2013 round this was changed to the "past six months", thus leading to much higher rates of reported morbidity. In light of this, our main results up to 2013 exclude "*health2*", while we also report estimates including it, but the results for these are valid for the period up to 2011 only.

The first five indicators related to the standard of living are also very similar to those in the global MPI, and do not require any special comment. The global MPI also includes a deprivation indicator based on the use of inferior sources of cooking fuel. The APIS data do not offer a direct measure for such an indicator. It is possible to proxy this with information on whether the household owns a gas range or stove with oven – one of the asset ownership items included in the questionnaire. However, this seems to be a rather noisy indicator with implausible fluctuations over certain rounds of the survey; for instance, the proportion of population in households not owning a gas range or stove with oven registered a sharp increase between APIS 2011 and 2013, from 78% to 87%. While the reasons for this are not entirely clear, the possibility that there was a sudden and marked deterioration in the use of improved sources of cooking fuel seems unlikely. Hence, we opted not to include this indicator in this assessment.

Note that the final indicator in Table 1 relates to employment – a dimension that is not in included the UNDP MPI nor typically in most applications. Thus, a brief comment on the rationale for its inclusion is apposite. Employment generates income, so its pecuniary significance is obvious. But employment may also be considered an independent dimension in its own right as it represents more than just a means to earning a living. Sociologists have long recognized the importance of employment as a basis for social differentiation; see for instance, the centrality of "weak labor force attachment" as a defining characteristic of the "underclass" in the pioneering work of Wilson (1987). The linkage of employment with life satisfaction, happiness, self-esteem, social status, mental and physical health and wellbeing has also been widely documented.[7] There is also a well-established tradition of using employment-based indicators in social exclusion measures in OECD countries; see for instance, indicators of quasi-joblessness included in EU-2020 measures/ targets for poverty and social exclusion. Employment-based indicators are also increasingly being included in National MPIs in many developing countries.[8] There is

[7] See for instance, Dooley, Catalano, and Wilson (1994), Dooley, Prause, and Ham-Rowbottom (2000), Helliwell and Putnam (2004), Stutzer and Lalive (2004), Lundin and Hemmingsson (2009), Stuckler et al. (2009a, 2009b), ILO (2010), Blanchflower and Oswald (2011).

[8] There are many examples. For instance, for Colombia's MPI, two of the 15 indicators relate to the absence of long-term unemployment and formal employment, and these indicators are included under "Labour" as a separate dimension. For South Africa, "Economic Activity" is included as a separate dimension, with an indicator on unemployment amongst 15-64 year old adults. The Ecuador MPI has "Work and Social Security" as a separate dimension, with an indicator on unemployment or inadequate employment amongst those 18 years or older. Similarly, for Costa Rica, "Work" is included as a separate dimension, with indicators on long-duration unemployment, informal employment, and earnings less than the minimum wage. Employment dimension or indicators are also included in MPIs for El Salvador and Chile.

thus a case for considering inclusion of the employment dimension in multidimensional welfare assessments.

2.2 Weights

While a number of different approaches to weighting of indicators have been considered in the literature,[9] in this paper we explore three of them, as described below.

i) Nested Uniform Weights

These set of weights follow the convention adopted by the UNPD for its global MPIs. Under this convention, the three main dimensions – corresponding to education, health and the standard of living – are first assigned equal weights of one-third each. Then, all indicators within a main dimension are also assigned equal weights. Thus, for instance, when using the 10 indicators in Table 1, the two education indicators have weights of 1/6th each, the same for the two health indicators, and the six indicators for the standard of living have weights of 1/18 each. When using 9 indicators (omitting *health2*), the weight for the sole health indicator (*health1*) becomes 1/3rd, while the weights for the other indicators remain unchanged.

ii) Nested Inverse Incidence Weights

Similar to the idea in the construction of an asset index where a more commonly-owned asset is deemed less valuable, this approach has been proposed in Desai and Shah (1988) and Cerioli and Zani (1990). The weights assigned to different deprivation indicators in such a weighting scheme vary inversely with the prevalence of those deprivations in the population; the higher (lower) the prevalence or incidence, the lower (higher) the weight. There is however a potential issue in that the weights will be sensitive to the number of indicator used to represent a certain type of deprivation. For instance, if one were to use four instead of, say, two indicators to represent education deprivation, then other things being equal, this will raise the combined weight of education deprivation indicators. Without any correction, the approach will ceteris paribus tend to favor dimensions represented by a larger number of indicators. To guard against this, we thus use a nested version of the inverse incidence approach, which in this respect is similar to the nested approach to uniform weights used in the global MPI.

[9] See Decanq and Lugo (2013) for a review.

The nested inverse incidence weights are thus determined in two steps. First, we begin with the three main dimensions relating to education, health and the standard of living and livelihood, and establish their weights based on inverse incidence. In the second step, we establish inverse incidence weights for individual indicators within any main dimension such that their sum equals the weight established for that main dimension in the first step. These weights are determined for 2004 using APIS data for that year, and then kept fixed over time.

iii) Subjective Welfare Weights

This approach generates weights from an estimated relationship between a measure of subjective welfare (obtained through a survey) and the indicators that are sought to be included in a multidimensional welfare index.[10] For constructing these weights, we exploit data from the 2004 APIS survey relating to the following question in the survey:

> "Imagine a ladder with ten steps. The first represents the poorest in society and the tenth represents the richest. On what step of the ladder would you be?"

The percentage of the population at different steps of the ladder turned out to be as below:

Step (poorest to richest)	1	2	3	4	5	6	7	8	9	10
% of population	6.3	15.8	21.9	17.9	25.6	7.7	3.3	1.2	0.2	0.2

Based on this, we define a binary subjective poverty variable which takes a unit value (and zero otherwise) if a household perceives themselves to be on the second rung of the ladder or lower.[11] We then estimate a logit regression of subjective poverty on the 9 (or 10) multidimensional poverty indicators in Table 1. The marginal effects of indicators estimated from this regression are shown in Table 2.[12] The subjective welfare weights are then constructed as proportional to the estimated marginal effects.

[10] See Bellani (2013), Bellani et al. (2013), Decanq et al. (2013) and Mitra et al. (2013) for related applications of this approach.

[11] This is arbitrary but yields a subjective poverty incidence of about 22% that is not very different to the official income poverty incidence of 25% (for 2003 based on FIES).

[12] The estimation of marginal effects takes into account the fact that the independent variables in the regression are also dichotomous.

2.3 Identification and aggregation

Beyond the choice of indicators and their weights, the other important considerations in measuring multidimensional poverty have to do with the well-known issues of identification and aggregation. The first has to do with how, given the multiplicity of indicators, should the poor be identified, and the second has to do with how deprivations across individuals and dimensions be aggregated into a scalar measure of multidimensional poverty.

Within the global MPI framework, following Alkire and Foster (2011), the poor are identified by reference to a cross-dimensional cut-off specified in terms of the minimum percentage of (weighted) dimensions a person must be deprived in for him/her to be considered poor. While the Alkire-Foster approach is more general (potentially allowing for the cross-dimensional cut-off to range from the minimum weight of any dimension to 100 percent), the global MPI sets this at one-third. There is thus the possibility of using more than one value for the cross-dimensional cut-off, or of not using the cross-dimensional cut-off at all. The former is in the spirit of investigating robustness of comparisons of multidimensional poverty to the choice of this cut-off. This is explored in Balisacan (2015) who finds a measure of robustness with respect to this choice. The latter takes us to the so-called "union approach" to identification, where a person is considered multidimensionally-poor if deprived in *any* dimension. The union approach asserts the essentiality of all deprivations. It also has the merit that it ensures regressive transfers from a more to a less deprived person are poverty-increasing – a property that is not always satisfied by measures that use cross-dimensional cut-offs.[13] In this paper, we will present multidimensional poverty measures using both a cross-dimensional cut-off of one-third as well as union-based measures. Thus, from an identification perspective, the two measures we consider can be written as:

$$M(k) = \frac{1}{n}\sum_{i=1}^{n}\left(\sum_{j=1}^{d} w_j I_{ij}\right) I_i^{(k)} \qquad (1)$$

where the multidimensional poverty measure $M(k)$ is a function of the cross dimensional cut-off k, where I_{ij} is a binary (0-1) variable denoting whether individual i is deprived in dimension j with weight w_j amongst a total of d dimensions and a population of size n, and $I_i^{(k)}$ is a binary (0-1) variable

[13] See Datt (2017) for a formal statement of this property as well as further discussion of why the union approach may be worth considering.

denoting whether individual i is deprived in at least k fraction of the weighted dimensions. In particular, we will construct measures for $k = 1/3$, $min\{w_j\}$. In the union-case ($k = min\{w_j\}$), the multidimensional poverty measure can also be written more simply as:

$$M(union) = \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{d} w_j I_{ij} \qquad (2)$$

Thus, the difference between the measures in (1) and (2) is that while $M(union)$ counts all deprivations of all individuals, $M(k)$ counts the deprivations of only those who are deprived in at least fraction k of all weighted dimensions.

There is one further aggregation issue that is worth considering, and it relates to the dispersion or inequality in the distribution of deprivations amongst the poor. This can be described by first noting that either of the above measures is equivalent to the ratio of the weighted sum of the deprived dimensions *of the poor* to the sum of all possible deprivations (when everyone is deprived in every dimension). Since the weights do not vary across persons and these measures aggregate deprivations by simply summing them up, they depend only on the total number of deprivations not their dispersion or concentration. Whether deprivations amongst the poor are evenly distributed or concentrated amongst a few, $M(k)$ and $M(union)$ return the same value of multidimensional poverty. In view of this, we also consider an alternative measure that is sensitive to the distribution of deprivations amongst the poor:

$$M(union;\beta) = \frac{1}{n}\sum_{i=1}^{n}\left(\sum_{j=1}^{d} w_j I_{ij}\right)^{\beta} \quad for\ \beta \geq 1 \qquad (3)$$

where β is interpretable as an "inequality-aversion" parameter such that for $\beta > 1$, a higher concentration of a given set of deprivations yields a higher value for multidimensional poverty.[14] Note that for $\beta = 1$, $M(union;\beta)$ coincides with $M(union)$. In the following, we will thus present three multidimensional poverty measures: $M(k = 1/3)$, $M(union;\beta = 1)$ and $M(union;\beta = 2)$.

[14] See Datt (2017) for the properties of this class of multidimensional poverty measures; also see Chakravarty and D'Ambrosio (2006) who proposed such a measure of social exclusion.

3. Results

3.1 Summary trends in indicators and alternative weighting schemes

Table 3 shows the trends in the deprivation indicators over time. The data suggest significant declines in the deprivation indicators related to education and the standard of living and livelihood over the period 2004-13, though the improvement in water and sanitation appears limited to first sub-period 2004-7 with little or no change thereafter. The record of the two health indicators is mixed. While the illness/injury-related indicator shows a decline during 2004-11 (note that we do not have a comparable estimate for 2013 due to the change in the reference period for this variable, as discussed before), there is virtually no change in the food-consumption-based nutrition indicator over the entire period. Overall, since most indicators show an improvement over time, one may expect multidimensional poverty to register a decline over this period. However, to what extent that is the case or not will also depend upon changes in the joint distribution of indicators as well as on how these indicators are weighted.

The set of weights corresponding to the three weighting schemes discussed above are shown in Table 4 for both the 9- and 10-indicator cases. Recall that the nested inverse incidence (NII) weights are based on the 2004 incidence rates for the deprivation indicators, and are kept fixed over time. The subjective welfare (SW) weights are also estimated for 2004 based on the socio-economic ladder question, and are also kept fixed over time. The nested uniform (NU) weights are fixed over time by construction.

Table 4 shows some notable differences across the three sets of weights. (For comparison, the Table also shows the weights in Balisacan, 2015.[15]) Looking first at the three main dimensions, relative to the nested uniform (NU) weights, the nested inverse incidence (NII) weights accord a higher value to education and health, while the subjective welfare (SW) weights accord a lower value to both. Indeed, the SW weights put the highest value on the standard of living and livelihood dimension, and lowest on the health dimension. By contrast, the NII weights put the highest value on education, and the lowest on the standard of living and livelihood. This pattern holds both in the 9- and 10-indicator cases.

Looking at individual indicators, relative to the NU weights, the NII weights accord a premium to the two education indicators at the expense of the standard of living and livelihood indicators, while the SW

[15] Note that Balisacan (2015) does not use exactly the same indicators as in this paper. The Table reports his weights for the APIS application, lining them up as closely as possible against the indicators in this paper.

weights accord a premium to sanitation, electricity, roof-wall of the dwelling and assets at the expense of school attendance, water and employment, and the health indicators. Note also that under the 9-indicator scenario, there is only one health indicator related to food consumption, and the NU and NII weights accord primacy to this indicator with a weight of one-third or higher, which in turn has the implication of making deprivation in food consumption a sufficient condition for being deemed multidimensionally-poor when using the cross-dimensional cut-off of one-third of weighted dimensions. By contrast, the SW weighting scheme assigns a weight of less than one-fifth to this indicator. The employment indicator is also accorded a very low weight (of 2%) under the SW weighting scheme, while the NII (NU) weight for employment is about twice (nearly thrice) as high. Thus, there is considerable variation across these weighting schemes. The following results look at the implications of this for the assessment of multidimensional poverty for the Philippines.

3.2 Trends in multidimensional poverty

The results on trends in multidimensional poverty based on 9 indicators are presented in Table 5 and those based on 10 indicators in Table 6. In both cases, results are presented for the three alternative weighting schemes and for the three alternative poverty measures. The first important finding is that between 2004 and 2013 (2011 when using 10 indicators) there is a statistically significant decline in multidimensional poverty for all three weighting schemes and all three poverty measures. Thus, the reduction in multidimensional poverty over this period seems fairly robust to alternative choices with respect to weighting, identification and aggregation.

Nonetheless there are differences in the magnitude of decline across the weighting schemes. For measures based on 9 indicators, the fall in multidimensional poverty over 2004-13 is largest for SW weights, while the magnitude of decline is similar though smaller for NU and NII weights.[16] Thus, for instance, the $M(k = 1/3)$ measure with SW weights fell by 42% between 2004 and 2013, while the decline in this measure with NU and NII weights was around 11-13%. Similarly, the $M(union; \beta = 1)$ and $M(union; \beta = 2)$ measures with SW weights fell by 26 and 37 percent respectively, while the corresponding declines were smaller at 14-18% with NU weights and 22-25% with NII weights. This largely reflects the fact that the SW weights are more positively correlated with the absolute reduction

[16] Using the 10 indicators, however, the decline in multidimensional poverty over 2004-11 is of similar magnitude across the three weighting schemes. But this also omits the last year 2013 due to the comparability issue with the illness/injury-related indicator.

in deprivation indicators. That is, deprivation indicators that fell the most, e.g. those related to assets and electricity, have relatively higher SW weights, while the deprivation indicator related to food consumption which showed little change has a much lower SW weight.

How do these results compare with Balisacan's (2015) APIS-based estimates of multidimensional poverty (also reproduced in the last column of Table 6)? Amongst our estimates, the ones most comparable with Balisacan (2015) are those based on 10 indicators, using NU weights and $M(k = 1/3)$ as the multidimensional poverty measure for the period 2004-11. We find a fall in this measure by 26% between 2004 and 2013; by comparison, Balisacan reports a decline of 19% over the same period. Thus, the estimates in this paper corroborate the results in Balisacan, though we find evidence of a larger decline in multidimensional poverty. The decline is steeper if we use the subjective welfare weights, and as noted above, steeper still if the measures are based on 9 indicators.

3.3 Dimensional contributions to multidimensional poverty

It is also instructive to look at how the contributions of different dimensions and indicators to aggregate multidimensional poverty vary by the weighting scheme and the aggregate measure used. Dimensional contributions can be evaluated using Shapley decomposition methods (Shorrocks, 2013); see Datt (2017) for how these methods can be applied to dimensional decomposition of multidimensional poverty measures. The decomposition evaluates the contribution of a particular dimension j as the expected reduction in the multidimensional poverty measure $M(..)$ due to the elimination of deprivation j when the expectation is taken over all possible elimination paths (ranging from j being the first deprivation to be removed to its being the last, and for all possible combinations of the presence or absence of other deprivations). The results of this dimensional decomposition (for the 9 indicator case) are shown in Table 7 for alternative weighting schemes and aggregate multidimensional poverty measures.

As seen in Table 7, dimensional contributions are highly sensitive to both the choice of weighting scheme as well as the aggregate poverty measure, especially the former. For instance, using nested uniform weights and $M(k = 1/3)$, the health dimension (based on the food consumption indicator) accounts for 82% of total multidimensional poverty in 2013. This is due, in part, to the relatively high incidence of food consumption deprivation (Table 3), but more importantly it reflects the large weight of 1/3 for this indicator (see Table 4). With the cross-dimensional cut-off also set at $k = 1/3$, this large weight ensures that everyone deprived in food consumption is necessarily multidimensionally poor too,

while the same is not true of any other indicator. Nested inverse incidence scheme assigns a still higher weight of 0.37 to the food consumption indicator, and hence its contribution to $M(k = 1/3)$ is even higher at almost 87%. By comparison, the contribution of the food consumption indicator for both NU and NII weights is moderated to less than 70% when union-based measures, $M(union; \beta = 1)$ and $M(union; \beta = 2)$, are used. This is because union-based identification now allows other deprivations to be counted in more often. A major contrast in dimensional contributions is however observed with respect to subjective welfare weights. With SW weights, the standard of living and livelihood dimension accounts for the bulk of aggregate multidimensional poverty, its contribution in 2013 ranging between 53 and 62 percent. Education accounts for 9-12 percent, while health (food consumption) accounts for 26-38 percent.

Alongside other considerations, these results on dimensional decomposition can help inform judgements about the choice of weighting schemes and aggregate measures. For instance, a combination of NU or NII weights with dual cut-off measures (with k set at one-third) renders multidimensional poverty in the Philippines almost entirely a matter of food consumption deprivation. If this appears excessive, the dimensional decompositions remind us that it is largely a consequence of the particular weighting schemes and measures used, and it may be worthwhile to consider other reasonable alternatives.

4. Conclusion

Official estimates of income poverty for the Philippines over the decade or so since 2003 have indicated little decline despite respectable rates of economic growth over this period, leading to conjectures on whether this has been a lost decade for poverty reduction for the country. This concern has also prompted inquiry into trends in non-income indicators of welfare to assess whether progress in the reduction of multidimensional poverty has fared any better. Recent work by Balisacan (2015) has suggested better performance on the multidimensional front. This paper has sought to contribute further to this line of investigation by constructing estimates of multidimensional poverty over the period 2004-13 using data from six rounds of the Annual Poverty Indicators Survey. A key emphasis of the paper has been on examining the robustness of trends in poverty to alternative weighting, identification and aggregation choices in the construction of multidimensional poverty measures.

In particular, the paper presents estimates for three alternative weighting schemes for different dimensions, and using three alternative measures of multidimensional poverty. The weighting schemes range from uniform weights broadly following the approach of global multidimensional poverty indices (MPI) produced by the UNDP, to weights based on inverse incidence of different deprivations and those derived from the estimated relationship of deprivations to a survey-based measure of subjective welfare. The multidimensional poverty measures similarly range from the "dual cut-off" indices analogous to UNDP's global MPI, to "union-based" indices that count all deprivations, to indices that are also responsive to the distribution of deprivations.

The main finding of the paper is that there is evidence of a significant decline in multidimensional poverty that is robust to these alternatives, although the magnitude of decline differs across the alternatives. The reduction in multidimensional poverty tends to be largest for subjective welfare weights and for union-based distribution-sensitive measures. The results thus corroborate and supplement the findings in Balisacan (2015). Notwithstanding the absence of a significant trend in income poverty, the period 2004-13 has witnessed improvement in several non-income dimensions of poverty in the Philippines. An examination of the factors underlying different trends in income and multidimensional poverty however remains a topic for further research.

We also find that the contributions of different dimensions to aggregate multidimensional poverty can vary enormously with the choice of the weighting scheme and the aggregate poverty measure. Dimensional decompositions of multidimensional poverty such as those presented in this paper alert us to particular aspects of the judgments implicit in these choices, and thus offer further input into making these choices.

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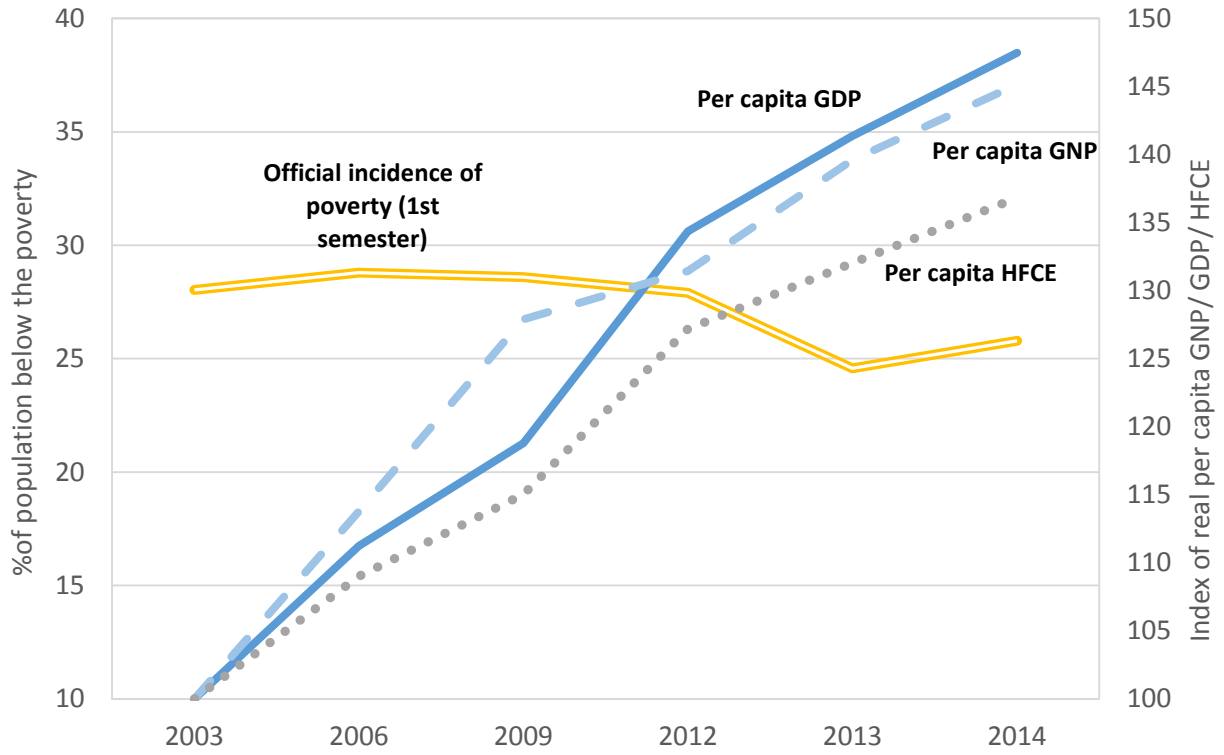
Figure 1: TRENDS IN REAL PER CAPITA INCOME AND CONSUMPTION (FROM THE NATIONAL ACCOUNTS) AND OFFICIAL POVERTY RATES (BASED ON SURVEYS)



Note: HFCE refers to household final consumption expenditure from the national accounts.
Source: Based on official poverty estimates from the National Statistics Coordination Board, and national accounts statistics from the Philippines Statistics Authority.

TABLE 1: DIMENSIONS AND INDICATORS FOR MULTIDIMENSIONAL POVERTY ASSESSMENT FOR THE PHILIPPINES

Main dimension	Variable name	Indicator	Description
Education	*educ1*	Primary schooling	No household member has completed at least six years of schooling
	educ2	School attendance	A school-age child (up to grade 10, i.e. between age 6-16) is not attending school
Health	*health1*	Food consumption	If per capita food consumption < 4/5 of food poverty line
	health2	Illness	If more than 50% of household members report illness or injury over the past month (past 6 months for 2013)
Standard of living and livelihood	*sliv1*	Sanitation	If household does not use own flush or closed pit toilet
	sliv2	Water	If household's main source of water is not piped water or protected well
	sliv3	Electricity	If there is no electricity in the house
	sliv4	Roof-wall	If roof and outer wall is not made of predominantly strong materials
	sliv5	Assets	If household does not have at least one communication asset (amongst phone, tv, radio, or PC) AND at least one mobility asset (amongst car, motorcycle or motorboat) OR at least one livelihood asset (amongst agricultural land, livestock, refrigerator/freezer)
	sliv6	Employment	If less than 50% of working age members who are not students worked over the past 6 months

Source: APIS survey instruments and data sets for rounds 2004 through 2013.

TABLE 2: MARGINAL EFFECTS OF DEPRIVATION INDICATORS ON SUBJECTIVE POVERTY (2004)

Indicator		9 indicators		10 indicators	
		Marginal effect	Std. Err.	Marginal effect	Std. Err.
educ1	Primary schooling	0.088	0.008	0.084	0.008
educ2	School attendance	0.027	0.007	0.028	0.007
health1	Food consumption	0.095	0.006	0.096	0.006
health2	Illness			0.036	0.006
sliv1	Sanitation	0.055	0.005	0.054	0.005
sliv2	Water	0.009	0.005	0.009	0.005
sliv3	Electricity	0.069	0.007	0.068	0.007
sliv4	Roof-wall	0.055	0.006	0.055	0.006
sliv5	Assets	0.089	0.007	0.088	0.007
sliv6	Employment	0.009	0.006	0.010	0.006

Note: The dependent variable is a measure of subjective poverty defined as a binary variable taking the value 1 if the household reports being on the lowest two steps of a 10-step economic ladder, zero otherwise.
Source: Estimated using data from APIS 2004.

TABLE 3: INCIDENCE OF DEPRIVATION, 2004-2013

Dimension/ indicator			Fraction of population deprived					
			2004	**2007**	**2008**	**2010**	**2011**	**2013**
Education	*educ1*	Primary schooling	0.064	0.051	0.050	0.048	0.045	0.040
	educ2	School attendance	0.137	0.139	0.126	0.118	0.104	0.082
		Total education	**0.180**					
Health	*health1*	Food consumption	0.253	0.299	0.233	0.274	0.281	0.261
	health2	Illness	0.100	0.116	0.075	0.091	0.080	0.257
		Total health	**0.327**					
Standard of living and livelihood	*sliv1*	Sanitation	0.237	0.203	0.199	0.182	0.196	0.200
	sliv2	Water	0.205	0.177	0.167	0.162	0.162	0.172
	sliv3	Electricity	0.207	0.161	0.161	0.131	0.129	0.108
	sliv4	Roof-wall	0.178	0.171	0.139	0.124	0.126	0.112
	sliv5	Assets	0.152	0.142	0.126	0.104	0.103	0.078
	sliv6	Employment	0.127	0.132	0.118	0.119	0.118	0.096
		Total std. of living and livelihood	**0.554**					

Note: The incidence for total education refers to the incidence of deprivation in *educ1* or *educ2* (i.e. any deprivation in terms of education indicators), and similarly for total health and total standard of living and livelihood. The value of *health2* for 2013 is not comparable with previous years due to a change in the reference period for this indicator (see text for details).
Source: Calculated from APIS survey data sets for rounds 2004 through 2013.

TABLE 4: ALTERNATIVE SETS OF WEIGHTS FOR MULTIDIMENSIONAL POVERTY ASSESSMENT FOR THE PHILIPPINES

			9 indicators			10 indicators			
Main dimension	**Variable name**	**Indicator**	**Nested Uniform Weights**	**Nested Inverse Incidence Weights**	**Subjective Welfare Weights**	**Nested Uniform Weights**	**Nested Inverse Incidence Weights**	**Subjective Welfare Weights**	**Balisacan (2015) weights**
Education	*educ1*	Primary schooling	0.167	0.212	0.172	0.167	0.220	0.155	0.167
	educ2	School attendance	0.167	0.195	0.057	0.167	0.203	0.056	0.167
		Total education	**0.333**	**0.407**	**0.230**	**0.333**	**0.423**	**0.211**	
Health	*health1*	Food consumption	0.333	0.371	0.189	0.167	0.157	0.178	0.167
	health2	Illness	0	0	0	0.167	0.190	0.071	
		Total health	**0.333**	**0.371**	**0.189**	**0.333**	**0.347**	**0.249**	
Standard of living and livelihood	*sliv1*	Sanitation	0.056	0.035	0.114	0.056	0.036	0.105	0.083
	sliv2	Water	0.056	0.036	0.019	0.056	0.037	0.019	0.083
	sliv3	Electricity	0.056	0.036	0.139	0.056	0.037	0.129	0.083
	sliv4	Roof-wall	0.056	0.037	0.112	0.056	0.039	0.105	0.083
	sliv5	Assets	0.056	0.038	0.177	0.056	0.040	0.163	0.083
	sliv6	Employment	0.056	0.039	0.020	0.056	0.041	0.019	
		Other sources of income							0.083
		Total std. of living and livelihood	**0.333**	**0.221**	**0.581**	**0.333**	**0.230**	**0.541**	
All indicators		**Total sum of weights**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**

Note: Balisacan (2015) weights are those corresponding to the APIS-based indicators

Source: Calculated from APIS 2004, and Balisacan (2015).

TABLE 5: MULTIDIMENSIONAL POVERTY ESTIMATES BASED ON 9 INDICATORS

Year	Nested Uniform Weights		Nested Inverse Incidence Weights		Subjective Welfare Weights	
	Multidim. Poverty Estimate	Std. Err.	Multidim. Poverty Estimate	Std. Err.	Multidim. Poverty Estimate	Std. Err.
M($_{k=1/3}$)						
2004	0.140	0.002	0.139	0.002	0.114	0.002
2007	0.152	0.002	0.155	0.002	0.104	0.002
2008	0.122	0.002	0.122	0.002	0.089	0.002
2010	0.135	0.003	0.138	0.003	0.085	0.003
2011	0.135	0.002	0.138	0.002	0.080	0.002
2013	0.121	0.004	0.125	0.004	0.066	0.004
M($_{union;\ \beta=1}$)						
2004	0.179	0.002	0.174	0.002	0.176	0.002
2007	0.186	0.002	0.185	0.002	0.169	0.002
2008	0.158	0.002	0.155	0.002	0.149	0.002
2010	0.164	0.003	0.165	0.003	0.143	0.003
2011	0.165	0.002	0.165	0.002	0.145	0.002
2013	0.150	0.004	0.149	0.004	0.130	0.004
M($_{union;\ \beta=2}$)						
2004	0.081	0.001	0.083	0.001	0.081	0.001
2007	0.084	0.001	0.088	0.001	0.075	0.001
2008	0.068	0.001	0.070	0.001	0.064	0.001
2010	0.073	0.002	0.077	0.002	0.062	0.002
2011	0.071	0.001	0.075	0.001	0.060	0.001
2013	0.061	0.002	0.065	0.002	0.051	0.002
H($_{k=1/3}$) : fraction poor in at least one-third of weighted dimensions						
2004	0.281	0.004	0.270	0.004	0.207	0.004
2007	0.318	0.005	0.310	0.004	0.190	0.004
2008	0.258	0.004	0.248	0.004	0.165	0.003
2010	0.288	0.006	0.282	0.006	0.155	0.005
2011	0.295	0.004	0.289	0.004	0.149	0.003
2013	0.274	0.008	0.269	0.008	0.126	0.006
H($_{union}$) : fraction poor in any dimensions						
2004	0.635	0.004	0.635	0.004	0.635	0.004
2007	0.630	0.004	0.630	0.004	0.630	0.004
2008	0.587	0.004	0.587	0.004	0.587	0.004
2010	0.564	0.006	0.564	0.006	0.564	0.006
2011	0.583	0.004	0.583	0.004	0.583	0.004
2013	0.560	0.008	0.560	0.008	0.560	0.008

Note: These estimates omit the *health2* indicator. The standard errors allow for design effects due to stratification and clustering.

Source: APIS survey data sets for rounds 2004 through 2013.

TABLE 6: MULTIDIMENSIONAL POVERTY ESTIMATES BASED ON 10 INDICATORS

	Nested Uniform Weights		Nested Inverse Incidence Weights		Subjective Welfare Weights		Balisacan (2015) weights
Year	Multidim. Poverty Estimate	Std. Err.	Multidim. Poverty Estimate	Std. Err.	Multidim. Poverty Estimate	Std. Err.	Multidim. Poverty Estimate
M(k=1/3)							
2004	0.084	0.002	0.067	0.001	0.107	0.002	0.154
2007	0.082	0.002	0.068	0.002	0.099	0.002	0.140
2008	0.064	0.001	0.051	0.001	0.082	0.002	0.130
2010	0.069	0.002	0.056	0.002	0.080	0.003	0.128
2011	0.062	0.001	0.050	0.001	0.075	0.002	0.124
2013	0.072	0.003	0.063	0.003	0.068	0.004	
M(union; β=1)							
2004	0.154	0.002	0.143	0.002	0.171	0.002	
2007	0.156	0.002	0.146	0.002	0.166	0.002	
2008	0.131	0.002	0.122	0.001	0.144	0.002	
2010	0.134	0.002	0.126	0.002	0.140	0.003	
2011	0.131	0.002	0.122	0.001	0.141	0.002	
2013	0.149	0.003	0.144	0.003	0.140	0.004	
M(union; β=2)							
2004	0.053	0.001	0.049	0.001	0.073	0.001	
2007	0.053	0.001	0.049	0.001	0.069	0.001	
2008	0.042	0.001	0.039	0.001	0.058	0.001	
2010	0.044	0.001	0.041	0.001	0.056	0.002	
2011	0.041	0.001	0.038	0.001	0.055	0.001	
2013	0.047	0.002	0.046	0.002	0.050	0.002	
H(k=1/3) : fraction poor in at least one-third of weighted dimensions							
2004	0.186	0.003	0.140	0.003	0.204	0.004	0.319
2007	0.185	0.004	0.146	0.003	0.190	0.004	0.301
2008	0.145	0.003	0.110	0.003	0.160	0.003	0.281
2010	0.157	0.005	0.123	0.004	0.153	0.005	0.277
2011	0.144	0.003	0.110	0.003	0.147	0.003	0.275
2013	0.167	0.007	0.140	0.006	0.138	0.006	
H(union) : fraction poor in any dimension							
2004	0.668	0.004	0.668	0.004	0.668	0.004	
2007	0.668	0.004	0.668	0.004	0.668	0.004	
2008	0.615	0.004	0.615	0.004	0.615	0.004	
2010	0.599	0.006	0.599	0.006	0.599	0.006	
2011	0.612	0.004	0.612	0.004	0.612	0.004	
2013	0.663	0.008	0.663	0.008	0.663	0.008	

Note: The estimates for 2013 are not comparable due to a change in the reference period for the *health2* indicator (see text for details). The standard errors allow for design effects due to stratification and clustering.
Source: APIS survey data sets for rounds 2004 through 2013; and Balisacan (2015).

TABLE 7: CONTRIBUTION OF DIMENSIONS TO MULTIDIMENSIONAL POVERTY FOR DIFFERENT WEIGHTING SCHEMES AND MEASURES (%AGE)

Poverty measure/ var. name	Dimension/ Indicator	Nested Uniform weights		Nested Inverse Incidence weights		Subjective welfare weights	
		2004	2013	2004	2013	2004	2013
M(k=1/3)							
educ1	Primary schooling	4.7	2.8	4.7	2.7	8.5	8.6
educ2	School attendance	7.0	3.8	7.1	3.8	4.5	3.7
	Education	**11.7**	**6.6**	**11.8**	**6.5**	**13.0**	**12.3**
health1	Food consumption	71.9	82.0	78.4	86.6	23.8	25.8
	Health	**71.9**	**82.0**	**78.4**	**86.6**	**23.8**	**25.8**
sliv1	Sanitation	3.4	2.7	2.0	1.5	12.0	12.9
sliv2	Water	2.9	2.4	1.7	1.5	2.4	2.9
sliv3	Electricity	3.8	2.2	2.2	1.3	18.2	16.7
sliv4	Roof-wall	2.8	1.9	1.7	1.2	10.6	10.7
sliv5	Assets	2.7	1.6	1.7	1.0	19.6	18.2
sliv6	Employment	0.7	0.6	0.5	0.4	0.4	0.4
	Std. of living & livelihood	**16.4**	**11.5**	**9.9**	**6.9**	**63.2**	**61.9**
		100.0	100.0	100.0	100.0	100.0	100.0
M(union; β=1)							
educ1	Primary schooling	5.9	4.4	7.7	5.7	6.2	5.3
educ2	School attendance	12.7	9.1	15.3	10.7	4.5	3.6
	Education	**18.6**	**13.5**	**23.0**	**16.4**	**10.7**	**8.9**
health1	Food consumption	47.1	58.1	53.8	64.9	27.2	37.9
	Health	**47.1**	**58.1**	**53.8**	**64.9**	**27.2**	**37.9**
sliv1	Sanitation	7.4	7.4	4.7	4.6	15.4	17.6
sliv2	Water	6.4	6.4	4.2	4.1	2.2	2.5
sliv3	Electricity	6.4	4.0	4.3	2.6	16.4	11.5
sliv4	Roof-wall	5.5	4.1	3.8	2.8	11.4	9.6
sliv5	Assets	4.7	2.9	3.3	2.0	15.3	10.5
sliv6	Employment	3.9	3.5	2.9	2.5	1.5	1.5
	Std. of living & livelihood	**34.3**	**28.4**	**23.2**	**18.7**	**62.1**	**53.2**
		100.0	100.0	100.0	100.0	100.0	100.0
M(union; β=2)							
educ1	Primary schooling	7.0	5.3	9.1	6.7	8.0	7.2
educ2	School attendance	13.1	9.0	15.6	10.6	3.7	2.6
	Education	**20.1**	**14.2**	**24.7**	**17.2**	**11.7**	**9.9**
health1	Food consumption	52.6	63.2	58.8	69.5	25.8	33.7
	Health	**52.6**	**63.2**	**58.8**	**69.5**	**25.8**	**33.7**
sliv1	Sanitation	5.7	5.4	3.2	3.0	13.7	15.0
sliv2	Water	4.9	4.9	2.9	2.9	1.6	1.8
sliv3	Electricity	6.1	4.1	3.6	2.4	18.0	14.5
sliv4	Roof-wall	4.7	3.7	2.9	2.2	11.1	10.2
sliv5	Assets	4.3	3.0	2.8	1.9	17.7	14.6
sliv6	Employment	1.7	1.5	1.1	1.0	0.4	0.4
	Std. of living & livelihood	**27.3**	**22.6**	**16.5**	**13.2**	**62.5**	**56.5**
		100.0	100.0	100.0	100.0	100.0	100.0

Note: See text for details.

Source: APIS survey data sets for rounds 2004 and 2013.