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# Analysis of Multidimensional Poverty

## Theory and Case Studies

Louis-Marie Asselin

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Contributions from

Jean-Bosco Ki
Vu Tuan Anh

International Development Research Centre
Ottawa • Cairo • Dakar • Montevideo • Nairobi • New Delhi • Singapore

Louis-Marie Asselin
Institut de Mathématique Gauss
9 Carré F.X. Lemieux
Lévis QC G6W 1H2
Canada
imgasselin@globetrotter.net

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*To an unknown Nepalese child once seen in Jumla, no more than 5 years old and already working hard, with so much sadness in his eyes.*

*An unforgettable face of poverty.*

*Il suffit qu'un seul homme soit tenu sciemment . . . dans la misère pour que le pacte civique tout entier soit nul; aussi longtemps qu'il y a un homme dehors, la porte qui lui est fermée au nez ferme une cité d'injustice et de haine.*

*It only takes one man consciously maintained . . . in destitution for the entire social contract to be null; as long as there is one man outside, the door shut on his face closes a city of injustice and of hate.*[1]

***Charles Péguy***
***Cahiers de la Quinzaine***
***Novembre 1902***

[1] Free translation by L.-M. Asselin

# Preface

Poverty is a paradoxical state. Recognizable in the field for any sensitive observer who travels in remote rural areas and urban slums and meets marginalized people in a given society, poverty still remains a challenge to conceptual formalization and to measurement that is consistent with such formalization. The analysis of poverty is multidisciplinary. It goes from ethics to economics, from political science to human biology, and any type of measurement rests on mathematics. Moreover, poverty is multifaceted according to the types of deprivation, and it is also gender and age specific. A vector of variables is required, which raises a substantial problem for individual and group comparisons necessary to equity analysis. Multidimensionality also complicates the aggregation necessary to perform the efficiency analysis of policies. In the case of income poverty, these two problems, equity and efficiency, have benefited from very significant progress in the field of economics. Similar achievements are still to come in the area of multidimensional poverty.

Within this general background, this book has a very modest and narrow-scoped objective. It proposes an operational methodology for measuring multidimensional poverty, independent from the conceptual origin, the size and the qualitative as well as the quantitative nature of the primary indicators used to describe the poverty of an individual, a household or a sociodemographic entity. It is my view that the proposed methodology should allow to integrate into the analysis of multidimensional poverty the sets of techniques already available or forthcoming in the area of income poverty. Despite this, I do not want to avoid the issue of the conceptual foundations of poverty. Thus, I propose from the start a quite comprehensive definition of poverty, whose ethical basis is briefly presented in an annex which can be skipped by readers not interested in such issues. The core of the methodology rests on a solution to the issue of the aggregation across the multiple subdimensions of poverty. The rationale of the proposed solution consists in exploring the internal structure of association between these subdimensions of poverty.

The methodology aims to be operational, by which I mean that it should be feasible with the use of computational tools that are easily accessible, as well as feasible without any specific limitation on the number and the nature of the poverty indicators used by the analyst. I also sincerely believe that the conceptual debates on the dimensions of poverty and on the measurement methodologies need to be lit with numerous empirical studies showing the strengths and weaknesses of different

approaches. This explains the structure of the book. It does not try to be encyclopedic and thus does not include an exhaustive review of the literature on multidimensional poverty; there is however a short overview of the main methodological trends to situate the chosen approach.

The first part, which is theoretical, develops the rationale underlying the proposed methodology, the concepts being illustrated with numerical examples taken from an empirical study realized in Vietnam. My co-authors join me in a second part to present two case studies using partially (first) or fully (second one) the methodology of the first part. The first case study presents a static analysis realized in Senegal under the coordination of Jean-Bosco Ki. I had the opportunity to work closely with this team and to benefit importantly from this collaboration to refine the methodology. My colleague and friend Vu Tuan Anh and I have realized the second study, a dynamic analysis of poverty in Vietnam during the period 1993–2002. This last study uses the full methodology presented in the first part. Both case studies are based on large household surveys implemented by the different national statistical offices. Many other research works realized within the Poverty and Economic Policy (PEP) network have also helped test the proposed methodology. I thank all of these developing country researchers for the fruitful discussions that have helped me much in writing this book.

I thank the International Development Research Centre (IDRC) whose support has made this book possible. I have had the privilege to be involved for 12 years in the Micro Impact of Macroeconomic and Adjustment Policies (MIMAP) program and in the PEP network, both funded by IDRC. Thirty years ago, IDRC had also welcomed me as an associate researcher for the writing of a book that much influenced my professional and scientific life. From this institution to which I owe so much, I am particularly grateful to Marie-Claude Martin, Randy Spence, Rohinton Medhora and to their colleague managers of the above-mentioned programs, based either in Ottawa, Dakar, Nairobi, New Delhi or Singapore. Their generous and sustained trust moves me deeply. Laval University is a mother institution for me since my very first student life in the 1960s. There, I have been student, professor, student again, professional partner and now associate researcher. I have never been a long time away from the campus. I thank the numerous colleagues, professors, students and administrative staff who contributed so much to my training and research work. Regarding this book, Jean-Yves Duclos, from the Department of Economics, has accompanied me from the beginning. His critical eye, always constructive, his tight review of the theoretical part and his unfailing support contributed a lot to improve the first drafts and to come to a conclusion. I thank many other MIMAP and PEP coworkers, from Laval or other institutions, for their encouragement, critique and friendship, *inter alia*: Bernard Decaluwé, John Cockburn, Celia Reyes, Cosme Vodounou, Touhami Abdelkhalek, Samuel Kaboré, Swapna Mukhopadhyay, Ponciano Intal, Abdelkrim Araar, Sami Bibi, Anyck Dauphin, Dorothée Boccanfuso, Luc Savard. I thank an unknown reviewer of the Vietnam case study from the Philippines. The Canadian Centre for International Cooperation and Study (CECI) has welcomed me during 20 years as Director of Studies, Training and Poverty unit. In this position, I have had the opportunity to be frequently in the field, which contributed in an inestimable

way to develop my thinking on poverty. I thank all of my CECI colleagues, either from the headquarters, Africa, Asia or Central and Latin America.

My close family, Lise, Pierre, Marie-Claude, and Matthieu, has accepted my frequent and often long absences from home. Without their affection and generous comprehension, my professional life resulting in this book would not have been as fruitful. I thank them with much love and emotion.[2]

Lévis, Quebec Louis-Marie Asselin
October 2008

[2] This work was carried out with financial and scientific support from the Poverty and Economic Policy (PEP) Research Network, which is financed by the Government of Canada through the International Development Research Centre (IDRC) and the Canadian International Development Agency (CIDA), and by the Australian Agency for International Development (AusAID).

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# Chapter 1
# Introduction

The technical problem that we are facing originates from the multidimensionality of the poverty concept, which is by now universally accepted. The form given to this multidimensionality depends on the definition given to poverty, for which there is not a unique formulation; however, there is usually a significant overlap among the various meanings found here and there. We would like to share with the readers the following definition, which expresses well our own views on poverty:

> Poverty consists in any form of inequity, which is a source of social exclusion, in the distribution of the living conditions essential to human dignity. These living conditions correspond to the capabilities of individuals, households and communities to meet their basic needs in the following dimensions:

- income (1)
- education (2)
- health (3)
- food/nutrition (4)
- safe water/sanitation (5)
- labor/employment (6)
- housing (living environment) (7)
- access to productive assets (8)
- access to markets (9)
- community participation/social peace (10).

The particular faces of poverty become particularly meaningful if we consider that, at the individual level, the different dimensions mentioned above may take specific forms according to gender and age group. From this point of view, looking at individual poverty seems to be the most feasible way of implementing multidimensionality. Moreover, and even more importantly, looking at individual poverty seems a natural way of exploring poverty dynamics, perceived as a life-cycle poverty status that may be differentiated according to gender.

From a human development point of view, a poverty indicator must be significant and eventually measurable at the individual, household, or community level. It must

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allow a ranking of these demographic units as more or less poor, in one of the above-mentioned dimensions.

We would like to characterize this definition as reflecting *poverty with a human face*. With reference to inequity, it obviously leads us to a discourse on ethics and moral philosophy. Such considerations are developed in Appendix I.1, *Poverty Measurement, A Conceptual Framework*.

Our objective here is not to discuss the different concepts of poverty, as this type of discussion is already found abundantly in the literature.[1] We would rather operationalize the different expressions of multidimensional poverty. Our focus is really on *measuring multidimensional poverty* using sound scientific basis, with a methodology applicable to a wide range of situations, as well as available data sets.

Our specific objective is to operationalize multidimensional poverty comparisons. But practical issues and measurement choices are quite dependent on the level of comparisons being made: are we interested in international, national, or local comparisons? Our implicit reference is at the level of national and local comparisons. By "national comparisons" we refer to socioeconomic-group (SEG) comparisons within a country or across-time comparisons, while "local comparisons" refer to comparisons between communities. International analysis is based on a much smaller universe of statistical units (that is, no more than 200 countries[2]) and with no sampling issues. On the other hand, analytical issues are different: ranking countries with composite indicators is the central aggregation issue, instead of aggregating countries through composite multidimensional indices for comparisons between groups of countries. Targeting issues are also different. At the international level, with around 100–130 identified less-developed countries, targeting is almost country-specific by definition, which is a completely different context from targeting national programs with a universe of thousands of communities or small administrative units and millions of households. Nevertheless, this approach does not prevent the possibility that some targeting concepts and methodologies developed in one context can also be applicable to another context.

It is now universally recognized that multidimensional poverty is a richer concept than the traditional unidimensional income approach. In addition to philosophical reasons for considering multidimensional poverty measurement, the technical difficulties of income measurement, especially in developing countries, have provided an impetus for looking at other poverty measures.

> In the vast majority of African countries, we remain unable to make inter-temporal comparisons of poverty due the unavailability of data. And where survey data are available at more than one point in time, the determination of changes has proven problematic. First, survey designs change. It is now well established that differences in recall periods, changes in the survey instrument (e.g., the number and selection of item codes listed), and even the nature of interviewer training, can have large systematic effects on the measurement of

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[1] A review is given in Asselin L.-M. and Dauphin A., *Poverty Measurement, A Conceptual Framework,* CECI, MIMAP Training Session on Poverty Measurement and Analysis, Laval University, Quebec, August 1999.

[2] The last UNDP Human Development Report publishes tables for 177 countries.

> household expenditures. Compounding this problem, intertemporal comparisons of money-metric welfare are only as precise as the deflators used. Consumer price indices (CIPs) are often suspect in Africa, due to weaknesses in data collection and related analytical procedures. Thus, relying on official CIPs is often precarious, at best. Alternatives such as deriving price indices from unit values, where quantity and expenditure data are collected, also have serious drawbacks.[3]

The same comment certainly applies to most low-income countries.

Therefore, we must be aware that the central issue in operationally defining the concept of poverty is that poverty is completely different in the multidimensional case and in the standard income and money-metric one. In this latter case, it is usually understood that poverty needs to be distinguished from inequality by referring to a poverty line. This calls for techniques either to numerically determine the poverty line or to free comparisons from the intricacies and arbitrariness of poverty lines through the use of stochastic dominance techniques, for instance. On the contrary, in the multidimensional case, the content of the vector of indicators chosen to measure poverty is crucial to determine the poverty concept, and fixing a poverty line or indicator-specific poverty lines is not a first requirement to grasp the concept of poverty. This difference underlies the developments of Chapter 2 on indicators.

It must also be recognized that the income measurement of poverty presents a great technical advantage: it is unidimensional, and it thus allows for a complete ordering of households according to income level. This property is very important for targeting policies and programs for welfare mapping, data aggregation, inequality analysis, and more sophisticated poverty analysis. That is why there is a strong request for retrieving a similar property with multidimensional poverty measurement. There are many proposals coming out of current research work on this issue: as a well-known example, there is the set of human development and human poverty indices[4] developed and published by UNDP. The search for such an analytical property in multidimensional poverty analysis is in fact the core subject of this book and is addressed in Chapter 3 on composite indicators.

Once we have derived a composite indicator as a basic tool, the field is wide open for poverty and inequality analysis with the specificity of a multidimensional background. These analytical issues are developed in Chapter 4. These three chapters make up the first part of this book, which is on multidimensional poverty analysis theory. The second part illustrates the methodology with two case studies on Sénégal and Vietnam.

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[3] Sahn David E. and David C. Stifel (2000), p. 1.

[4] With the terminology proposed in this book, these UNDP indices would be called “indicators”, or more precisely “composite indicators.”

# Chapter 2
# Indicators and Multidimensionality Analysis

Upstream from technical measurement issues, the selection of indicators constitutes an important conceptual step. Multidimensional poverty analysis cannot just stay at a formal level and escape the necessity to look deeply inside poverty vectors appearing here and there in the universal effort to capture the multiple facets of poverty.

## 2.1 Structured Poverty Vectors

Multidimensional poverty refers to a measurement of poverty which relies on a vector $I$ of $K$ variables, here called primary poverty indicators, with $K > 1$.

These indicators are possibly heterogeneous in their nature:

- quantitative indicators, e.g., household income, number of bicycles,
- qualitative or categorical indicators, e.g., type of toilet.

A minimal requirement for a variable to be admissible as a poverty indicator is to be ordinal. Thus, for a categorical indicator, there should be a clear consensus on the ranking of the finite set of categories, from the worst one to the best one, in terms of some type of basic welfare, e.g., for the type of toilet, nature of wall material for the house. Variables like "main occupation of household head," "place of residence (urban/rural)," and "region" are not admissible poverty indicators. Obviously such non-ordinal variables can play an important role in poverty analysis, for example as characteristics associated with poverty.

Note that all of these indicators are or can be expressed numerically, the number being a fully significant one in the case of "quantitative" indicators, and a non-significant one in the case of "categorical" ones, where it is simply a numerical code. If well chosen, this numerical code can reflect the ordinal structure of the given poverty indicator, which is normally desirable.

We are thus in the statistical domain of multivariate analysis. It does not mean that the number of poverty dimensions is $K$. We have to identify some more structure in the vector $I$. Take as an example the case of the UNDP Human Poverty Index for the developing countries, HPI-1. There are four primary indicators in the vector:

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- $I_1$: the probability at birth of not surviving to age 40
- $I_2$: the adult illiteracy rate
- $I_3$: the percentage of the population without sustainable access to a safe water source
- $I_4$: the percentage of children undernourished.

Within the vector $I$, *poverty dimensions* will be defined as disjoint subsets of indicators covering $I$. For the HPI-1, there are three poverty dimensions:

- dimension 1: a relatively long and healthy life, or vulnerability to death at a relatively early age, corresponding to the subset $\{I_1\}$,
- dimension 2: knowledge, or exclusion from the world of reading and communications, corresponding to the subset $\{I_2\}$,
- dimension 3: a decent standard of living, or lack of access to overall economic provisioning, corresponding to the subset $\{I_3, I_4\}$.

Thus, a poverty dimension is defined a priori as being represented by a univariate or multivariate measurement, each variable of the subset being a poverty indicator. We can thus have the health dimension, the education dimension, the income dimension, etc. Strictly speaking, we are in the domain of multidimensional poverty if there are at least two poverty dimensions identified within the vector $I$. Given a vector $I$ of K primary poverty indicators and a partition into D subsets representing as many poverty dimensions, the number $|d|$ of indicators in the subset d can already be seen as an *implicit weighting* of the poverty dimension d. In the last example with four indicators for three dimensions, the implicit relative weights of dimensions 1, 2, and 3 are respectively 25, 25, and 50%. This weighting will become explicit according to each analytical treatment of the vector $I$, particularly in the aggregative technique used to produce a composite indicator of the multidimensional poverty (CIP).

A primary poverty indicator can itself be represented by a multivariate measurement. The best known example is the money-metric indicator of income given usually as a vector of household expenditures and aggregated by simple addition.

Another structure we introduce within the vector $I$ is the notion of a *poverty type* which we define as a subset of poverty indicators all positively correlated.[1] A poverty type can also be described as a *statistical poverty dimension*, expressing the fact that there is some redundancy within a subset of the vector $I$. It is obviously *distribution dependent*, in contrast to a normatively defined poverty dimension, and can go across many of these dimensions. Two poverty types can in fact overlap, which is not the case for poverty dimensions. This structure will appear useful in the process of exploring poverty multidimensionality and of reducing multivariateness.

[1] Intentionally we do not enter here into the technical definition and measurement of "correlation," which depends on the type of indicator (such as the usual Pearson correlation, the rank-order correlation like Kendall's $\tau$, etc.).

Empirically, most multidimensional poverty micro-measurements[2] rely directly on ordinal categorical indicators, such as household sanitation, source of potable water, ownership of assets, school attendance, and child health status. Higher-level measurement is usually made of indices based on such indicators. Since quantitative indicators can always be transformed into ordinal categorical ones,[3] we are naturally inclined to pay special attention to that type of indicator. Let $I_k$ be an ordinal categorical indicator. What should we expect of $I_k$ as a potential good *poverty* indicator? In addition to referring to some kind of basic capability, need or right, to differ really from a welfare indicator, most of the categorical values of $I_k$ should refer to different poverty statuses, more or less acute, instead of describing many different levels of welfare. Consider the following example of housing conditions, linked to the following six categories in a household questionnaire:

a) temporary house
b) semi-permanent house
c) one-storey permanent house
d) two-storey permanent house with one toilet
e) two-storey permanent house with two toilets
f) more than two-storey permanent house.

We can consider that the last four categories are too detailed for a good *poverty* indicator and that only the following three are really relevant:

a) temporary house
b) semi-permanent house
c) permanent house,

the last one representing the non-poverty status for basic good "decent dwelling conditions," and the first one referring to an extreme poverty status in that regard.

We thus define a *pure categorical poverty indicator* $I_k$, with $J_k$ categories, as one which meets the following conditions:

I. It has an ordinal structure.
II. The lowest category $I_{k.1}$ refers to an extreme poverty status in reference to the basic need (good, right) considered.
III. The highest category $I_{k,Jk}$ is considered as the non-poverty status, meaning that once you reach this status, there is a general agreement that you have exited this particular dimension of poverty.

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[2] By micro-measurement, we mean measurement at the individual or household level.

[3] There are different optimization techniques for discretizing a quantitative variable, e.g. cluster analysis. Any process of discretization should nevertheless be aware of the information loss thus involved (Kolenikov and Angeles (2004)). The information loss should not be overweighted in case of variables bearing usually significant measurement errors like household income and expenditure.