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Priority-Based Multidimensional Poverty

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Abstract:

In this paper, we propose a new methodology of multidimensional poverty measurement. Our approach is based on using self-stated responses to household spending priorities. This information is first used to know what the relevant deprivations are. In particular, the stated top priorities allow us to identify the poor. For each household, the deprivations are aggregated according to relative weights computed from the data on priorities. Such procedure can be justified by a set of axioms.

Using the priorities data in such a way allows us to: (1) eliminate ‘Command variables’ in favour of ‘Intrinsic welfare variables’, which correspond better to the ‘basic needs approach’; and (2) solves problems arising with needs heterogeneity, (3) avoids the arbitrariness that typically arises in many stages of construction of multidimensional poverty indices.

Finally, we propose an empirical application to Seychelles that: (1) elicits what the main deprivation dimensions are, (2) delivers a realistic estimated incidence of poverty, as opposed to what is found with the usual approaches, (3) shows the approach consequences in terms of targeting statistics of using multidimensional poverty rather than monetary poverty. We also use data on public budget to exhibit the ‘implicit multidimensional poverty index’ of the State in Seychelles.
1. Introduction

In this paper, we propose a new methodology of multidimensional poverty measurement. Our approach is based on using self-stated responses to household spending priorities. This information is first used to know what the relevant deprivations are. In particular, the stated top priorities allow us to identify the poor. For each household, the deprivations are aggregated according to relative weights computed from the data on priorities. We shall justify this procedure by a set of axioms.

Using the priorities data in such a way will allow us to: (1) eliminate ‘Command variables’ in favour of ‘Intrinsic welfare variables’, which correspond better to the ‘basic needs approach’; and (2) solves problems arising with needs heterogeneity, (3) avoids the arbitrariness that typically arises in many stages of construction of multidimensional poverty indices.

Even if one-dimensional poverty and deprivation measures based on income still dominate the economic literature, many authors argue that multidimensional dimensions must be accounted for. More generally, the basic needs approach emphasizes human development as first fulfilling a set of fundamental needs, rather than placing all the attention on income factors.

Among the Multidimensional Poverty Indices (MPI) that have been proposed in the literature, Chakravarty and Bourguignon (2003), Alkire and Foster (2009, 10, 11), Alkire and Santos (2010) and Belhadj (2012) propose formulae that aggregate individual discrete poverty features into a synthetic ‘individual poverty score’. These scores are then summed at country level to yield a poverty index\(^2\).

In the case of some middle-income countries, the applied MPIs used in the literature do not appear as being terribly relevant. Indeed, in these countries the general living conditions may be good enough so that in practice almost nobody is observed in household surveys as living in a shack, or having toilets outdoors, or having a house with dirt soil, or malnourished children, etc\(^3\). But in other countries there are still poor people that are legitimate targets for social policy.

Moreover, the estimation results of the used applied MPIs may invite to displace some of the poverty alleviation aid from low income towards middle-income countries (like in Alkire and Santos, 2010). Although, it may be possible that many poor households have been overlooked in middle-income countries when using traditional monetary poverty measures, one may worry that the above policy recommendations would originate from disproportionate weights given to deprivation in dimensions that are not as important as actual basic needs.

Another shortcoming of the MPI indices is that they are aggregating heterogeneous basic deprivation indicators, while it is not always clear what is the justification of adding such indicators as income per capita and life expectancy for example, and using

\(^2\) For example: Cavapozzi et al. (2013), Decancq and Lugo (2013).
\(^3\) This is the case in Seychelles (Muller, 2012b).
arbitrary weights. Various issues of arbitrariness typically arise with the construction of such indices: Which deprivation dimensions? Command variables or basic needs variables? How to deal with heterogeneity? Which aggregation weights? Moreover, it is debatable that just counting such heterogeneous dimensions constitutes a relevant, safe and accurate basis for incorporating multidimensionality in poverty analysis.

The notion of basic needs can be seen as somewhat related to the freedom of choice. As DasGupta (1993, p. 42) states it: ‘It is an inadequate index of wellbeing which neglects primary negative liberties.’ Rawls (1972) calls ‘social primary goods’ those commodities that are essential to the exercise of freedom. Obviously, having enough food to survive or to conduct usual activities is one of these primary goods. There may also be primary goods that have no instrumental value, but are valued for their intrinsic worth. These goods or welfare attribute seems to be particularly relevant in the early stages of development, in which many households can be considered as poor. Indeed, it is often acknowledged that ‘luxury needs’, such as democracy or television, become really important for poverty analysis only once basic needs are satisfied for most of the population. This supports our investigation of household priorities among basic needs in this paper.

In Section 2, we present the methodology for our new multidimensional poverty measures, which are based on household spending priorities. In Section 3, we report an empirical application to Seychelles and Mauritius. Finally, Section 4 concludes.

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4 Poverty measures that follow Alkire and Foster methodology are implemented by Alkire and Santos (2010) with additional hypotheses based on ten variables linked to living standards, health and education. A weighed score is calculated from adding deprivation indices in these ten dimensions. Then, a multidimensional poor is characterised as someone deprived across at least thirty percent of the weighed score.
2. Priority-Based Multidimensional Poverty Indicators

We now discuss the methodology of our multidimensional poverty indicators. Spending priority data is used in the specification at three stages: the definition of the destitution dimensions, the selection of top priorities for the identification of the poor, the aggregation of the deprivations. The data on spending priorities come from the question: “To what would you spend a small additional sum of money?”

2.1. The identification of the welfare dimensions: ‘Which ones’?

A major step in defining multidimensional poverty indicators is the selection of the relevant welfare dimensions to consider. Thorbecke (2011) emphasizes that this is ultimately dependent on the purpose they should serve. First, each considered welfare dimensions must be meaningful and well recognized as central to poverty. This is for example the case for income and health status, or any basic needs. Second, some corresponding data must be available. There is no use, at least for policy guidance, to develop indicators that could not be calculated. Finally, only dimensions for which non-negligible poverty issues have been measured need be included. Incorporating a dimension for which nobody can be considered poor should not change the level of the multidimensional poverty indicator.
In theory, welfare attributes should be intrinsically good and directly deliver well-being or utility. However, in practice, some variables used as welfare attributes in the literature, starting with income and perhaps education, are rather justified by the fact that they command over commodities, while other variables may instead directly produce well-being. Nonetheless, they are several good reasons for using variables that command over well-being attributes in multidimensional poverty analyses. First, these variables can be observed, while more direct measures of wellbeing or satisfaction may not come handy. Second, they summarize a great deal of information, as it is case for total expenditure that encompasses many elementary consumption goods. This is for example the approach used in the HDI or the MPI in UNDP (2010, 2011) that mix information on income, education and longevity, all variables allowing commands. Some of these variables may also provide direct welfare benefits, although this is a contentious question.

However, these justifications for using instruments commanding other wellbeing variables are only practical. If it is possible, one should rather define poverty in terms of direct satisfaction of basic needs. As a matter of fact, such relevant normative information is easier to elicit in terms of possible dissatisfaction of some basic needs. For example, one can refer to the budget necessary for acquiring some specific goods or services. This is our approach.
2.2. The specification of the individual deprivation indicators: ‘What?’

A well-known way to define the deprivation dimensions in empirical analysis is by comparing the expenditure for a given dimension with a dimension-specific monetary poverty line. For example, one may want to compare household health care expenditure with a monetary measure of subsistence minimum for health care. However, this method raises several problems for multidimensional poverty. First, several dimensions of welfare may not correspond to private market expenditure.

Second, needs may be heterogeneous across households for some welfare dimensions. In that case, accounting for household composition, as it is typically done in poverty studies, may not be sufficient to control for such heterogeneity. For example, in the case of health deprivation, the health care expenditure should mean something completely different when somebody is severely ill in the household and when everybody is in good health. Also, the type and the severity of diseases and other health problems should much affect the way the corresponding subsistence minimum is calculated.

Moreover, the expenditure on health may be seen as responding to intrinsic welfare needs, or to be a ‘command expenditure’ to improve health status of household members. Health expenditure raises specific difficulties in that it corresponds to the occurrence of a welfare reduction linked to illnesses or other health problems. Then, counting it as a positive welfare argument may yield the opposite of what is searched when measuring welfare. To be able to undertake proper welfare measurement in the
dimension of health by using expenditure information, one must have a way to measure the drop in health status that motivates the health expenditure. This is a problem of unobserved transient needs. But if one could measure health status accurately, why not using it as the relevant welfare attribute in the first place. Fundamentally, the issue here is that it is much easier to record health expenditure information than to measure health status or health needs accurately.

The interviewed households themselves can sometimes deal with needs heterogeneity when they assess subjectively their own needs, which they usually know better than anyone else. In such situations, using direct self-deprivation information, even if discrete and simple, may yield more sensible results than trying to calculate deprivation indices by comparing measures of dimension-specific household expenditure with dimension-specific subsistence minima. This is the approach we follow in this paper, which is therefore more general than using individual wellbeing indicators, and we make it practical by pointing households at their own spending priorities in a specific questionnaire.

2.3. The identification of the poor: ‘Who?’

Let us consider a population of n individuals. Let $x_{ij}$ be the $j^{th}$ welfare attribute of individual $i$, for future reference. Individual $i$ is characterised by a row $m$-vector of deprivation indices, $d_i$ in $\mathbb{R}^m_+$. We consider that all the deprivation indices are non-negative as it is generally the case in applied work. However, this restriction does not play a role in the discussion. The row-vector $d_i$ is the $i^{th}$ row of matrix $D$ that belongs to

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Note that our approach is more general than just working with welfare attribute. In particular, it includes the case where $z$ is the $m$-vector of the $m$ dimension-specific poverty lines ($z_j$, for $j = 1, \ldots, m$) and an individual $i$ is said ‘poor in the $j^{th}$ attribute’ if $x_{ij} < z_j$. 

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$M^n$ that is the set of all $n \times m$ matrices of nonnegative numbers. Let $d_{ij}$ be the quantity of the welfare deprivation $j$ suffered by individual $i$. Matrix $D$ is a convenient notation as each of its columns provides the information on the distribution of a specific deprivation in the population. Let $d_j$ be the $j^{th}$ column of $D$. It describes the distribution of the $j^{th}$ deprivation.

To be able to consider all possible population sizes, we define $M$ as the union of all sets $M^n$ for all population sizes $n$. This set describes all the relevant social welfare situations we may want to examine.

In typical monetary poverty analysis, a person is deemed poor if its living standard falls below a given monetary poverty line. In multidimensional analyses, the ‘Intersection approach’ states that a poor is an individual who is poor in all welfare dimensions. However, when applied empirically, this approach often leads to a very small number of people considered as poor. Moreover, one would like to consider as poor some households who may not have a very low income level, while they may be destitute on other grounds. An important justification of constructing multidimensional indicators is indeed to rescue miserable households who would not pass a means test of income used for allocating social benefits.

In the ‘Union approach’, adopted by Bourguignon and Chakravarty (2003), a person is poor if she falls below at least one of the dimension-specific poverty lines. One issue with this approach in empirical analyses is that encompassing many welfare dimensions lead to exaggeratedly high poverty incidence estimates.
Atkinson (2003) re-examines the differences between Union and Intersection approaches, and the approaches counting deprivations for social welfare analysis. He recalls that the Intersection approach corresponds to ALEP substitute attributes (\(p_{jk} > 0\), for the individual poverty intensity function \(p(x_1, \ldots, x_j, \ldots, x_k, \ldots, x_m)\)), while the Union approach corresponds to ALEP complement attributes (\(p_{jk} < 0\)). We can therefore deduce that other approaches correspond to situations where one would reject the exclusive hypotheses of ALEP substitutability and ALEP complementarity. Note that these properties depend not only on the shape of the indifference curves but also on the cardinalisation chosen for the function \(p\). This makes them less clear as fundamental hypotheses, which suggests also investigating other approaches. On another hand, Atkinson showed that just counting deprivation could correspond to indicators such that correlation increasing switches may increases or reduce poverty, which would therefore not fit well Union or Intersection approaches.

Counting deprivations in order to assess multidimensional poverty is systematically exploited by Alkire and Foster (2011) and Aaberge and Peluso (2011). In each dimension, they still use a poverty line to determine the individual deprived with respect to a given attribute. In addition, the poor are identified by counting the dimensions in which they are deprived and comparing the result to a chosen threshold \(k\) for counts. A shortcoming of such definition is that an individual with extreme deprivation in one dimension only, e.g., food intakes, may not be considered as poor as soon as \(k > 1\). Instead, we assume that severe deprivation in some crucial dimensions may be enough to be considered as poor. We now turn to the aggregation of these individual deprivations over the whole population.
2.4. The aggregation of the individual deprivations: ‘How?’

A simple way to assess poverty is just to count the poor. Let us consider the Union approach. Let \( p_0(x_i, z) = I[\text{There is at least one } j \in \{1, \ldots, n\}, d_{ij} > 0]. \) Then, the number of the poor in this approach is equal to \( H = \sum_i p_0(x_i, z). \)

Bourguignon and Chakravarty (1998, 2003) assume a series of axioms\(^6\): Strong Focus (SF), Weak focus (WF), Symmetry, Monotonicity, Continuity, Principle of Population, Scale Invariance and Subgroup Decomposability, One Dimensional Transfer Principle (OTP), Multidimensional Transfer Principle (MTP), Non-Decreasing Poverty under Correlation Increasing Switch (NDCIS). This allows them to propose various multidimensional indicators.

Most of these axioms are common and familiar to specialists. A few of them deserve additional comments. The Strong Focus axiom forbids that an individual could give up some amount of a non-meagre attribute to improve the position of a meagre attribute. It is defined by imposing that the poverty index does not change when the non-meagre attributes of any individual change, including for the poor. The Weak Focus axiom only assumes that the poverty index is independent of the attribute levels of the non-poor. SF imposes that the isopoverty contours of an individual in a one-dimensional space is parallel to the axis for a meagre attribute. WF only imposes such restriction asymptotically. They both exclude or limit the possibilities of substitution of meagre attributes by non-meagre attributes. Indeed, if such substitutions are considered as fundamental for poverty analysis, then the utility-consistent approach that explicitly

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\(^6\) See the definition in the Appendix.
models these substitutions may be the best route to follow. In that sense, multidimensional poverty indices reflects the fact that policymakers would think about different deprivation indices without completely allowing for such substitution. In this conception, deprivation indices are important because not everything can be easily compensated in society. For example, changing the income of the rich may not help in alleviating poverty directly.

Note that there remains ample room for substitution between attributes in any case. As long as the two considered attributes j and k are meagre, any ALEP substitutability \( p_{jk} > 0 \) or complementarity \( p_{jk} < 0 \) can be dealt with. Under subgroup decomposability and with substitute (respectively complement) attributes, an increasing correlation switch yields non-decreasing (non-increasing) poverty (NDCIS, respectively NICIS). However, it may be that in general attributes are neither complement nor substitute.

The One-Dimensional Transfer principle (OTP) assumes that poverty does not increase under a progressive transfer. The Multi-Dimensional Transfer principle (MTP) assumes that poverty does not increase under redistribution of the attributes of the poor according to a bistochastic transformation. They imply that the marginal rate of substitution between two meagre attributes is non-increasing in the corresponding two-dimension plan.

Bourguignon and Chakravarty show that subgroup decomposability jointly to OTP implies that the derivable poverty indicators are in the form of a weighted mean of individual poverty contributions associated with each individual i and each attribute j. What matters for MPIs is therefore mostly to define these contributions. This
decomposition allows for example to identify the share of each attribute in global poverty. In settings, many authors also introduce positive weights $w_j$ to account for differences in importance of the attribute deprivations.

The aggregation of deprivation indices is criticised in Ravallion (2011, 2012). In particular, he is much concerned about the arbitrariness of hypotheses and would instead consider dimension-specific indicators. Arbitrariness is indeed a pervasive feature of the literature about multidimensional poverty. First, the choice of attributes itself is generally arbitrary. Second, the weights used to construct the aggregate poverty score are also generally arbitrary. Although, many methods of calculating the weights have been suggested, it seems fair to say to none has reached general consensus. The most popular approach is to have equally weighed dimensions. But this neglects the obvious fact that some deprivations are generally seen as much more important than other ones. The weights are sometimes obtained from ancillary data and sometimes imposed using normative opinions. However, what remains is a general impression of ambiguity about which weights should be used.

An original way of generating weights is to refer to priorities between dimensions. We proceed to do this in the next sub-section.

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7 See for example, Bossert, Chakravarty and D’Ambrosio (2009), Decancq and Lugo (2010)
8 Belhadj (2012) proposes an approach based on Fuzzy sets theory to account for such ambiguity. Namely, he defines an identification (of the poor) function such that: (i) an individual that is not deprived in any attribute is non-poor and the function takes the value 0; (ii) an individual that is deprived in all the attributes is poor and the function takes the value 1; (iii) in the other cases the identification function can take a positive value strictly inferior to 1. Then, the author derives a formula for the weights and the poverty index by making the aggregation depend on the identification function.
2.5. Selection of deprivation dimensions by using priorities data

Our new approach is first based on accounting for priorities in needs stated by the households themselves; and second, when considering the list of dimensions, by disconnecting the identification of the poor from the computation of total poverty severity.

First, it is possible to identify the poor by checking if they are deprived in the dimension that has the highest priority, and then, if not, if they are deprived in the dimension with the second highest priority, and so on until the last relevant dimension. When the ranking of priorities is fixed a priori and is the same for all individuals, this way of doing is exactly equivalent to use the Union approach of identifying the poor. Therefore, as long as one only want to identify the poor, such notion of priority of dimensions used as above is unsubstantial and does not depart from checking that there is no deprivation in any relevant dimension. However, this is no longer the case if the ranking of priorities is not determined a priori, or vary with time or contexts to compare, or is heterogeneous across individuals. For example, in the data that we avail of, we use the answers to the question ‘To what would you spend a small additional sum of money?’ as our information basis to define each household priority.

Using our priority approach may also yield the same unrealistic results: too few poor or too many poor when judged by the general public, as soon as even a few dimensions are considered. That is a glaring default in all the current multidimensional approaches. We solve this problem by using a different set of dimensions to identify the poor and to measure total poverty intensity. That way, keeping only the highest priority deprivations
to identify the poor has the advantage of reducing the extent of the corresponding Union
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head-count index, which is in the range of realistic levels. Doing so also makes less
dramatic the omission of one or several minor dimensions in the index, a typical feature
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of data.
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An important parameter is therefore the number of high-priority dimensions that should
be used. Diverse practical rules can be used to determine the value of this parameter. A
simple one is to estimate it from the household responses when several priorities are
asked. Indeed, a truncated count model can be estimated and the estimated model can be
used to estimate the mean number of high-priority dimensions. This avoids another
arbitrary step in the usual indicators.
arbitrary step in the usual indicators.

2.6. Global aggregation by using priorities data

In order to bring more flesh to the use of priorities in poverty evaluation we further
propose to bestow to them different weights in the formula of the poverty index, instead
of just using them for identifying the poor. For example, an individual deprived in the
first priority dimension could be considered as a fully-fledged poor, while an individual
not deprived in this dimension but deprived in the second priority dimension would be
considered as ‘half-poor’, and so on. This kind of calculation delivers a weighed score
of all deprivation indices, with decreasing weights according to decreasing priorities.
This may be useful if there is a ‘ladder of basic needs’ on which most people could
agree. For example, one could generally consider that child mortality and caloric intakes
should be put in a first priority category, while clothing needs and leisure time could be allocated to a lower priority category.

Another way of specifying ‘priority weights’ is to account for explicit statements of households in the population. For example, the percentage of households stating a given priority could be used as a natural of way of specifying weights. This has the advantage of generating non-arbitrary weights.

Moreover, one could imagine some vote rules that could yield this result. Using frequencies of priorities shadows the result of a proportional vote of the relevant households on their priorities. This procedure could be also be interpreted as reflecting expectations about the priorities when drawing households at random.

Another perspective is that of the priorities of public planners. One way to approximate them is to use as weights the share of public budget allocated to different social sectors, or to use the share of GDP or of aggregate consumption from the national accounts.

The identification of the poor is the Union rule defined on the highest priority dimensions. A given count threshold could be used to define the highest priority dimensions. However, the data should often show obviously what they should be in practice. For example, in the case of Seychelles, according to household responses they are two high priority dimensions on which household would spend an additional amount of resources if they could: shelter and food.
Another approach is to estimate a count model of priorities, when households have been asked to state several ones if wishes, and predict the expected number of priorities of the population of interest. The prediction is rounded to the closest integer k, and only the highest k priorities are used for the identification of the poor.

As a consequence, our indicator of multidimensional poverty incidence is the following proportion of the poor based on the two highest priorities (shelter and food in the Seychelles case):

$$IM(D) = \frac{1}{n} \sum_i \{ 1[d_{i1} > 0] + (1 - 1[d_{i1} > 0])1[d_{i2} > 0] \},$$

which can of course be adjusted to any other set of ‘highest priorities’. This corresponds to the Union approach based on the elicited household priorities and aggregated to the whole population. Alternatively, one could also try to use more information on the household-specific priorities, as in the next sub-section.

In practice, most available deprivation indicators are categorical or even discrete. In that case, specifying more or less ‘poverty severity’ sensitivity by using a poverty severity function in the formula of the poverty indicators is not likely to yield interesting empirical results. Alkire and Foster go around this difficulty by counting dimensions. Our approach is instead to introduce further deprivation indicators corresponding to all levels of priority. Our ‘severity of poverty’ indicator is therefore based a weighed sum of deprivation indicators, albeit only when counting the poor as defined by their highest priorities. We obtain:
\[ M(D) = \frac{1}{n} \sum_{i} \left\{ 1[d_{i1} > 0] + (1 - 1[d_{i1} > 0])1[d_{i2} > 0] \right\} \sum_{j} w_j 1[d_{ij} > 0] \],

where \( w_j \) is the ‘priority’ weight allocated to dimension \( j \).

Rawls (1972, p 5) argues that the conception of justice must be public. This suggests us to use aggregate priority statistics that would represent well the general interest in such priorities and would be relatively easy to grasp by citizens. A natural candidate for this is to use the relative frequencies of the different responses, as a basis for computing the \( w_i \)’s.

In a more general sense, it seems important for political implementation of poverty alleviation policies that the poverty measure describes appropriate public norms in a robust, representative and objective way. This objectivity would bring some useful legitimacy to the use of our poverty measure. Such feature is what may explain the success of objective nutritional minima used as anchors for poverty line calculation, for example.

Consistently with these concerns for accounting objectively for the welfare priorities of the poor, we therefore choose as \( w_j \) the proportion of monetary poor households who stated \( j \) as their first priority. Of course, other rules could be used for the weights.
2.7. Using the distribution of household-specific priorities

To do

The formal priority rule corresponds to comparing n-uplets of consumption increments, such as \((0, \ldots, 0, 1\text{ in } i^{th}\text{ position}, 0, \ldots, 0)\).

In consumer theory with a unique constraint that is the budget constraint, if all goods have identical measurement units, this would correspond to comparing their respective prices, since marginal utilities would be proportional to prices. However, when prices are normalised, all goods have the same price and therefore the same expenditure priority. There is no motivation for meaningful responses to the priority question in that case.

When there are several constraints or missing prices, one can try to use shadow prices to rank the attributes according to their priorities. In particular, the presence of additional constraints specific to some goods amounts to increase their priority, according to the Le Chatelier principle.

However, pointing out the priority of a given welfare attribute, it is also signalling that the corresponding constraint may be binding. This is notably interesting because in a situation with many nonlinear constraints, only some of these constraints can be binding, and sometimes only one. In all cases, the information on household-specific priorities seems to inform on the presence of relevant constraints to consumption that may be specific to each welfare attribute.
Our approach in that case is just to keep only the individual deprivation variables that correspond to the (at most) three expenditure priorities stated by the individual. An imperfect solution is to give arbitrary weights (e.g., 3, 2 and 1) to the corresponding deprivations. It is also possible to use as weights the percentages of the populations stating these priorities and to apply them only to the three deprivations signalled by the individual, while this makes the approach less household-specific.

Finally, the information on the distribution of priorities in the population can be used.

**To do**

### 2.8. The axiomatics of priorities

**to do**

Among the interesting axioms that we want to mobilize we have:

1. Decomposition axioms (or Pareto axioms) with three types of decomposition: incidence, intensity, multidimensional poverty;
2. Weak/Strong focus axioms applied to three levels: incidence, intensity, and multidimensional poverty.
3. Priorities axioms with three levels: definition of the goods, selection of the top priorities for the definition of the poor, aggregation of the deprivations.
In our setting, the weak and strong focus axioms, as in Bourguignon and Chakravarty, can be applied, or not, at three different levels: incidence of poverty, intensity of poverty, and multidimensional poverty.

Again, the decomposability axioms can be mobilized at three different levels: incidence of poverty, intensity of poverty, and multidimensional poverty.

The fact that our index is a weighted mean of deprivation indices implies that it is subgroup decomposable. This is important because among the main interests of deriving a measure of multidimensional poverty is the possibility of deriving the contribution of each component of welfare in the form of a 'share of poverty'.

To do

2.9. Stochastic Dominance Results

To do

e.g. with decreasing weights according to the priority

Other characterization of the interaction of weights and priorities are possible
We now apply our new indicators to the case of Seychelles.

3. An Empirical Application

3.1. The context and the data

Seychelles is an upper middle-income country enjoying relatively satisfactory levels of social indicators. This country is currently undertaking the difficult transition from a welfare state to a market-based economy. As a small open and service-based economy, it remains vulnerable to global shocks, which affect tourist arrivals, the main source of foreign earnings. A macro-economic stabilization plan was recently carried out, accompanied with medium-term structural reforms, which were intensified at the end of 2008. These policies coincided with the global economic slowdown that faded away in 2011, but reemerged from 2012.

Inefficient targeting of social transfers plagues Seychelles’ generous social security system (Campling et al, 2011). However, the reforms made the social system less costly. Public sector transfers fell from 5.5 % GDP in 2005 to 1.9 % in 2009. The Agency for Social Protection is now directly funded by personal income taxes.

For one-dimensional monetary poverty in 1996, the estimated general poverty line was worth 13554 Rupees per adult-equivalent per year. It corresponds to an estimated monetary poverty rate of 17 percent, and 12 percent of poor households (Muller, 2012a). These figures depict a broad notion of poverty based on the opinions of Seychelles
households on subsistence minima expressed in terms of total consumption expenditure, including housing expenses. Monetary poverty was found higher in households led by female, little educated or unemployed heads. In Seychelles, large families and fishermen families especially suffer from monetary poverty.

We designed a Living Conditions Survey (LCS), which was conducted in collaboration with the National Bureau of Statistics, so as to provide information on basic needs for diverse welfare dimensions (Muller, 2013). The same households who had been randomly selected for the 2006/07 Household Budget Survey (HBS) were re-surveyed. A total of 1,125 households were interviewed from February to June 2011. The data was collected through interviews conducted in Seychelles Creole and that lasted about 20 minutes per household. The final response rate was of 96.9 percent.

The responses to this survey elicit a mixed picture of diverse deprivations that are seen to affect a non-negligible minority of the population. One third of Seychelles households state that they have sometimes some difficulty to obtain daily food, and another 5% considerable difficulty. About 7% of households admit to wear worn clothes and 10% not to have adequate clothing for outing. A proportion of 15% of persons have stated health problems in the last twelve months, which reaches 47% for the elderlies.

In Seychelles, almost all households use gas or electricity as the energy source for cooking or lighting. However, as much as 7% of households admit to have had electricity disconnected because of failure of payment during the past 12 months. Besides, 11% of households state that they had not been able to pay electricity in time.
In the same fashion, almost all households have access to treated water. Yet, 10% of the households state that they could not afford paying their water bill every month in the last twelve months, and slightly less than 5% that they suffered water disconnection.

One fifth of households encounter difficulties in financing their transport needs. Other three percent meet considerable difficulties, or cannot at all pay for their transport. Unsatisfied education needs are probably almost inexistent when there is no child of schooling age in the household. However, 21% of households state that they cannot afford school items. Moreover, 5.5% of households say that they don’t have the means to buy lunch for their children to take to school. This is worrying in a country like Seychelles where education is mostly free of charge. Now, these statistics rather inform on schooling needs for children than on current education deprivation for adults, which could be better described by constrained adult education levels. However, adult education is also not infrequent, and it is somewhat unclear how to delineate child and adult education needs.

3.2. Definitions of indicators

The available information in the survey limits the variables that can be a priori used to describe the welfare dimensions. Moreover, we want to favour basic needs information over the use of command variables. One advantage of this is that much of the used information is in the form of self-stated destitution, thus avoiding dealing with needs heterogeneity. Also, the sample must also be reduced further to 783 observations because of missing values for some of these well-being variables.
We asked the surveyed households about what their spending priority would be if they had a little more money. 31% answer that they would spend it on shelter, 15% on food, 14% that it would be set aside for worst times, with the other categories less often chosen. Asking only the monetary poor households\(^9\) shows the same pattern of answers on priorities. First comes Shelter with 34.5% of responses, then ‘Set aside for worst times’ (13.9%), Food (12.2%), Debt repayment (9.8%), Water and Electricity (9.1%), Health (7.0%), Household appliances (5.6%), Other (3.5%), Uniform/Shoes/School necessities (1.4%), Transportation (1.1%), Holiday (1.1%), etc. Focussing on the monetary poor has the advantage of availing of priority information from households who are generally in dire straits, and have an accurate perception of what their unsatisfied basic needs are.

Excluding the responses that do not directly pertain to immediate basic needs, we obtain the following rankings: A. Shelter; B. Food; C. Water/Electricity; D. Health; E. Education. Debt and household appliance and saving-insurance also matter for these households, while we choose not to include them into basic needs. We remain with five dimensions, with shelter and food appearing as prominent. It is interesting here that this is an empirical argument that leads us to the choice of the welfare dimensions, instead of arbitrary ‘expert opinions’. We have also avoided ‘command variables’ like income, using instead deprivation variables more directly related to basic needs.

We now discuss the practical construction of the deprivation indices for each of the five identified dimensions, under the constraint of the information available from the survey. The measure shelter deprivation is based on the number of persons per room,

\(^9\) As defined by comparing their 2005-06 per adult-equivalent total expenditure with the Seychelles national poverty line deflated to correspond to this year.
which ranges from 0.125 to 7, has a mean 1.05 and a standard deviation 1.07. The variable ‘shelter deprivation’ is defined as the dummy variable for households with four persons per room or more. 3.69 percent of households are in this situation. A household is deemed ‘food deprived’ if he states having ‘considerable difficulties in obtaining food. There are 4.72 percent of such households. The ‘water-electricity deprived’ households are defined as those households who cannot pay either for their electricity bill or for their water bill. 11.72 % of such households are in this case. Households ‘deprived in health’ are the ones who state that they is at least one person with a health problem in their household. They are 26.75 percent of such households, often composed of elderly persons. Households are said ‘deprived in education’ if their head has no education or has only primary education. They amount to 35.89 percent of all households.

No household observed in the LCS survey cumulates the five considered deprivations. Clearly, the Intersection approach to poverty identification is not appropriate for Seychelles since it would yield a poverty estimate equal to zero. On the other hand, the Union approach, which identifies the poor households as deprived in at least one dimension, yields a percentage of 42 percent, an exaggerated figure for such a prosperous society like Seychelles.

Cutting down the number of dimensions used in the Union approach, according to their stated priorities, yields more sensible estimates. Thus, omitting education and health reduces the percentage of multidimensional poor households to 17.6 percent. Keeping only the two main priority dimensions, shelter and food, leads to 8.16 percent, a figure that is close to the estimated incidence of monetary poor households (12 percent).
Shelter-deprived households are also often water-electricity deprived (24 percent of them) and especially health-destitute (41 percent of them), but rarely food-deprived (6.9 percent) and almost never education-deprived. However, no strong correlation emerges among the considered dimensions of deprivation, with the larger one being the correlation of food destitution with water-electricity destitution (14 percent). This weak statistical link between the various dimensions of basic needs is a further motivation for the multidimensional poverty approach that cannot be well summarized by any dominating dimension.

As we mentioned before, shelter corresponds to 34.49 percent of the answers related to basic needs by the monetary poor households as their first such expenditure priority; food comes second with 12.20 percent of answers, then come water-electricity (9.06 percent), health (6.97 percent) and finally education (1.74 percent). These respective percentages are used as weights for our multidimensional poverty indicator. However, and this is different from the other approaches in the literature, we apply it only to the poor households defined as the households that are destitute in shelter or food, or both. Introducing the additional information on non-principal needs makes our approach distinct from a pure Union approach that would be based only on the highest spending priorities of households.

The final formula of our multidimensional poverty estimator is therefore obtained in two steps. First, we define the score
P5 = (34.49 d_shelter + 12.20 d_food + 9.06 d_waterlec + 6.97
d_health +1.74 dEduc ) / (34.49 + 12.20 + 9.06 + 6.97 + 1.74 ),

where the variables with a prefix ‘d_’ are the corresponding dummies for each dimension-specific deprivation. That is, P5 is a mean deprivation variable, weighted by the priority percentages for each of the five dimensions, as observed in the population of the monetary poor households.

The estimated score P5 has a mean of 0.076 and a standard deviation of 0.13. For 58 % of the households this indicator is nil, which corresponds to the Union identification criterion when using five dimensions. However, as we mentioned before, we now restrict our set of poor households to the ones being deprived only either in shelter or in food. This is done by defining our multidimensional poverty (intensity) measure at the household level as

\[ M = IM \times P5, \]

where the variable IM is our multidimensional incidence indicator, that is, it is equal to 1 for poor households who are destitute in shelter or/and food, and 0 otherwise. We now estimate IM and M using Seychelles data.

### 3.3. Estimates of multidimensional poverty

The IM and M indicators are multiplied by 100 in the tables to make them more legible. Thus, IM is the percentage of the multidimensional poor, although M is not a
percentage. Preliminary estimates in terms of number of poor households and detailed description of the data and the context are in Muller et al. (2012).

We obtain our estimated multidimensional poverty indicator $M$, which has a mean of 3.6 percent and a standard deviation of 13 percent. $M$ reaches its maximum at 86 percent and is non-zero only for 8.1 percent of the observed households. The latter figure corresponds to the estimated multidimensional poverty rate given by IM. Some household are shelter-food poor, but not deprived in other dimensions. Some households are not only shelter-food poor, but also deprived in other dimensions. The linear correlation coefficient of $M$ and IM is very high (0.90). This is also the case when restricting to the population of households deprived at least in one of the five considered dimensions (0.89). This is because most of the deprivation originates from food and shelter in Seychelles and including the other dimensions in the analysis does not affect much the diagnosis. That is a first interesting result, which cannot be found by using only one-dimensional poverty statistics. Note that the correlation of our poverty measures with the Union poverty rate based on five variables is much lower: 0.31 with $M$ and 0.35 with IM.

At the aggregate level (i.e., over all Seychelles households), the estimates show that shelter contributes to 56.1 percent of $M$, food to 25.4 percent, water and electricity to 9.1 percent, health to 9.0 percent, and finally education to 0.2 percent. Even when accounting for other dimensions, shelter and food remain the dominating dimensions of multidimensional poverty in Seychelles. Education has a negligible contribution to multidimensional poverty because very few households are simultaneously food-shelter destitute and education destitute (There are only 3 such observed households in the
sample). This may be partly due to government policy that allocates free accommodation to households led by heads with low education level. This result may be specific to Seychelles.

Table 1: Multi-Dimensional Poverty by Education of Head (in %)

<table>
<thead>
<tr>
<th>Education of Head</th>
<th>Severity of Multidimensional Poverty</th>
<th>Incidence of Multidimensional Poverty</th>
<th>Incidence of Monetary Poverty</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Schooling</td>
<td>1.8</td>
<td>6.9</td>
<td>33.0</td>
</tr>
<tr>
<td>Primary</td>
<td>3.8</td>
<td>8.3</td>
<td>20.7</td>
</tr>
<tr>
<td>Secondary</td>
<td>4.0</td>
<td>10.0</td>
<td>14.1</td>
</tr>
<tr>
<td>Vocational/Polytechnic</td>
<td>3.1</td>
<td>5.8</td>
<td>12.0</td>
</tr>
<tr>
<td>University (&amp;pre)</td>
<td>2.7</td>
<td>6.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Whole Country</td>
<td>3.6</td>
<td>8.1</td>
<td>17.0</td>
</tr>
</tbody>
</table>

Table 1 shows that multidimensional poverty, measured with M, is lower for households with primary education heads as compared to households with secondary education heads. Let us neglect the households whose heads have no education or have university level education as they correspond to few observed households only, and let us focus on the central three education levels. For one-dimensional monetary poverty, the estimates are inversely related to the education level of the head. However, this is not the case when considering multidimensional poverty. To understand this result we have to realize that shelter and food are the dominating dimensions in M. When crossing the education of the head variable with the shelter destitution variable we find that primary education heads live indeed less often in crowded dwellings. This seems to be the consequence of the abovementioned government policy towards providing free accommodation to low education adults. In that sense, having primary education only is
an advantage against multidimensional poverty as compared to having secondary education.

3.4. Estimated Multidimensional Targeting

We now turn to the data about Social Welfare benefits as collected from the Living Condition Survey. Only 12 percent of the surveyed households state that they are receiving social welfare benefits at the time of the survey.

Our estimates of multidimensional poverty are about twice higher for households receiving social benefits (15 percent of them are multi-dimensionally poor) than for the population at large (8 percent).

Table 2: Coverage and Non-Coverage by welfare benefits

<table>
<thead>
<tr>
<th>Receiving Welfare at present</th>
<th>Shelter-Food Poor</th>
<th>Monetary Poverty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Poor</td>
<td>Not Poor</td>
<td>Not Poor</td>
</tr>
<tr>
<td>Yes</td>
<td>10.69</td>
<td>21.88</td>
</tr>
<tr>
<td>No</td>
<td>88.75</td>
<td>78.13</td>
</tr>
<tr>
<td>Not Stated</td>
<td>0.56</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Moreover, Table 2 shows that only about 22 percent of the multidimensional poor households and only 15 percent of the monetary poor households receive social assistance. Non-poor households receive social benefits slightly less frequently. The very low estimated proportion of the monetary poor who receive welfare benefits may come from the fact that monetary poverty has been observed in 2006, while the information about multidimensional poverty and social programs corresponds to year
2011. As a result, some households may have escaped monetary poverty between the two periods, and therefore would not need social support anymore. However, on the whole, the coverage rate of the poor by social welfare programs appears to be mediocre at best. Adopting a multidimensional perspective significantly enhance the appearance the coverage problem, even if the undercoverage of the poor by welfare programs remains pervasive.

We also estimated the percentages of household beneficiaries that are poor and non-poor. 85 percent of beneficiaries are not multidimensional poor, in the sense that they are not shelter-food destitute. It occurs as a statistical coincidence that exactly the same percentage of wrongly selected households is found for monetary poverty. This coincidence in both notions of poverty for leakage estimation implies that the high leakage found is not likely to be a statistical artefact. Even if a high degree of leakage of welfare benefits is relatively common, the situation in Seychelles seems to be particularly serious. The huge majority of households benefiting from social benefits are just not poor according to both our poverty measures, which suggest that they may often not be relevant targets of social programs.
4. Conclusion

In this paper, we propose a new methodology of multidimensional poverty measurement. Our approach is based on using self-stated responses to household spending priorities. This information is first used to know what the relevant deprivations are. In particular, the stated top priorities allow us to identify the poor. For each household, the deprivations are aggregated according to relative weights computed from the data on priorities. We shall justify this procedure by a set of axioms.

Using the priorities data in such a way will allow us to: (1) eliminate ‘Command variables’ in favour of ‘Intrinsic welfare variables’, which correspond better to the ‘basic needs approach’; and (2) solves problems arising with needs heterogeneity, (3) avoids the arbitrariness that typically arises in many stages of construction of multidimensional poverty indices.

Our estimates of multidimensional poverty severity and multidimensional poverty incidence are highly correlated, while not with Union or Intersection criteria based on the set of stated deprivations by Seychelles households. In Seychelles, multidimensional poverty is dominated by deprivations in shelter and in food, which contribute to 77 percent of multidimensional poverty. About 8 percent of households appear to be multidimensional poor, to be compared with the 12 percent of monetary poor households. As opposed to what results for monetary poverty exhibit, education is relatively weakly correlated with multidimensional poverty. This is likely to be the consequence of government policies providing free accommodation for households led
by low-educated heads. Such insight had escaped from monitoring poverty just by using monetary statistics.

When assessing the performance of the social program, whether in terms of multidimensional poverty or monetary poverty, we find that the coverage of the poor by social welfare programs is dramatically low in Seychelles, while the amount of leakage of social benefits to the non-poor is huge. However, using multidimensional poverty indicators somewhat improve the appearance of the coverage properties of Seychelles social programs.

Of course, extensions of our methodology are possible to: welfare, inequality, stochastic dominance, and inverse stochastic dominance. Nonetheless, there is no reason why deriving a multidimensional poverty index should prevent the analyst to examine well-chosen dimension-specific deprivation indices. On the contrary, we believe that these dimension-specific indicators, such as child mortality or income poverty measures, should still be the basis of poverty-alleviating policies. What multidimensional poverty measures bring is additional information about the correlation of these deprivations.

+ **more policy lessons**
+ **limitations**
+ **extensions**
References


Appendix:

Definition of some axioms:

**Strong Focus (SF).** For any \( n \in \mathbb{N}, (X, Y) \in M_n, z \in Z, j \in \{1, 2, \ldots, m\}, \) if

(i) for any \( i \) such that \( x_{ij} \geq z_j, y_{ij} = x_{ij} + \delta, \) where \( \delta > 0, \)

(ii) \( y_{it} = x_{it} \) for all \( t \neq i \), and

(iii) \( y_{is} = x_{is} \) for all \( s \neq j \) and for all \( i \), then \( P(Y; z) = P(X; z). \)

**Weak Focus (WF).** For any \( n \in \mathbb{N}, (X, Y) \in M_n, z \in Z, \) if for some \( i, x_{ik} \geq z_k \) for all \( k \) and

(i) for any \( j \in \{1, 2, \ldots, m\}, y_{ij} = x_{ij} + \delta, \) where \( \delta > 0, \)

(ii) \( y_{it} = x_{it} \) for all \( t \neq j \), and

(iii) \( y_{rs} = x_{rs} \) for all \( r \neq i \) and all \( s \), then \( P(Y; z) = P(X; z). \)

**Symmetry (SM).** For any \( (X; z) \in M \times Z, P(X; z) = P(\Pi X; z), \) where \( \Pi \) is any permutation matrix of appropriate order.

**Monotonicity (MN).** For any \( n \in \mathbb{N}, X \in M_n, z \in Z, j \in \{1, 2, \ldots, m\}, \) if:

(i) for any \( i, y_{ij} = x_{ij} + \delta, \) where \( x_{ij} < z_j, \delta > 0, \)

(ii) \( y_{it} = x_{it} \) for all \( t \neq i \), and

(iii) \( y_{is} = x_{is} \) for all \( s \neq j \) and for all \( i \), then \( P(Y; z) \leq P(X; z). \)

**Continuity (CN).** For any \( z \in Z, P \) is continuous on \( M. \)

**Principle of Population (PP).** For any \( (X; z) \in M \times Z, P(X; z) = P(X^k; z), \) where \( X^k \) is the \( k \)-fold replication of \( X. \)

**Scale Invariance (SI).** For any \( (X; z) \in M \times Z, P(X; z) = P(X'; z') \) where \( X' = \Lambda X, z = \Lambda z, \Lambda \) being the diagonal matrix \( \text{diag}(\lambda_1, \ldots, \lambda_m), \lambda_i > 0 \) for all \( i. \)

**Subgroup Decomposability (SD).** For any \( X_1, X_2, \ldots, X_k \in M \) and \( z \in Z. \)
\[ P(X_1, X_2, \ldots, X_K; z) = \sum_{i=1}^{n} \left( \frac{n_i}{n} \right) P(X_i; z), \]

where \( n_i \) is the population size corresponding to \( X_i \) and \( n = \sum_{i=1}^{n} n_i \).

**Definition of a Pigou–Dalton Progressive Transfer.** Matrix \( X \) is said to be obtained from \( Y \in M_n \) by a Pigou–Dalton progressive transfer of attribute \( j \) from one poor person to another if for some persons \( i, t \):

(i) \( y_{it} < y_{ij} < z_j \),
(ii) \( x_{it} - y_{it} = y_{ij} - x_{ij} > 0 \), \( x_{ij} \geq x_{it} \), (iii) \( x_{ir} = y_{ir} \) for all \( r \neq i, t \), and
(iv) \( x_{rk} = y_{rk} \) for all \( k \neq j \) and all \( r \).

**One Dimensional Transfer Principle (OTP).** For all \( n \in N \) and \( Y \in M_n \), if \( X \) is obtained from \( Y \) by a Pigou–Dalton progressive transfer of some attribute between two poor, then \( P(X; z) \leq P(Y; z) \), where \( z \in Z \) is arbitrary.

**Multidimensional Transfer Principle (MTP).** For any \( (Y; z) \in M \times Z \), if \( X \) is obtained from \( Y \) by multiplying \( Y_p \) by a bistochastic matrix \( B \) and \( B.Y_p \) is not a permutation of the rows of \( Y_p \), then \( P(X; z) \leq P(Y; z) \), given that the attributes of the non-poor remain unchanged, where \( Y_p \) is the bundle of attributes possessed by the poor as defined with the attribute matrix \( Y \).

**Definition of a Correlation in Creasing Switch.** For any \( X \in M_n \), \( n \geq 2 \), for all \( (j, k) \in \{1, 2, \ldots, m\} \), suppose that for some \( i, t \), \( x_{ij} < x_{it} < z_j \) and \( x_{ik} < x_{it} < z_k \). \( Y \) is then said to be obtained from \( X \) by a ‘correlation increasing switch between two poor if:

(i) \( y_{ij} = x_{ij} \), (ii) \( y_{it} = x_{it} \); (iii) \( y_{ij} = x_{ij} \) for all \( r \neq i, t \), and
(iv) \( y_{rs} = x_{rs} \) for all \( s \neq j \) and for all \( r \).

**Non-Decreasing Poverty Under Correlation Increasing Switch (NDCIS).** For any \( n \in N \) and \( n \geq 2 \), \( X \in M_n \), \( z \in Z \), if \( Y \) is obtained from \( X \) by a correlation increasing switch, then \( P(Y; z) \geq P(X; z) \).

The converse property is denoted by NICIS.