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# POVERTY MEASUREMENT

**A THEORETICAL CONTRIBUTION AND APPLICATION TO PORTUGAL 2007**

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## Resumo

Neste trabalho apresenta-se uma história do pensamento económico na medição de pobreza – desde o que pode ser considerado o início da economia da pobreza até a era de redescoberta da pobreza durante a década de 1960 – bem como uma revisão da literatura sobre as principais ferramentas de medição da pobreza apresentadas pela Ciência Económica.

É ainda apresentado, no âmbito da abordagem multidimensional, uma proposta de um índice de medição de pobreza, inovadora quanto à ponderação dos diferentes atributos considerados como elementos de privação. O propósito do índice proposto é o de medir a pobreza na sua multidimensionalidade, sendo que cada dimensão de privação é ponderada no índice de acordo com a Hierarquia de Necessidades de Maslow. Esta forma de ponderação faz com que o índice proposto seja diferente dos já existentes pelo facto de se incorporarem elementos de uma teoria psicológica consolidada na sua estrutura.

Por fim, o índice apresentado é aplicado através de dados do European Union Statistics on Income and Living Conditions (EU-SILC) para Portugal em 2007 e comparado com dois outros métodos multidimensionais de medição da pobreza.



**Palavras-chave**: Abordagem Multidimensional, Hierarquias de necessidades de Maslow, Medição, Pobreza, Processo Analítico Hierárquico, Teoria dos Conjuntos Difusos.

## Abstract

This work presents a history of the economic thought on poverty measurement – from what can be considered the beginning of the Poverty Economics until the "Rediscovering Poverty" era during the 1960s – as well as a review of the literature on the main poverty measurement tools presented by the Economic Science.

We also present, having the multidimensional approach as background, a proposal for a poverty measurement index, somehow innovative regarding the weighting of different attributes considered as elements of deprivation. The aim of the proposed index is to measure poverty as a multidimensional phenomenon, where each dimension of deprivation is weighted in the index according to the Maslow's Hierarchy of Needs. This way of weighting makes the proposed index different from the existing indices given that it incorporates elements of a consolidated psychological theory in its structure.

Finally, the index is applied using the European Union Statistics on Income and Living Conditions (EU-SILC) microdata for Portugal in 2007, and compared with two other methods of measuring multidimensional poverty.



**Keywords**: Analytic Hierarchy Process, Fuzzy Set Theory, Maslow's Hierarchy of Needs, Measurement, Multidimensional Approach, Poverty.

# INTRODUCTION

Despite the «pressures for conformity» (Galbraith, 1955:35), poverty has been a worry in society – especially for governments – for the last couple of centuries. In the last decades, this worry has been spreading to every part of society and turning into a main fret. In Economics, poverty has been studied since the seminal works of Charles Booth in the nineteenth-century (1887, 1888 and 1903). Nonetheless, conceptual and measurement discussions had not been significant before the 1970s, when noteworthy new ideas began coming up contributing to a deeper understanding of the poverty phenomenon. In spite of being largely recognized as multi-causal and multidimensional, poverty has been studied predominantly through only one variable, usually income. Even nowadays – more than a quarter of century after the introduction of the concept of capabilities by Amartya Sen (1983, 1985b) – the one-dimensional approach is the only one considered and employed by most governmental decision makers and many social scientists. Actually, the concept of capabilities introduced a shift in the conceptualization and measurement of poverty, opening a door for the multidimensional approaches developed in the last decades.

***Motivation***

This thesis proposes a contribution to the Economics of Poverty, centered in a suggested index of poverty measurement, contextualized by the multidimensional environment, particularly the fuzzy set and relative approach. This suggestion is based on the fuzzy and relative index proposed by several multidimensional papers, especially Costa (2002) and Dagum and Costa (2004), although developing a different weighting scheme.

The multidimensional indices that are available in the economic literature tend to employ data for several items of deprivation, being these weighted by data-driven – but not necessarily the most suitable for measuring poverty – weightings. One good exception on this data-driven trend is a well-grounded relative deprivation method to measure poverty presented by Desai and Shah (1988), although in the one-dimensional family of poverty indices. As so, we consider that there is room to develop the weighting scheme of the deprivation items toward an alternative and suitable framework. The perfect weighting framework of deprivation items would be one that discriminates each item by its importance in a consensual measure of the overall poverty. Our proposal tries to be closer of this utopian goal. More specifically and always considering the family of multidimensional indices as a reference, the main motivation for our index is, considering different elements of deprivation, to weight each dimension of deprivation according to the Maslow's Hierarchy of Needs, incorporating, so, important elements of a consolidated psychological theory in its structure. This may be seen as an important effort towards a poverty index that captures all the relevant and available measurable dimensions of poverty, where the importance of each dimension is the adequate when taking in account the human well-being, according with a well-grounded and consolidated theory in Psychology, the science of human behaviour.

***Aim and Scope***

The vagueness of the word "poverty" takes us to delimit the frontiers of the work in this thesis. First of all, we will study poverty with a static approach. We prefer to deep the discussion of the indices within this approach instead of widening the discussion for the dynamics of poverty, which, although having many advantages, would leave us for specific operational issues that could preferably be discussed in a specific work.

Secondly, we privilege a quantitative analysis using statistical techniques instead of a qualitative analysis through anthropological or sociological research techniques. This is due to the characteristics of the data base used in the work which is not centered in data relating to people's judgments and attitudes, although marginally it has some interesting data in such perceptions. We can not hide so, that we would prefer to let a work centered in a qualitative approach for a future interdisciplinary one.

It is also important to define what is understood by poverty measurement here. In this work we use the phrase "poverty measurement" for any technique used to measure deprivation, taking a comprehensive view of poverty, so that deprivation may be related to numerous dimensions. More specifically, we will focus on the measurement of deprivation having the household as the unit of analysis, provided that the most relevant data related to deprivation in the EU-SILC database is available considering the household as the data unit.

The core objective of this work is to present a multidimensional poverty index where each dimension of deprivation is weighted according to the Maslow's Hierarchy of Needs. This index would become part of the Fuzzy Relative Indices, but innovating in the weighting scheme.

There is also the objective of applying the presented index to the EU-SILC microdata for Portugal in 2007.

***Methodology and Data***

The methodology used in this work strongly relies on the multidimensional poverty measurement procedures generally used in the economic literature. The concept of fuzzy sets is important as the poor set is a subset of the household sample. Also important is the Maslow's Hierarchy of Needs, particularly in the weighting process of

the deprivation attributes. A detailed explanation of the methodology is given in Chapter 3.

The empirical part is carried out by using EU-SILC data for Portuguese households in 2007.

The Portuguese case is interesting not only for the Portuguese decision makers, politicians and its overall population for obvious reasons, but also because it is considered, according with the Eurostat, the poorest country of the Western Europe (European Comission, 2010). The year chosen was the last one available with firm and consistent data.

***Plan of the Thesis***

The presentation of the suggested index is preceded by a review of the main ideas in the history of the poverty measurement and by a review of the main poverty measurement tools proposed in the economic literature. In the final part, we provide a comparison of the suggested index with a selected set of indices through Portuguese data for 2007.

In Chapter 1 there is a history of the economic thought on poverty measurement – since what can be considered the beggining of the Poverty Economics until the Poverty Rediscovery Era in the 1960 decade – as well as a presentation of the major approaches and the present challenges of poverty measurement.

In Chapter 2 you can find a review on the main poverty measurement tools presented in the economic literature, including monetary and multidimensional poverty indices, as well as the limitations of these indices, trying to disclose a motivation for some innovation.

In Chapter 3, in the scope of the multidimensional approach, we present an original proposal of a poverty measurement index, innovative in the way of weighting the

different attributes considered as elements of deprivation, with the details of the Psychology-based method, the Maslow's Hierarchy of Needs, as well as the important choices that are necessary to define the index and the computations, such as the analysis unit or the choice of attributes.

In Chapter 4 we implement the new index presented, compared with similar indices, such as the Dagum and Costa (2004) index and the Principal Component Analysis method, through EU-SILC microdata for Portugal in 2007.

# CHAPTER 1 - POVERTY MEASUREMENT: HISTORICAL DEVELOPMENTS AND PRESENT CHALLENGES

Poverty is a human state, and Economics is a social science. Therefore, it may be not very surprising to ascertain that poverty has been a significant subject in the Economic Thought. As well, measurement is one of the most crucial topics in economics since the concepts of poverty and poverty alleviation are perennial questions that governments and scholars continuously discuss. From simple household surveys in the nineteenth-century to the complex research design models today to create new indicators and variables of poverty, the literature has gone a long way towards developing a scientific approach to the problem.

The purpose of this chapter is to present the main historical developments on the economic thought on poverty and poverty measurement, as well as the main current analytical and operational challenges for the measurement issue.

Section 1.1 thoroughly describes the economic literature on poverty at a first period starting at the transition from the nineteenth to the twentieth-century, characterized by the development of poverty surveys in Britain and the first attempts to launch scientific studies on poverty-related issues.

Section 1.2 summarizes the main developments in the economic thought on poverty at a second period, mostly to be found in the 1960s, which is typified by a rediscovering of the importance of poverty issues on the economic, political and sociological literature.

Section 1.3 is focused on the description of major approaches leading with poverty measurement - particularly the absolute, relative, subjective, capabilities and functionings, and multidimensional approaches, among others. This section also examines some concerns related to methodological issues on poverty measurement.

Section 1.4 surveys recent empirical economic literature on poverty measurement and shows how some current concerns challenge the operationalization of the poverty analysis.

The final section puts the general findings of the chapter in a larger background, taking some conclusions about the leading objectives of the ground-breaking authors who first dedicated their hard work and time to the study of poverty and the importance of several social scientists on the development of the conceptualization and economic analysis of poverty. This section also generally examines the state-of-the art in poverty measurement.

## *1.1 The roots of the economic thought on poverty*

According to Murmis and Feldman (1995), the study of poverty began with the sociological analysis. Perhaps we could say that it began with William Sumner, with his book "What Social Classes Owe to Each Other" (1883), where he states, for instance, that «"The poor", "the weak", "the laborers", are expressions which are used as if they had exact and well-understood definition» (p. 13), meaning that there is no possible definition of a poor human being. While concerning to the economic approach, it certainly began with Charles Booth, the author of the very first paper written and published specifically about poverty (1887). Before becoming a well-respected statistician and scholar on poverty in London, Booth worked in a shipping company and set up a business where he learned the foundations of business methods. This became a good basis of the methodology that he would apply in his approach to social investigation. As a matter of fact, in business as in social investigation, Booth not only had appreciation for rigorous descriptions of the reality in facts and figures, as he also believed that this was essential for success – whether in business or in the fight against poverty.

His social life and friendships – when he was in his forties living in London – created the environment in which he could discuss social problems. While a growing city of enormous economic importance, London focused the attention on poverty. During this period, social science was yet to develop systematic methods in its analysis and rigor over press reports about poverty. In his seminal book *Life and Labour of the People in London* (Booth, 1903), he attempted to uncover and explain the nature, conditions, and trends in poverty by looking at the working and living situations of people in London from 1886 to 1903. Using his own money, he gathered responses through a massive survey of approximately 120,000 respondents, which included heads of families,

employers, trade union officials, workers, administrators, clergy, and those engaged in social and charitable activities. His major contributions were a) the classification of the population according to the means and position of the heads of families and to the character of their employment, b) the trade inquiries to show the conditions under which people work, and c) the district inquiries to show the conditions under which they live. His work includes what remains to be one of the first scientific social surveys of London.

In his earlier works (Booth 1887, 1888), he contributed in understanding and measuring poverty through an exhaustive classification of the population, based on their social conditions. The object of these works is to «show the conditions under which the people live, but it would also give their employments; the principal object of the trade inquiry would be to show the conditions under which the people work, but it would indirectly deal with their manner of life» (Booth 1887:326). Although the work cannot be considered a crucial development in statistical methodology, the comprehensive and detailed descriptions of the different work types, their incomes, and their purchasing power relative to the prices all contributed in the systematization of defining who the poor are. More importantly, he employs a dual classification - based on condition and occupation - to define a poverty line, thereby classifying certain job types as "poor" and "very poor" (curiously the poverty line would then be referred by Robert Hunter in his book "Socialists at Work", published in 1908). Poor is defined as «those who have a fairly regular though bare income, such as 18s. to 21s. per week for a moderate family» while very poor are «those who fall below this standard, whether from chronic irregularity of work, sickness, or a large number of young children» (Booth 1888:328).

Using this classification, he sought to find out the extent of poverty by knowing how many are very poor, the poor or the well to do. This allowed him to infer something of the poverty-inducing conditions that prevail in British society (Warner 1889, 1894). His major finding was a breakaway from the common perceptions on poverty: while most scholars on that time thought poverty was concentrated in Tower Hamlets (East London), he showed that it was in the districts of Waterloo, St. Saviour's, and Bermondsey (South). It raised the need for a systematic examination on the cause and conditions of poverty (Abbott 1917, Booth 1887, Booth 1888). As a matter fact, Booth's work is very important to the history of poverty measurement not only due to his pioneering effort to measure poverty, but also to his conviction – put in practice in the

study of social conditions, including poverty – that a truly grounded description in facts and figures of social situations is important to succeed. Finally, he also contributed in the social scientific inquiry distinguishing poverty from unhappiness, thereby alerting social economists and other social scientists from the mistake of treating both as the same.

General Francis Amasa Walker, a prominent figure in the second half of the nineteenth-century, would be the author of the first paper specifically on the economic nature of poverty, written with no political motivation, but with an economic one. He was the first president of the American Economic Association, the first lecturer on Economics at Johns Hopkins, one of the first presidents of the Massachusetts Institute of Technology, president of the American Statistical Association, head of the statistical bureau of the U. S. Treasury, professor at Yale University and he would award the "Walker Medal" to leading Economists for lifetime achievements. His theory of distribution, inspired and developed from the "Ricardian" theory of rent, has come to be known as the residual theory.

Though not familiar with much of the newer literature in economics, Walker possessed a powerful intellect and was very welcoming to the newer ideas. All through his life, Walker struggled to set up the scientific status of Economics and was a pioneer in using statistical data to illustrate economic arguments. In the last year of his life, his seminal work on the search of the cause of poverty (Walker 1897) was very interesting from an economic point of view. He successfully criticized the shortcomings of existing explanations on poverty ranging from the theological to the socialist views. His basic thrust is that «all only-one-cause explanations are not sufficient to explain poverty» (Walker 1897). Though not defining it, he proposed four basic explanations for poverty: (1) the naturally difficult, established conditions of the humankind; (2) a secondary poverty which results from industrialization (for instance, the division of labor forcing certain people to take low wage jobs under severe working and living conditions); (3) the existence of the great law "For unto every one that hath shall be given, and he shall have abundance: but from him that hath not, even that which he hath shall be taken away", meaning a weak social mobility; and (4) finally, the carelessness, lack of frugality and bad habits on the part of the working classes. To fight against the poverty, Walker suggests the treatment of mental and moral disease as well as a bigger sensibility for popular education. We cannot be assured of what moved Walker in

writing this article. It is difficult to understand if his main objective would be to give a pure contribution to the understanding of the causes of poverty or a response to the temptation of the religious and the socialists to take over Economics for them. In this way, he participated in the struggle to recognize Economics as a scientific subject. Very likely he condensed both objectives in one article, as parallel to other articles in other branches of Economics. However, his major flaw is that his "economic reasons" were not justified on scientific grounds but rather only with opinion-based arguments, not using a very refined method.

At the turn of the century, two authors brought out contributions about poverty: Dadabhai Naoroji (1901) and Benjamin Rowntree (1901). Naoroji's contribution is the so-called "drain theory", which attempts to explain the "pitiless drain" of India's resources to England during the colonial period. He was the author of one of the first books written to raise nationalist sentiments (Naoroji 1901). He argues that the "drain of wealth", or the unilateral transfer of resources from India to Britain, was the principal cause of poverty in India, such as when Britain puts the average tax burden in India at twice that of contemporary England, although average income there was fifteen times greater at that point in time. During the first decade of the twentieth-century he was prominent in several Socialist International Congresses speaking on matters related to colonial exploitation and workers in the industrialized world. It is clear that his reasons to write about poverty were nationalist and political. More importantly, he explains poverty exclusively by external factors, with any systematic reflection on the internal problems of India. This is essential since his drain theory seems to be fallacious, especially if compared to the development of theories on classical political economy. The theory resembles several similarities with the dependency school in the field of political economy, such as the exploitative nature of external capitalist forces (primarily the colonial power) and the unequal global structure leading to systematic poverty. Hence, Naoroji's work is important in contributing to the literature of political issues rather than the development of Economics and Poverty Measurement.

Benjamin Seebohm Rowntree was the most influential economist on poverty in the turn of the twentieth-century. Inspired by the work of Charles Booth, and of his own father, Joseph Rowntree, he got on a long investigation of poverty which would become the content of the book "Poverty: A Study of Town Life" (Rowntree, 1901). In this book, he uses research methods that, although in a very different circumstance, still have

validity today. His investigation was applied to his native city of York, based on his house to house survey in this city. In the beginning of Chapter IV – The Poverty Line – when he tries to answer to the question of what proportion of the population is living in poverty, Rowntree proposes two definitions of poverty, distinguishing between primary and secondary poverty. Families living in primary poverty are those «whose total earnings are insufficient to obtain the minimum necessaries for the maintenance of merely physical efficiency» (ibidem, p. 86), while in secondary poverty are those «whose total earnings would be sufficient for the maintenance of merely physical efficiency were it not that some portion of it is absorbed by other expenditure, either useful or wasteful» (ibidem, pp. 86-87). As a matter of fact, his work replicates the objectives and methods of Booth to come up with a more precise definition of poverty line. Rowntree derived the poverty line using the minimum necessary expenditure for the maintenance of physical health. This derivation was computed in 3 steps:

1. To choose the nutritional dietary requirements and the costs of obtaining them on a weekly basis. Here, he used the cheapest rations set by the Local Government Board (3s. gd. for a man, 2s. gd. for a woman, and 2s. gd. for a child) with protein as the basic component of adequate food supplement;
2. To calculate the minimum necessary for clothes, fuel, and other sundries (£4 11d. per week for a family of five);
3. To compute for the total earnings of the family to maintain mere physical efficiency.

So, according to his definitions of poverty, the poverty line became clearer: those families with insufficient earnings to maintain this base line are considered living in primary poverty, while those who have sufficient earnings but with some portion of it being absorbed by other expenditure are defined as living in secondary poverty. His findings show that nearly 10% of the population of York is living in primary poverty, while 18% is living in secondary poverty. Overall, his goal was to generate information that would show the «general characteristics of York, the social and economic condition of the wage-earning class, the standard of life, including careful studies of the working people divided into several classes, and concerning the poverty line, showing the point below which people were unable to obtain enough to give physical efficiency» (Hunter 1902:159).

Methodological issues emerged from the study. First, in the face of making a conceptual distinction between primary and secondary poverty, Rowntree maintained that both

concepts were not of an objective nature. Primary poverty is not objective since the point at which primary passes into secondary poverty is largely a matter of opinion, depending on the standard of well-being that is considered necessary, and secondary poverty as it obviously depended on the standard of lifestyle held satisfactory by the investigators. Second, Rowntree, who popularized the concept of poverty line, derived it as an heuristic device - rather than a normative one prescribing planned patterns of expenditure - to show that, contrary to beliefs held at least since Francis Walker, not only carelessness and vice but also low incomes, accounted for the poverty of the working classes. This meant a deviation from the popular perception of deriving poverty measurement during this time.

Rowntree made a second and third survey in York to show that poverty was almost disappearing in England. The second survey was conducted in 1936, which would come out in his book "The Human Needs of Labour" and the third survey in 1951 together with G. R. Lavers which would be entitled "Poverty and the Welfare State".[1] In his second book, he developed and refined his poverty line in York at a time when a national poverty line was being developed. This so-called "human needs" standards have six basic requirements for a household: food, rent, clothing, fuel and light, household sundries, and personal sundries. In his dietary requirement, he states that

«A man of normal stature engaged in work of moderate severity, required, if health and working capacity were to be maintained, a diet which provided 3,400 calories of fuel energy. It should comprise 100 grams (nearly 4 oz.) of protein and about 100 grams of fat (Rowntree 1937:113).

It is important to point out that some elements of inexactness were introduced to establish minimum wages. In the early 1950s, Lavers and Rowntree published the third social survey to compare the changes in poverty throughout the interwar period. Following the basic design of the 1899 and 1936 surveys, they found out that 4.6% of working class households (2.8% of individuals) were in poverty compared with 31.1% (of households or individuals) in 1936. This basically became the basis of the so-called "absence of poverty". More specifically, their research aimed to establish the effect of the Beveridge reforms (welfare state) on alleviating poverty in England. In comparison, the definition of a working class in 1936 is done as those not earning more than £250 per annum and not more than £550 per annum in 1950. The claims of those who support

[1] The discussion here relied heavily on the analysis of Hatton and Bailey (1998 and 2000).

that the Beveridge reforms are effective do use the Rowntree and Lavers (1951) study. Hence, after Rowntree, poverty would not be a major issue for more than half-century.

Several methodological issues were raised to question the absence of poverty in the interwar years in Britain. There are problems with respect to (1) the reliability of the survey, (2) the representativeness of York in comparison with other towns, and (3) the compatibility of the 1950 poverty line with the 1936 poverty line (Hatton and Bailey 1998, 2000; Townsend 1954, 1962:211-215). However, its major strength is the accuracy of specific data that were gathered, such as the rent paid and the earnings of working class populations. In effect, Rowntree's contribution is enormous with respect to the systematic social survey on poverty as it moved beyond the limitations of the study of Booth.

## *1.2 Rediscovering Poverty in the 1960s*

The disappearance of poverty in the discourse of Economics during the first half of the twentieth-century can be attributed to three reasons. First, there is a combination of full employment, larger real wages and a dramatic increase of married women in the labor market (paid employment); both brought prosperity to the general population. Second, there has been a marked redistribution of income from rich to poor and, indeed, a continuing equalization of income and wealth. Finally, the introduction of a welfare state has created a net that prevented nearly all those who were sick, disabled, old or unemployed from falling below a civilized standard of subsistence (Townsend 1962:210). The question of poverty was raised again by Peter Townsend, who questioned not only the status of poverty measurement but also whether the 1930s to 1950s indeed had very low poverty rates. Starting from Rowntree, his work was the first systematic endeavor towards a more precise and accurate poverty line. Unlike Booth and Rowntree who used sociological approaches in defining the poor, Townsend suggests selecting, from all those households that satisfy nutritional requirements, the quarter of households that do so at the lowest level of income, and to take total average expenditure per household in this group (less some fixed costs), as the poverty line.

In his book *Poverty in the United Kingdom*, he reports the planned survey he made to over 3,000 households (10,000 individuals) using a 35-page questionnaire. This is the

first attempt to respond to various issues in conducting survey research: interviewing, representation, response rates and sampling, among others. In this work, he pioneered the concept of "relative poverty" as opposed to "absolute poverty".[2] Poverty is not simply the lack of income but also the «lack of resources to participate in a society - resources that stem from a variety of resource distribution systems operating in the society» (Vogel 1982). He criticizes Rowntree for the inadequacy of using mere physical requirements for sufficiency because there is some relativity involved when it comes to diet based on availability, prices and even psychological conditioning (Townsend 1962:218). In his alternative approach, he challenges the notion of *subsistence* as a definition and measure of poverty. First, he established the relative connection between levels of income and levels of nutrition. Instead of merely looking at the nutritional requirements for a family and how many fell to meet this income level, it is better to make a random sampling in the population to know how many families with particular income levels are not able to meet *certain* level of nutrition. Hence, he posits that there are various levels of nutrition that families attempt to secure at a particular bracket of income. Second, he argues that standards of living also vary among the working populations, such that individuals who earn more tend to have a higher living expenditure compared to the unemployed or the retired people. Third, poverty could be defined on the basis of the number of households or families of certain types having a total income of less than, say, half or two-thirds of the average. This means that more sensitive indicators to standards of living are needed to be developed to properly define poverty. He suggests the use of 'average disposable income per head' or 'average household income' for the income levels of different households. Fourth, he poses that poverty is not always a function of income but also the distribution of non-monetary resources among individuals and households. Discrepancies over housing, education and medicine and welfare are some of the resources that might affect the definition of poverty. Whether these resources are public or private likewise interferes in measuring the extent of poverty experienced. Finally, Townsend seeks to expand the studies of poverty beyond Great Britain. This is especially important in the context of the decolonization (the increase in number of nation-states becoming independent) where poverty in the so-called Third World would be different from Europe. He sought to take into account the inequitable distribution of resources at the international level

[2] See (Sen, 1985) and (Townsend, 1985) for a discussion of the debate on relative and absolute approaches to poverty.

not only to draw some comparisons but also to systematically analyze poverty in a general sense. In developing indicators for poverty, he suggests the following procedures: (i) collection of data relating to the food consumption and expenditure as well as the income of working-class households; (ii) the comparison of this data, assembled according to constitution of household and income group, with a scale of nutritive needs, such as that in the Report of the Committee on Nutrition of the British Medical Association, 1950; and (iii) the isolation, from all those securing minimum nutrition, of, say, the 25 per cent in the various household groups who achieve it on the smallest incomes, or rather, the smallest incomes less one or two fixed involuntary overheads, such as rent and compulsory insurances. The average total expenditure of these households, less the overheads, according to their different sizes, can be taken as the poverty line. Overall, he concludes by arguing for the creation of a more general theory:

«Our general theory, then, should be that individuals and families whose resources, over time, fall seriously short of the resources commanded by the average individual or family in the community in which they live, whether that community is a local, national or international one, are in poverty» (Townsend 1962:225).

Nonetheless, the "rediscovery" of poverty would really begin with a series of American empirical studies in the 1960s. Harrington's *The Other America* (1962) would be the first significant book on the issue. Born in St. Louis, Harrington was educated by the Jesuits at St. Louis University High School. In later life he was sensitive to the resemblance between the Thomistic scholasticism in which he was trained and the Marxist scholasticism that he embraced as an adult. He would admit his influences: "I have long thought that my Jesuit education predisposed me to the worst and best of Marx's thought." *The Other America*, a moving portrait of the poor in rural and urban America, is not only a simple descriptive book about poverty, but also a critic for what he believed was an implicit policy of hiding poverty in America and for the consequent unimportance given to the avoidable distress of the poor: «Clothes make the poor invisible, America has the best-dressed poverty the world has ever known» or «If there is a technological advance without a social advance, there is, almost automatically, an increase in human misery» are examples of sentences that illustrate Harrington's ideas.

Two years after "The Other America", W. Anderson wrote another major work about the poverty in America entitled *Trickling Down* (Anderson, 1964). In the context of an

ever-growing economy, his original ideas were to question if economic growth is necessarily poor-favorable and if there is indeed a trickle-down effect, which is the dispersion of economic gains from the rich to the poor. In his article, Anderson tries to measure the variations in the strength of the trickle-down effect by connecting economic growth with the rightward movement of a lognormal income distribution. He finds that the poverty reduction effect of growth increases with growth, albeit it should increase at a decreasing rate because of the non-linear tail effects of the distribution of income. This suggests that the poverty reduction effect of high growth may take place partly in the course of inequality reduction effects. Economic growth helps to ease poverty in two ways: (1) as economic growth occurs, the number of jobs will automatically increase due to higher labor demands; and (2) growth creates an upward push in the real wages paid to the workers. Empirical cases have proven this through the analysis of the steady increase in income growth and wages in industrialized and industrializing economies. Even though growth first and foremost benefits those in the upper portions of the income distribution, sufficiently robust growth benefit even those in the lower portions. The idea is that a sufficiently large growth rate has a more than proportional effect on the poverty rate. However, he also points out that the increase in average income is accompanied by income dispersion, which is why poverty incidence still increases as growth occurs. Hence, public policies designed to redistribute income or earning power are necessary to reduce the persistence of poverty (1964, p. 513).

His contribution to poverty measurement is at best the concept of *poverty incidence curve*, which he refers to as «the curve defining the proportion of families in the United States with incomes below $3000 as a function of the log of median income for the period 1947-60» (1964, p. 514). The curve is divided into three phases, with subgroups in Phase 1 experiencing high poverty incidence and low income, Phase 2 with relatively equal level of income and poverty incidence, and Phase 3 with high levels of median income and low levels of poverty incidence. In his study, he divided the population into subgroups - such as rural-urban and white-non-white groups - and used the data on median income and poverty incidence. By treating each subgroup with their own median income and poverty incidence, he found out that non-farmer white majority has entered Phase 3 (meaning poverty drops as median income increases) and that most subgroups in Phases 1 and 2 were excluded from the growth process. Other findings include: a) Age is a disadvantage for families headed by males but not for those headed

by females, b) among the aged, it is not additionally disadvantageous for the head to be a female; it is among the young that this matters, c) the largest differences among families headed by a male under 65 are found between white and non-white farmers, and between farm and non-farm nonwhites (1964, p. 520). His conclusion based on the movements along the poverty curve is supportive of a poverty program designed to change the existing income distribution and reduce the rate of poverty to any median population income.

Another American empirical work would come up in 1964, but with a focus on social mobility. Stephan Thernstrom, a professor of History at Harvard University, created a thorough portrait of working class life in Newburyport from 1850 to 1880 - the decisive years in which this old Massachusetts town changed into a thriving industrial city (Thernstrom 1964). Thernstrom was aware of the usefulness of data linking individuals across censuses, but lacked the resources to create such data. As a consequence, supported by census reports, local records and newspapers, he traced the career patterns of hundreds of manual workers and their sons over this period, exploring in detail the differing mobility patterns of native-born and Irish immigrant workmen. His book *Poverty and Progress* suggests that when the family strategies function well, the economic security of parents is practically based upon the children's sacrifice in the form of private taxation on earnings and lost opportunity for human capital accumulation.

Important changes in the concept of poverty took place from the mid-nineteenth century to the decade of 1960. An impressive analysis of these changes may be found in the work of Herman P. Miller, especially in his book "Rich Man, Poor Man" (1964) and in his chapter "The Dimensions of Poverty" (1965). In these works, Miller asks who are the poor, argueing that «Poverty is hard to define and even harder to measure it» (Miller, 1965:20), as well as «there is no objective definition of a poor man» given that «the standards of poverty are culturally determined» (1965:36). In fact, we can find out a relative poverty approach in Miller, as well as in Townsend - even if not assumed as so - when he states that these standards «may be defined arbitrarily for a given time and place, but they vary from place to place and they differ from time to time for a given place» (1965:36). Miller also poinsts up the difficulties involved in assigning the poverty, attacking the concept of the poor as a single group, rather than a diverse one.

Certainly the rediscovery of poverty in the 1960s - specially grounded on the work of Townsend and other social scientists – was connected with some evolutions that had been happening in the society. In those days, it was noticeable that certain groups habitually lived in hard conditions. These conditions had been a consequence of the mode society had evolved over the decades before, particularly since World War II.

## *1.3 Major approaches to poverty measurement*

### 1.3.1 Traditional approaches

#### 1.3.1.1 The absolute approach

Mollie Orshansky wrote *Counting the Poor* (Orshansky, 1965) in which, besides giving continuation to the American empirical studies of the "rediscovery of poverty era", she tackled directly the concepts of poverty and poverty line. She criticizes the measurement indicators of poverty by the Council of Economic Advisors (CEA) as insufficient since the figure, expressing an amount of cash income to define families living in poverty, must vary for age, family size, geographical area and gender. In a previous work (ibidem, 1963), she describes the evolution towards the desirable definition of equivalent incomes at a poverty level for different family types and shows how the variable poverty line is derived, the method used, and a summary picture of the groups who fell below the line (for 1963 incomes). She also compared the results with the ones from the cruder measure of the CEA. She remits some recognized limitations of the paper, such as the analysis of the situation of unrelated individuals and aged persons living in families headed by younger persons, remitting for subsequent works more refined methods, as the measures based on the relationship of income and consumption. Orshansky also recognizes that it is the purpose of the paper to sketch a profile of poverty based on a particular income standard that makes allowance for the different needs of families with varying numbers of adults and children to support. Although recognizing that the standard is arbitrary, she justifies its reasonability on the fact that it is based on the amount of income remaining after allowance for an adequate diet at minimum cost, illustrating it with real numbers. After a brief look at the poverty profile, Orshansky defines the poverty lines based on available standards for food adequacy, chose representative family types, calculated an income-food expenditure relationship and made a farm/non-farm adjustment. These procedures resulted in cut-off

points that would range from $1580 for a single person under age 65 to $5090 for a family averaging eight members. Then, she evaluated how adequated is the standard and analyzed the consequences of the variation of the reference point. Orshansky made use of what would later be called the "absolute poverty line" approach, one where the standard is not determined by the social context.

The World Bank would be a significant booster of the absolute approach, although poverty was basically absent on the World Bank's documents until the late 1960s. Its President in September 1973, McNamara, at the annual general meetings in Nairobi, mentioned explicitly the concept of absolute poverty. In March 1975 he implicitly defined it as «a condition of life so degrading as to insult human dignity». In June of the same year, the World Bank published the book *The Assault on World Poverty* (1975), which analyses the causes of poverty, examines ways in which it can be alleviated, and outlines programs through which the Bank plans to help. Three important trends have emerged in the debate in defining, measuring and looking at the policy implications of poverty: (1) choosing poverty lines, (2) choosing poverty measures, and (3) making the fine distinction and determining the relationship between inequality and poverty (Atkinson, 1987; Ravallion 1996; World Bank 1990; Clark *et al.* 1981).

Within this objective, a distinction is made between *absolute and relative poverty lines.* The former has a fixed value over time and space while the latter rises with the average expenditure (Ravallion 1998:5). Absolute poverty lines are anchored in nutritional requirements for good health and normal activities. In practice, the two most common methods of doing this are through the *Food and Energy Intake* (FEI) *Method* and the *Cost-of-Basic Needs* (CBN) *Method.* The FEI sets the poverty line by finding the consumption expenditure or income level at which food energy intake is just sufficient to meet pre-determined food energy requirements (Ravallion 1998; Ravallion and Lokshin 2003). More importantly, it measures consumption poverty rather than undernutrition, clearly looking for some monetary value of the poverty line at which the "basic needs" are met. The CBN stipulates a consumption bundle that is seen as the adequate level for basic consumption needs proceeded by estimation of costs for each subgroup being compared (Ravallion 1998; Ravallion and Lokshin 2003). There are two components to assess poverty, namely the food and the non-food component. The former is anchored at the nutritional requirements for good health, which most likely does not use monetary poverty line since several bundles of food groups can yield to the

same nutritional contents; the latter component creates problems in measurement. The food component of poverty line is divided by some estimate of the budget share devoted to the food. For instance, the average food share in the United States in 1963 was ⅓, making the poverty line three times of the food poverty line (Orshansky 1963).

### 1.3.1.2 The relative approach

In contrast with the absolute approach, Peter Townsend developed the relative approach as an alternative to measure poverty, breaking with prior definitions of poverty. In one of his surveys (Townsend 1979), he criticizes the definitions expressed in terms of some absolute level of minimum needs, though being historically the most influential, as inappropriate and misleading, on the basis that people's needs are conditioned by the society in which they live and to which they belong. In fact, the core focus of the relative approach is on the consideration of poverty as a phenomenon that cannot be separated from the social environment under investigation, that is, the poverty line is defined in connection with the standard of living that predominates in the social order.

The development of the relative approach toward relative, income-based poverty lines was characterized by the dominance of measures that would not alter when all incomes vary by the same proportion. This property may be considered very questionable. Recent studies also reveal, inclusively, that the number of relatively poor on a society may rise while the number of absolutely poor fall (e.g.: Ravallion and Chen, 2011).

### 1.3.1.3 The absolute approach versus the relative approach

In the 1980s there was a real Absolute versus Relative Poverty dilemma in the economic scientific literature that surpassed the scientific extent through the 1990s.[3] Actually, several problems arise from both absolute and relative methods. The solutions raised are to be conscious of welfare consistency and to treat people with the same living standards equally when measuring poverty. Further, an *upper bound* for poverty line anchored to certain basic capabilities is also ideal to make poverty measures comparable over time and space. Ultimately, a maximum admissible poverty line is ideal to best count the poor and to have a fairly good idea of the progress of anti-poverty programs. In updating poverty lines, the literature has developed either the use of the consumer price index or the re-doing of the poverty line itself (Ravallion 1998).

[3] Sometimes the dilemma was explicit and open, as clear as the following words: «absolute-relative disputation in the conceptualization of poverty» (Sen, 1983) and «Should poverty be measured using an "absolute" or "relative" approach»? (Foster, 1998)

Two different sorts of approaches to poverty lines are the *objective* and *subjective approaches*. Objective approaches, in which both absolute and relative poverty lines are included, can be interpreted as attempts to anchor a reference utility level to attainments of certain basic capabilities, of which the most commonly identified relate to the adequacy of consumption for leading a healthy and active life (including participating fully in the society, in the relative approach). Let $U$ denote the reference utility level needed to escape poverty (Ravallion 1998). Hence, it is assumed that the household's preferences over all the affordable consumption bundles can be represented by a utility function $U(\mathbf{Q}, \mathbf{X})$ which assigns a single number to each possible $q$, given $x$ (the vector **X** refers to the household's characteristics, the vector **Q** refers to the quantities consumed of the bundle of goods). The consumer's expenditure function can be described as

$$z = e(\mathbf{P}, \mathbf{X}, U). \tag{1}$$

Consequently, $z$ is the minimum cost to a household with characteristics **X** of a level of utility $U$ when facing the price vector **P** (when evaluated at the actual utility level, $e(\mathbf{P}, \mathbf{X}, u)$ is simply the actual total expenditure on consumption, $p \cdot q$, for a utility-maximizing household).

In his work on measuring poverty, Amartya Sen sees this as a descriptive exercise rather than an ethical one as often perceived. Here, Sen (1979) establishes equilibrium between the absolute and relative approaches, develops non-income indicators to identify the poor (which includes the direct or the income method), and aggregates the poverty characteristics into one overall measure. This article likewise recognizes (1) the difficulties in the conversion of families into equivalent adults, (2) the violation of elementary characteristics by the standard measures of poverty (such as the headcount ratio and the income gap ratio), and finally (3) shows intuitively how the "axiomatization" of the aggregation exercise leads to a poverty measure that is a function of the headcount ratio, the income-gap ratio and the Gini coefficient, and how the axioms used for deriving this poverty measure can be varied. His absolutist approach to poverty was realized in his article *Poor, Relatively Speaking* (1983). Poverty is relative in the spaces of income and resources – it largely depends on how

much another individual obtains – while it is absolute in the spaces of capability or functioning – it has to do more with the inability of the individual to be or to do certain things (Qizilbash 2002:758; Sen 1983, 1985a). We will get back to this idea later.

### 1.3.2 Consensual and subjective approaches

According to Cantillon (1996), «Most analyses of poverty employ objective measures. It does not matter whether the persons in question perceives him/herself as poor». Differently from this objective perspective, several authors developed subjective approaches to the poverty measurement, particularly in the 1970s. In fact, «In the scientific approach to poverty the definition of poverty seems to have changed quite markedly over time. It appears that in West European countries the focus has shifted from *absolute* and *objective* definitions (such as budget, calorie, or diet standards based on consumption) to *relative* and *subjective* standards (definitions based on minimum levels of deprivation, income or welfare)» (Muffels, 1996:158). The subjective standards are socially built, often making use of public opinion data on minimum income needs.

A key fundamental principle following the subjective approach is that the configuration of the poverty lines relies on popular judgment in a society to set a poverty line for that society.

In an early work, Robert Kilpatrick (1973) carried out a time series analysis of Gallup Poll Results (data from the United States) showing answers to the question "What is the smallest amount of money a family of four (husband, wife, and two children) needs each week to get along in this community?" by regressing the Gallup poll opinion on the average income of the country.

Nevertheless, we may consider the work developed by Goedhart *et al.* (1977) as the seminal work in the developing of a subjective perspective. They proposed a poverty line where family heads were asked what they considered a minimal income level for their own family. It was found that the respondents appeared to state higher amounts the greater their actual income and family size, and that the relationship was loglinear. The qualitative auto-evaluations of the family incomes (from excellent to very bad) are transformed into padronized numbers between 0 and 1 by identifying these evaluations with equal quantiles. According with van Praag (1968), the answers to the income-evaluation questions will follow a specific pattern: The evaluation of $U(z)$ on the padronized scale of an income $z$ is well approximated by

$$U(z) = [1/\sigma(\sqrt{2\pi})] \int_0^z (1/t) \exp\{-1/2 [(\ln(t)-\mu)/\sigma)]^2\} dt \equiv \Lambda(z;\mu,\sigma) \equiv N[\ln(z);\mu,\sigma] \quad (2)$$

where $\Lambda(.;\mu,\sigma)$ is the lognormal distribution function with parameters $\mu$ and $\sigma$ and $N(.;\mu,\sigma)$ is the distribution function with mean $\mu$ and variance $\sigma^2$.

Another example is Dubnoff (1985), which reported a study in which respondents were presented with descriptions of stimulus families possessing various levels of income. The respondents were asked to judge the standard of living for each such family according to a scale where one of the end points was "poor". Analyzing data obtained in Boston in 1983, the author also found that the income of the respondent affects the assessment of income adequacy.

More or less implicitly, the subjective approach casts doubts over the objectivity of using basic needs in the poverty measures, including nutritional requirements. It has the advantage of recognizing explicitly that poverty analysis and the process of setting a poverty line have - at least some - subjectivity, therefore preventing dependence on judgements from researchers and specialists[4].

Still taking account of opinions, the so called consensual approaches «seek to establish poverty lines by reference to the views of society as a whole» (Walker, 1987), specifically through three different methods: «those which require the public to estimate an adequate minimum income; those which ask people to specify a list of necessary items and those which ask what level of benefits the public is prepared to fund» (ibidem). However, these methodologies carry out the risk of biased responses, as the respondants can «mouth back what they think the 'experts' want to hear, or, perhaps more correctly, what they think the experts 'ought' to hear» (ibidem).

Admitting that value judgments affect measurements, then the methods are not objective and, therefore, it matters who is making such value judgments. Certain adjustments have been made to respond to these issues. Rather than dichotomizing their income between needs and luxury, this approach asks the "minimum income question" (MIQ) where individuals or households are asked «at what income level is considered absolutely minimal to survive» or «at what point will their families not be able to make both ends meet» (Ravallion 1998:21). The responses here are considered as the

[4] Some authors (e.g.: Citro and Michael, 1995) dislike the "subjective" label as all categories of thresholds involve subjective components.

consumer cost functions at a point of minimal utility (poverty line in utility space). Poverty measurement has encountered several problems due to the vagueness of the concept of 'income' in developing societies. Hence, the subjective poverty line has to be reformulated to make the surveys and data more comparable (see Ravallion (1998) for further discussion).

Nevertheless, to put the subjective approach into effect brings about many problems, and the subjective poverty lines should be interpreted with many concerns as poverty thresholds estimates are based on responses that frequently show a large variation around the mean and also vary considerably with the specific methodology, including the kind of query, the question wording, and the interpretation of the questions by respondents (including if survey responses are known to be used to set official poverty thresholds) or interviewers.

The consensual approaches try to find poverty lines oriented by the views of society all together[5]. The most prominent researchers of the consensual approaches to poverty lines are Halleröd (1994, 1995), Veit-Wilson (1987) and Walker (1987).

John Veit-Wilson argues that the indicators of deprivation should be derived from the society in question, as he rejects the prescription from experts and supports the social relativism of poverty. He also highlights the distinction between poverty and deprivation, but this could be understood as what we would call nowadays the distinction between income- and multidimensional- poverty.

In turn, Robert Walker distinguishes three ways of applying the consensual methods: based on estimates of the community for a sufficient income, based on a list of essential items specified by the community, and based on the level of benefits the community is prepared to finance. He suggests a methodology based on qualitative techniques that explore consensus on the definition of poverty, rejecting the operationalisation of the consensual approach through survey methodology.

Björn Halleröd underlines the advantages of a direct method for the consensual approach, despite his critique of a useless distinction between direct and indirect methods for consensual measurement of poverty, both at a theoretical and an empirical level. He suggests a direct method – the Proportional Deprivation Index - with a low

[5] A minimum income standard for Portugal, using the consensual approach, was set by the CAPP (Centro de Administração e Políticas Públicas) and by the "Absolute Poverty in Portugal" project (ISEG/UTL).

level of arbitrariness, a low sensitivity to the coverage of the initial list of consumption items, and a low sensitivity also to individual particular preferences. Unfortunately, this index revealed to be too complex and not easily interpreted.

### 1.3.3 Poverty lines plausability

All the previous presented approaches have in common the central role palyed by poverty thresholds. We would like to present a brief reflection about this minimum level deemed adequate.

First of all, the monetary value assigned to poverty lines tend to be positively correlated with the wealth of the nation, or region, considered (cf. Ravallion et al., 2009). For instance, the at-risk-of-poverty threshold (calculated in each country as 60% of median disposable income) for a single person defined by Eurostat in 2010 (Antuofemo and Di Meglio, 2012) varied from €1.222 in Romania to €19.438 in Norway.

Also, poverty lines are often drawn to assess whether growth has affected the number of people living in poverty and also frequently chosen based on its objective, whether it aims to improve particular social welfare functions or to reduce poverty (Atkinson 1998a, Pritchett 2006, Ravallion 1998), but some authors argue against this idea and even the poverty line itself, as Angus Deaton points out:

«For policy evaluation, the social welfare function is all that is required to measure welfare, including an appropriate treatment of poverty. While it is possible - and in my view desirable - to give greater weight to the needs of the poorest, I see few advantages in trying to set a sharp line, below which people count and above which they do not. Poverty lines and poverty counts make good headlines, and are an inevitable part of the policy debate, but they should not be used in policy evaluation. Perhaps the best poverty line is an infinite one; everyone is poor, but some a good deal more so that others, and the poorer they are the greater weight they should get in measuring welfare and in policy evaluation» (Deaton, 1997:141).

Some authors tried to bypass the sharp line issue considering the poverty line as a range. However, this consideration has never been transformed into a practical or operational tool. In fact, whatever the concrete specification it would take, it would not be exactly a poverty line anymore, as the sharp line is what characterizes a poverty line.

### 1.3.4 The capability approach

The capability concept was presented by Amartya Sen (1980) as a conception of social ethics. As disapproving utilitarism, Sen[6] (1983) joined a range of ideas that were out of the traditional approaches to the poverty analysis and conceived a framework known as the capability approach.

Although having an interdisciplinary nature and being inspired in contributions from so many authors and so diversified fields[7], some economists, such as Martins (2009), place the capability approach inside the Cambridge economic tradition, where theory and measurement are interdependent, in opposition to the Chicago tradition that highlights the application of simple principles to real-world problems. In academia, as in policy institutions, the capability approach has become more and more famous in the last decades.

A major underlying principle following the capability approach is that the capability to function given by the characteristics of the goods and services is what comes closest to the notion of standard of living, instead of the ownership of the goods, as it was implicitly pointed out by traditional approaches[8]. In other words, we could describe the capability approach as highlighting the worth of option and membership to the detriment of compulsion, joining several concerns of the basic needs theory into a consistent philosophical framework. This approach is also characterized by centering on multidimensional aspects of well-being. It has appeared as a principal alternative to traditional economic frameworks for leading with poverty and has become particularly relevant in the poverty discourse, having been serious in criticizing the one-dimensional income-based or resources-based measurement of poverty and inequality and the welfarist approaches.

As most poverty indicators have been in one way or another associated with income indicators, Sen (1985a) forcefully argues for the inclusion of non-income indicators, namely social indicators such as life expectancy, literacy and infant mortality. This is the basis of the Human Development Paradigm. International institutions, primarily the

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[6] Curiously (and surprisingly?), Amartya Sen is also linked with the pragmatist philosophers in the disapproval of positivist epistemology (truth and knowledge are contingent).

[7] Notably: Aristotle (Political Theory), Karl Marx (Critique of Political Economy), Isaiah Berlin (Theory of Freedom), John Rawls (Theory of Justice) and Paul Streeten (Basic Needs).

[8] In political philosophy we could say that the capability approach privileges the space of capabilities instead of the spaces of commodities, ownership or utility.

United Nations Development Program (UNDP), have adopted such practice in its poverty measures.

The turn towards multidimensional approaches in poverty analysis led to the development of multidimensional measurements of poverty, inequality and standards of living. Consequently, the capability approach stands out as the foundation of the Human Development Paradigm and is at the present an important perspective in welfare and development economics.

Sen forcefully argued for an absolutist core in judging the quality of life of peoples, relying this on the capability to achieve various "beings and doings". Poverty is, consequently, a function of the absence of capability.

According to Alkire,

«Capability refers to a person's or group's *freedom to* promote or achieve valuable functionings. It represents the various combinations of functionings (beings and doings) that the person can achieve. Capability, thus, is a set of vectors of functioning, reflecting the person's freedom to lead one type of life or another... to choose from possible livings. It is concerned with the *real opportunity* that we have to accomplish what we value. It has intrinsic as well as instrumental value» (2005, p.6).

In this perspective, the capability approach typifies individual welfare in terms of what the individual is truly able to do or to be, that is, the living standard may be regarded as a set of connected or related functionings, and a general assessment of welfare has to take the form of an evaluation of all these functionings. The idea of capability to function is directly related to this idea of functionings, meaning the different combinations of beings and doings that the individual can achieve.

Some opponents to this approach criticize it for not paying sufficient attention to groups and social structures, especially due to its supposedly over-individualistic character.

The critique of the capability approach also revolves its distinction between the means and the ends of well-being, since merely the ends are important, while means are ways to reach the objective of well-being. In fact, this distinction frequently does not fit in with reality, as some ends are simultaneously also means to other ends, like being literate or in good health.

Another criticism concerns the identification of valuable capabilities. This criticism shows reservation over the aptitude of operationalization of the capability approach,

especially for making inter-personal comparisons of well-being when the valuation of capabilities, and the relative weights to be specified to these capabilities, are not consensual.

At last, the amount and variety of data and information to be gathered for the implementation of the capability approach is pointed out as - in practical terms - very difficult to accomplish, as a huge number of functionings may be needed to evaluate the determining aspects of the social state, and many of these aspects cannot be observed.

In spite of the critique, many authors have undertaken attempts to operationalize the measure of well-being in the functioning and capability space, being Martha Nussbaum the most influential in that task.

### 1.3.5 Multidimensional approaches to poverty measurement

The recent past has seen enormous interest and developments in multidimensional poverty measurement: In fact, poverty «as a multidimensional phenomenon can be approached from different points of view» (Bellido et al., 1998:115). Besides, «in order to understand the threat that the problem of poverty poses, it is necessary to know its dimension and the process through which it seems to be deepened». (Bourguignon and Chakravarty, 2005:25). Poverty may be seen as insufficient well-being. This insufficiency depends on both monetary and non-monetary variables[9]. Income is important, but, it may not only be the case that markets for some non-monetary attributes do not exist, as also many attributes may well be difficult to be exchanged to monetary units[10].

Fusco and Dickes (2006) argue that «the answer as to whether the latent phenomenon of poverty is a unidimensional concept or if it is a multidimensional one can not be postulated in an ad hoc way but must be the result of an analysis of the data. Unidimensionality or multidimensionality of poverty has to be demonstrated through the use of a confirmatory approach, so as the homogenous or hierarchical nature of the items of the continuum» and concludes, after the examination of his empirical results, that the application of the Rasch model in his study allow «to demonstrate ex-post that poverty is multidimensional and not to postulate it ex-ante as it is sometimes done».

[9] For an updated survey on deprivation indicators, see Monteiro (2010).

[10] Da Costa (1994), who states that «poverty is, in general, a multidimensional phenomenon» calls our attention for the importance of «non-marketable and not purchasable items».

### 1.3.5.1 The fuzzy set theory-based contributions

Although the poor/non-poor dichotomy has been widely criticized, the capability approach failed to fully develop poverty indicators that are measurable. As a response, a new approach of the poverty measurement starts to be considered as an alternative: the fuzzy approach. This innovation in the study of poverty measurement consists in the application of some concepts developed in the Fuzzy Set Theory (FST), a mathematical theory developed mainly by Lotfi Zadeh (1975).

Why using fuzzy set theory in this context? A good number of categories used in describing real-world objects do not posses definite boundaries. Poverty is clearly one of these categories. Its fuzziness may be uttered by a real number in the unit interval [0, 1]. The closer that number is to 1, the higher will be the grade of the object's membership in the category. According to Pedrycz and Gomide (1998), a «fuzzy set is characterized by a membership function mapping the elements of a domain, space or universe to the unit interval [0, 1]». So, the fundamental novelty of this theory consists on the admittance that there are sets in which there are not only elements that verify the dichotomy "it belongs or it does not belong" to the set. In other words, there are sets whose elements have degrees of membership. In that way, poverty may also benefit from the application of the results of the research done with linguistic variables and linguistic hedges (e.g.: Zadeh, 1975; Yager and Zadeh, 1994; Klir et al., 1997:85-100; Pedrycz and Gomide, 1998:165-179).

The usually income-based analyses raised important problems: bias - due to an unbalanced undervaluation of the answers – and subjectivity – due to the complexity in the specification of the concept of income. Although the poverty line is understood by many authors as a continuum, there is still the distinction between poverty and not poverty across a simple line. Hence, a conceptual tool that would be useful is one that looks at individuals in poverty not in static form but in a gradual transition towards non-poor.

The FST gives the mathematical tools to beat the critiques of the dichotomous aspect of the one-dimensional approach. A very highly proficient and thorough way to operationalize a multivariate analysis of poverty and social exclusion, not forgetting Sen's capability approaches, uses the FST, claiming the reach of a poverty index as a function of attributes.

The first fuzzy set theoretic measurement of poverty is from Cerioli and Zani (1990), where a cut-off point is established upon which an individual is considered *non-poor*, *definitely poor*, and *relatively poor*. Let $A$ be the set of poor people, where $\mu_A$ belongs to the (0, 1) interval. An individual who is definitely poor corresponds to $\mu_A = 1$, while someone who is definitely not poor to $\mu_A = 0$. Someone who is poor *to some degree* has $0 < \mu_A < 1$. Cerioli and Zani developed an ordinal method of scoring to rank the level of deprivation.[11] Using the rank order score $P$ with poverty dimension $j$, we can come up with $P_j'$ for the score above which someone is definitely poor in that dimension, while $P_j''$ is the best for deprivation in dimension $j$. $P_{ij}$ stands for the score of individual $i$ related to dimension $j$. Let $z_{ij}$ be the degree of membership to the set of poor people in dimension $j$, where $z_{ij} = 1$ means $P_{ij} \leq P_j'$ and $z_{ij} = 0$ means $P_{ij} \geq P_j''$. Then, considering that, for $P_j' < P_{ij} < P_j''$

$$z_{ij} = (P_j'' - P_{ij}) / (P_j'' - P_j'), \tag{3}$$

$\mu_A$, the degree to which someone belongs to the set of poor, is a weighted average (by the weight of dimension $j$) of the degree of membership $z_{ij}$ (Qizilbash 2002).

The Totally Fuzzy and Relative (TFR) approach was proposed by Chelli and Lemmi (1995). This approach has the advantage of going beyond the arbitrariness of the *cutoff* point in Cerioli and Zani (1990). Nonetheless, the TFR indices raise aggregation, comparison and interpretation problems, once that its values have not an inherent meaning. Another disadvantage is the arbitrariness of the weighting used in the aggregation of the information supplied by the diverse indicators.

### 1.3.5.2 The latent class model

Pasi Moisio (2004) contributed in multidimensional measurement of poverty by formalizing it in the Latent Class Model. This type of latent variable model associates a cluster of observed discrete multivariate variables to a set of hypothetical (or latent) variables.

In response to the one-dimensional poverty measures (low income, poor living conditions, low consumption, subjective feeling of poverty), new poverty studies

[11] The discussion here is based on (Qizilbash, 2002).

employed indicators with direct and indirect measurements (e.g. Atkinson *et al.*, 2002). The studies by Moisio (2004) and Moisio and Breen (2004) combine the Generalisability Theory and Classical Test Theory to apply measurements in taking into account social stratification and exclusion. An LCM is defined as «a measurement model relating the categorical latent variable to the discrete scores or categories of manifest variables» (Lazarsfeld and Henry 1968:15–17, in Moisio 2004:709). The LCM is referred to as a log-linear model with a latent variable. It is a statistical model, which means that relationships between latent and manifest variables are accounted for by probabilistic relationships, thus also allowing for the estimation of error in the model. The two equations are as follows:

$$X_i = T_i + E_i \qquad \text{(Classical theory)}$$

$$X_{pi} = \mu_p + \mu_i + \mu_{pi,e} \qquad \text{(G Theory)}$$

The observed value X is expressed in the classical measurement theory as the sum of the true value $T_i$ and measurement error $E_i$. In G theory, the score of a person is expressed as the linear model of person effect $\mu_p$, indicator effect $\mu_i$, and their inter action effect $\mu_{pi,e}$. However, this does not reflect the multidimensional measurement of poverty; therefore, the value of *T* can be replaced by the latent variable η (eta). This is formally introduced as:

$$\begin{aligned} X^A{}_i &= \eta_i + e^A{}_i \\ &\ldots \\ X^N{}_i &= \eta_i + e^N{}_i \end{aligned} \qquad (4)$$

where the observed score $X^N{}_i$ of a person *i* in the variable *N* is presented as the sum of the latent score $\eta_i$ and the measurement error $e^N{}_i$ of the person *i* in the variable *N*. The equation presents the observed value of each measurement in the multidimensional measurement set as a simple sum of the latent (true) score and measurement error, like the classical theory, but it accepts multiple sources of error, just like the G theory.

Since each effect parameter can have error term, there are three estimates describing measurement error. However, the interaction effect itself is usually understood as one source of measurement error, because its coefficient indicates how differently indicators

measure different persons. In other words, the interaction parameter describes the measurement error that is caused (usually) by people interpreting the measurement device differently (Moisio 2004:707). In modeling the poverty dynamics in ten European countries (Moisio and Breen 2004) the latent model was also used where categorical rather than continuous variables were used. In this way, relative differences in wealth and other resources are assumed to cause an absolute difference in the capability to function or attain some minimum acceptable way of living in the society. The conclusions to draw are as follows: (1) correcting measurement errors through the LCM affects conclusions within and across countries especially the variation in poverty rates; (2) the poor (defined as relative income poverty) is badly identified more so inaccurately measured as non-poor; and (3) the LCM can be used to test whether the indicators correctly measure the corresponding latent variable. In these two studies, poverty measurement is treated as a way to correct the welfare function approach to poverty.

A plus of employing latent variables concerns the dimensionality of data, as it reduces the number of random variables under consideration. This type of model can aggregate many observable variables to represent an underlying concept, making it easier to comprehend the data while linking observable data in reality to symbolic data in the model.

### 1.3.6 Other approaches

This section discusses the specific contributions of various scholars in poverty measurement and the relations of poverty to other dimensions of economic well-being. Some experiments (e.g. Deitz 1996), designed to people get the notion of income inequality and poverty measures, are interesting for practical purposes of sensitivity, but shall not join this review, given that our aim is predominantly academic.

Also some approaches, as the approaches of spatial dimensions (Balk 1996, Kakwani and Hill 2002) or spatially conditioned distribution (Arbia et al. 2010, Maza et al. 2012) developed to compare welfare levels of households situated in different regions within a country or economic block, are not considered here in terms of reviewing, although

constituting, in some cases, valuable work in specific fields, such as income distribution or welfare measurement[12].

### 1.3.6.1 Poverty-line-discontinuous class of measures

Bourguignon and Fields (1990) showed that optimum allocations can be either of three types: (1) allocating the budget to the poorest of the poor who need the resources most; (2) allocating all the budget to the richest of the poor so as to increase the number of people escaping from poverty; or (3) making a mixed allocation of resources with some part going to the poorest of the poor and some part to the richest of the poor. This result was further explored 7 years later (Bourguignon and Fields 1997). It first considers two budget allocation issues, namely the specification of the loss-from-poverty function and the optimal allocation of an antipoverty budget. It justifies why a poverty-line-discontinuous (PLD) poverty function is the appropriate analytical tool for poverty measurement on budget allocation and this has been integrated in the 'generalized $P_\alpha$ measure'. It consists in substituting a social loss function associated to $P_\alpha$ measures (as the Foster-Greer-Thorbecke indices described in 2.1.1.1) by a PLD function $L(y) = \delta + N(y)$, where $\delta$ would be the fixed loss from poverty and $N(y)$ can be interpreted as the variable loss. Using this PLD function, the authors consider a new measure, a generalized $P_\alpha$ measure, denoted by:

$$P_{\alpha,\delta} = (1/N) \sum_{i=1}^{q} \{\delta + [(z - y_i)/z]^\alpha\} = \delta \cdot H + P_\alpha. \quad (5)$$

This measure, where $z$ is the poverty line, is a weighted sum of the original $P_\alpha$ and the headcount ratio; wherein $\delta$ would be the weighting parameter.

This poverty measure has been carried through another study. It was a group of scholars looking at poverty and income distribution at the time of policy adjustments. Bourguignon, de Melo and Morrisson (1991) drew policy lessons from the case studies of Chile, Cote d'Ivoire, Ecuador, Malaysia, Morocco and Indonesia on the possibility of

[12] We highlight the work of Pereira (2009) where she carries out a deep spatial analysis of poverty and rurality in Portugal (mainland), operationalizing variables of characterization of the territory and the concept of poverty, developing indicators of economic resources and material deprivation.

easing poverty and income distribution during economic transitions or reform period. This paper applies the indicators Bourguignon developed throughout his career and use them to assess the impact of structural adjustments to poverty and inequality. The debate is whether the poor would have fared worse or not had the adjustments not taken place; the paper considers the enormous difficulty in identifying the poor and attributing changes in their well-being to the government policy. It raises an essential issue and justification in using case studies: that poverty measure is inherently problematic and high levels of abstractions need to be complemented by in-depth studies looking at institutional contexts, conflicts of interests and power among social forces, and the role of human actions/strategic choices in the overall antipoverty effort.

### 1.3.6.2 The incidence of distribution of resources

In the study of Zheng (2001), he points out the shift in poverty measurement not simply considering the counting of the poor but also the incidence of distribution of resources among the poor. In developing appropriate statistical inferences for poverty measurement with relative poverty lines, the paper uses a class of decomposable[13] (*i.e.*, additively separable) poverty measures together with percentages of mean income and percentages of quantiles as indices. It is important to note that an imporyant property of decomposable poverty measures is that a *ceteris paribus* reduction in the poverty measure of a subgroup always decreases poverty of the population as a whole.

Considering a differentiable income distribution, $F(x)$, with $x$ the income defined in the interval $(0, \infty)$ and $z$ a given poverty line (under what each income is associated to a poor person), the decomposable poverty measure starts with a continuous form:

$$P(F; z) = \int_0^{\infty} p(x, z)\, \mathrm{d}F(x), \tag{6}$$

where $p(x, z)$ is the individual poverty deprivation function (*i.e.*, the function that measures the individual poverty, considering the individual income $x$) and is continuous

[13] A poverty measure is decomposable if the poverty measure of a set of individuals is a weighted average of the poverty measures of the individuals in the set.

in both $x$ and $z$ with $p(x, z) = 0$ for $x>z$, $\partial p(x, z)/\partial x \leq 0$ and $\partial^2 p(x, z)/\partial x^2 \geq 0$ over $(0, z)$. Zheng makes further assumptions:

«We also assume that $p_x(x, z) \equiv \partial p(x, z)/\partial x$ is bounded and that $p_z(x, z) \equiv \partial p(x, z)/\partial z$ – the increase in $p(x, z)$ when the poverty line $z$ is increased by an infinitesimal amount – exists and is uniformly continuous over $(0, \infty)$. Consequently, we may reasonably assume that $a \equiv \int_0^z p_z(x, z)$ $dF(x) = \partial P(F, z)/\partial z$ – the increase in $P(F, z)$ when the poverty line z is increased – exists and is finite» (Zheng 2001:340).

From this decomposable property, two types of relative poverty lines are developed: mean poverty lines and quantile poverty lines. This is formally derived using the definition:

A poverty line $z$ is a mean poverty line if $z = \alpha\mu$ where $\mu$ is mean income and $\alpha > 0$; a poverty line $z$ is a quantile poverty line if $z = \alpha\xi_q$ where $\xi_q$ is a quantile of order $q$, *i.e.*, $\xi_q = \sup \{x \mid F(x) \leq q\}$. The sample estimate of $z = \alpha\mu$ is $\check{z} = \alpha x$ with $x = (1/n) \sum_{i=1}^{n} x_i$; the sample estimate of $z = \alpha\xi_q$ is $\check{z} = \alpha x_{(r)}$ where $x_{(r)}$ is the $r$th order statistic of $(x_1, x_2, \ldots, x_n)$ with $r = (nq)$. If $q = \frac{1}{2}$, $z$ is a median poverty line.

From here, Zheng constructs an asymptotic covariance structure where the asymptotically nonparametric distribution-free statistical inference has been established. In determining the minimum sample size for the asymptotic theorem to be applicable, the Monte Carlo simulations with several parametric distributions were used. It was found out that 1000 was the sufficient value. Finally, this was further tested in stratified random samples and cluster samples.

By developing statistical inference for testing decomposable poverty measures with relative poverty lines, Zheng shows that «the estimates of poverty indices with relative poverty lines are asymptotically normally distributed and that the covariance structure can be consistently estimated. As a consequence, asymptotically distribution-free statistical inference can be established in a straightforward manner». (Zheng 2001:337).

### 1.3.6.3 Psychological resources and subjective well-being

The turn to subjective view on poverty can be indicated by the work of Lever *et al.* (2005). Here, the focus is to establish the effect of psychological factors in the relationship between poverty and well-being. Using non-probabilistic, stratified sampling method, the authors used the following explanatory variables: strategies for coping with stress, competitiveness, mastery, locus of control, depression and self-

esteem. The purpose of the study is to explain the mediating effects of all these variables.

In the literature, it is shown that there is a positive relationship between poverty and well-being; that is, the degree the population is impoverished, their well-being diminishes (Easterlin, 2001; Diener and Biswas-Diener, 2002). However, others argued that the association between one's material life situation and subjective well-being is limited, asserting that a significant part of the variance of well-being is not directly explained by economic variables, but rather by psychological and social variables such as personality, aspirations, adaptation to the environment and motivation (Andrews and Withey 1976; Schyns 1998a, in Diener and Biswas-Diener 2002; Csikszentmihalyi 1999; Fuentes and Rojas 2001; Csikszentmihalyi and Schneider, in press, in Csikszentmihalyi 1999; Diener *et al.* 2009). In this paper, the above-mentioned psychological variables act as mediating factors in the structural model of explaining poverty and well-being (*i.e.*, poverty influences well-being through those variables). The conclusion from the model is that there are basically three channels of poverty impact over subjective well-being. First, there is a direct correlation showing that precarious life conditions have a negative impact on the perception of subjective well-being. The second channel illustrates that poverty has an impact on well-being through its influence from passive, evasive coping strategies: «persons with an internal locus of control use direct coping strategies and those with a tendency toward externality use evasive coping strategies» (Lever *et al.* 2005:400). Finally, a third line presents itself when personal rejection (low self-esteem) and minimal orientation toward mastery are translated into depression, which directly impacts individuals' subjective perception of well-being.

#### 1.3.6.4 The human development index (HDI)

The shift to the multidimensional conceptualization of poverty raises two questions. First, what is the goal of poverty measurement with respect to quality of life? Second, how can developing new poverty measures address human poverty and inequality? As such, the Millennium Development Goals (MDGs) of the United Nations was conceptualized based on the link between poverty and quality of life. Consistently with the capability approach, the MDG measures poverty not simply to count the poor people per se, but also to identify which sectors are to be targeted by redistribution policies and poverty-reduction measures. In effect, human poverty is conceptualized and measured

to solve the discrepancy in the quality of life across countries and regions. This significantly contributes in reevaluating the understanding of poverty also as a policy issue.

The HDI is a concise measure of human development. Although in the family of aggregate measures, where the country is the unit of analysis (differently from all the others that have been reviewed in this chapter, where the unit of analysis is tipically the family, household or the individual), its practical importance in the non academic environment justifies a note on it. It averages the achievements in an economy in three fundamental aspects of human development: Extension of life, as measured by life expectancy at birth; Knowledge, as measured by the adult literacy and the combined primary, secondary and tertiary gross enrolment ratio; and Standard of Living, as measured by Gross Domestic Product per capita (in purchasing power parity).

The popularity of the HDI as a social indicator of poverty that supplements the official indicators is due to the fact that the data used to compile the HDI and the methodology applied to get the final values are uniform across the board. This allows for adequate comparison of poverty among various countries (something that was originally difficult given that there are no standard indicators of poverty prescribed internationally). It implies that there is greater accuracy in reading the trends in poverty globally, regionally and even within countries. Moreover, it makes this index easily accessible to many countries albeit their differing official sets of indicators, and easily applicable to any unit of analysis (country, region, or city units). This is why most countries through UNDP have been able to make significant assessment over the causes of poverty within countries and which sectors and regions require more and certain types of redistributive policies.

The HDI supplements traditional measures of poverty through an expansion of a per-capita income threshold into the realm of poverty indicators measuring well-being—a more holistic and realistic perspective of the tangible manifestations of poverty using social indicators that contribute to the degree of deprivation in poor countries. These capacities of the HDI as a poverty indicator is supported by its consistency to even the more conventional measures; it has a high correlation with other more conventional poverty indicators like the per capita income, the income threshold (the World Bank measure of $1 per day), and Food and Agriculture Organization's (FAO) measure of undernourished population. While it is consistent with these measures, it does not imply

that the HDI may be foregone in favor of conventional, income-based indicators in their own merit as the HDI will yield the same result. In fact, a clear case showing the utility of HDI as a social indicator of poverty is the comparison between the ranking in poverty if we use per-capita income and HDI.

New correlations were found through the development of HDI as a poverty indicator. Some of the implications offered by the International Monetary Fund (IMF) on the surface conclusions that may be surmised from HDI data over the years include a strong correlation between the improvement of the HDI and sound macroeconomic policies, or fostered per capita GDP growth. However, a country with an increase in GDP and possibly greater economic efficiency does not explicitly relate to a reduction of the incidence of *real* poverty among marginalized sectors. This efficient allocation of resources and efficient economy may not be socially-preferred still as a result of equity issues as regards the distribution of the increase in GDP among those whom poverty is evident.

This presents us with some weaknesses as regards the extent of capacity of the HDI as a poverty indicator and as a success benchmark for poverty alleviation[14]. Following from the conclusion of trends in HDI data that show how an increase in GDP implies an improvement in the HDI, and the possibility that an increase in GDP and its distribution may not be targeted towards the poor, this tells us that an improvement on HDI does not assure that benefits accrue to the poor toward the end of poverty elimination or alleviation. This also tells us that the HDI rather ambiguously describes the extent of poverty, its nature, and the subsequent effects of poverty-reduction policy.

Another important drawback on this index is the report of a high correlation verified between the three dimensions of the index, around 0.8 (Srinivasan, 1994).

## *1.4 Present challenges to poverty measurement*

In this subchapter we aspire to survey the most relevant and recent empirical literature on poverty in order to show the current concerns in poverty analysis and the challenges placed to its measurement.

[14] For a deeper discussion on this issue, see Klugman et al. (2011).

Even knowing that the traditional approach has some notorious adaptations, especially when considering lack of data (e.g. Elbers et al. 2003; Cuong, 2011), we focus on the multidimensional approach, once that the multidimensionality of poverty is consensual within social economic academia.

Silber (2007) reviews the major problems that have to be faced when taking a multidimensional approach to poverty and gives a survey of the solutions that have been proposed to solve these issues. It presents the cardinal approach to multidimensional poverty measurement and makes a description of the ordinal approach to poverty measurement and of some aspects of a more qualitative approach to poverty measurement. On the approach to multidimensional poverty analysis it puts some challenging questions. First, on the choice of poverty dimensions, challenging questions may be asked, such as what dimensions are important, which kind of interactions should one assume, or how to deal with interactions between indicators representing a given dimension. Other challenging questions are concerned with the vagueness of the concept of poverty.

The question of what dimensions are actually important is, in fact, a challenging question. Definitions of poverty have extended to place the social and psychological burdens of daily survival on the bottom rungs of society in the definitions. At present, a more holistic, multidimensional understanding of poverty has come up, drawn from interviews with the poor themselves. Such interviews make it easily understandable that, as well as not having enough financial resources, being poor frequently means:

- Anguish, humiliation and worry;
- Exclusion from the community and lasting hard social relations;
- Insecurity, lack of self-confidence and powerlessness;
- Suffering chronic pain, disease or exhaustion[15].

Moreover, many interactions may be identified, indeed, between several dimensions, such as health and possibilities of income-earning, or education and health issues[16], and certainly this kind of interactions also raise difficult challenges to be overcome by social science researchers.

[15] Narayan et al. (2000) deepens further the question of hearing the voices of the poor. Also interesting is the identification of the «missing dimensions of poverty data» (Alkire, 2007), namely: Ability to go about without shame, Empowerment, Physical safety, Psychological well-being, and Quality of work.
[16] Kanbur and Squire (2001) look into closely these and many other interactions.

Also the vagueness of the concept of poverty is a question that raises methodological concerns. This issue has been addressed gradually since the seminal work of Qizilbash (2003), but not with satisfactory results so far[17].

A paper of Tarditi (2007) develops a totally relative notion of deprivation in the scope of a fuzzy approach. He argues that the measurement of poverty presents many difficulties from a practical and from a theoretical point of view, explaining the drawbacks of the one-dimension method, both in the identification and the aggregation steps. After that he chooses the multidimensional approach as a solution, using the notion of FST to focus on the membership function and the weighting scheme, discussing two different approaches: the TFR and a complementary methodology. He recognizes one of the most fragile points in multidimensional analysis as the aggreagtion of intrinsically different measures, which represents a possible weakness of this approach.

In a study made by Njong and Ningaye (2008) they try to compare multidimensional poverty indices employing three distinct multivariate statistical methods of setting weights (principal component analysis, multiple correspondence analysis and fuzzy set approach), examining how composite poverty index comparisons are responsive to change in the aggregation and weighting systems. According to this study, the main challenges to poverty measures which incorporate information from many variables relates to the complexity in managing with the multidimensionality and the use of non-monetary variables, *i.e.*, many theoretical and methodological shortcomings raise up when trying to operationalize a multidimensional poverty concept. When using composite indexing all the events must be cautiously tackled, including the choice of the variables, the definition of a weighting system, the aggregation of the variables, and the identification of a threshold. The use of the Multiple Correspondence Analysis, which allows the analysis of the pattern of relationships of several categorical dependent variables, should be carried out only when the variables to be analyzed are nominal instead of quantitative. Finally, the FST is considered as particularly appropriate to model a vague concept as poverty.

A very interesting paper of Bastos and Machado (2009) assesses poverty amongst children applying a child-centered methodological framework that makes good use of FST to construct measures of child deprivation. The most interesting aspect in this study

[17] A very interesting extension of his seminal work has been actually done although (Qizilbash, 2006).

is that it tries to overcome the absence of indicators to assess poverty amongst children - especially as the household is the usual unit of reference – while constructing a multidimensional child deprivation index using information gathered from children themselves, where the concept of deprivation comprehends the areas of education, health, housing and social integration. The unit of analysis considered is the children individually, and deprivation for each indicator is measured in terms of degree according to a 0 to 1 membership function, being the weighting scheme defined as, for each indicator, a log of an inverse function of the average deprivation level. Consequently, this weighting scheme means that the higher the frequency of deprivation, the smaller the weight becomes. Considering these weights, the global index of deprivation is aggregated as a weighted sum of the membership average for each indicator. The weighting scheme considered results in a higher weight for the indicators where most children are not deprived, which are not necessarily the most important for the children. One present challenge we identify from the analysis of the methodological framework applied in this study is the need of a weighting scheme that associates higher weights with those deprivations indicators that are more important for well-being.

Also focusing in a subdivision of the society, Bastos et al. (2009) adds a gender perspective in the study of poverty in Portugal, focusing on women poverty, concluding that poverty prevalence is not gender neutral and, as well, that both genders also experience poverty in distinctive ways. It employs a multidimensional concept of poverty, with a cross-sectional and a dynamic analysis over 7 years. It is particular interesting its conclusion that, being labor the principal asset of the poor, it seems to subsist a cycle where low education heads to poverty and vice-versa. This work would challenge us to confirm its conclusions – namely the importance of ageing, education, labor market issues and lone motherhood as major contributors for a higher vulnerability to women's poverty - when applied to different countries.

Vega and Urrutia (2009) also tackle the problem of measuring multidimensional poverty, focusing in the Bourguignon-Chakravarty family of indices, arguing that no characterization of these indices has been done. The paper explores the properties satisfied by this family of measures and shows how those properties typify the family of indices. It also identifies two kinds of aggregation that are used to derive indicators for measuring multidimensional poverty: a combination of different elements of deprivation

which are then aggregated, and an indicator of the attributes based on individuals for each attribute to create. Nevertheless, they simply typify the functional form of the family of indices and quite a few choices stay open in the family of indices. Finally they argue that the policy maker should choose the poverty lines, the methodology to identify the poor, the measure of the deprivation felt by each individual with respect to any dimension, the weight attached to any dimension and the values of the parameters.

Abdullah (2010) suggests three different measurements of poverty lines using membership functions based on FST: Exponential, trapezoidal and quadratic sigmoid. The numerical results show the flexibility of poverty lines came about as a consequence of the composition of the proposed functions.

Alkire and Foster (2011) propose «a new methodology for multidimensional poverty measurement consisting of an identification method $\rho_k$ that extends the traditional intersection and union approaches, and a class of poverty measures $M_\alpha$». The first step consists on the identification problem, which «employs two forms of cutoff: one within each dimension to determine whether a person is deprived in that dimension, and a second across dimensions that identifies the poor by 'counting' the dimensions in which a person is deprived». The second step leads with the aggregation problem, where they employ «the FGT measures, appropriately adjusted to account for multidimensionality». Also, the axioms are presented as combined restrictions on identification and the measures, while the methodology satisfies a variety of desirable properties including decomposability. Their methodology is illustrated with examples from the United States of America and Indonesia.

The paper of Diallo (2010) studies multidimensional poverty in Guinea. His methodology relies on the fuzzy set approach of Dagum and Costa (2004). The main results that emerge are the identification of the key variables associated with poverty and the identification of deprivation according to selected attributes for different groups.

Esposito and Chiappero-Martinetti (2010) refer several challenges in the measurement of multidimensional poverty. One of them is that, when multiple attributes are considered, a criterion determining the relative importance attached to the different dimensions has to be adopted. They argue that this has not been done so far in the literature. Thus, they aim to take the first step in this direction, suggesting two ways in which such a hierarchical system can be understood, labeled as *restricted* and *unrestricted hierarchy*. The analytical conditions allowing the inclusion of these into a

poverty index are derived and their implications in terms of the understanding of poverty are discussed. Finally, an empirical study shows how the choice of the hierarchical system for poverty dimensions can direct to opposite conclusions on the poverty tendency.

Peñaloza (2011) tries to solve some challenges building multidimensional fuzzy versions of the headcount and FGT poverty indices for ordinal variables with endogenous weights. The methodology basically develops a theory of moments for ordinal categorical variables, first defining ordinal expectation and ordinal variance for ordinal variables and extending Theil's theory of dual variability to ordinal categorical variables, what let make the weights of the built multidimensional fuzzy poverty measures endogenous.

## *1.5 Conclusion*

The leading objectives of the pioneering authors who studied poverty varied from one to another. Being the social concerns the common characteristic among all, different purposes were present in each one: Walker wanted to defend Economics as a science, Naoroji had political and nationalist objectives, and Rowntree had scientific concerns.

With the faster growing of the 1950s and 1960s a little over the world, but especially in the United States, the rediscovering poverty era came up when the great intra-national inequalities became obvious. Harrington, for instance, was a combative social democrat (or socialist?) who wanted to show the hidden poverty in America, or, on the other side, Orshansky who represented the U. S. Social Security position showing that there was work being done to fight against poverty.

Townsend and Sen would be the fundamental authors to influence the Economic study of poverty for decades, leading the beginning of the incontestable dominance of the academia in the subject. Townsend redefined poverty as a relative phenomenon. Sen contributed with many and varied works, especially trying to explain the underlying mechanisms of poverty, to unite the better of the absolute and relative approaches and introducing the concepts of functioning on the basis of the capabilities approach.

In the meanwhile, methodological problems surged due to data gathering mismatches with the theory and also because some theories were difficult to be applicable with the

existing poverty indices. Some important comments and contributions to the resolution of these problems were figured out in the turn to the twentieth-first century by Alkire (2005), Atkinson (1998b), Ravallion, and Pritchett.

The state-of-the-art in poverty measurement relies on the multidimensional approaches and other proposals in the economic literature and, in some cases, in interdisciplinary works between Economics and Psychology and Sociology. The Fuzzy Set Theory is largely employed to help Economics of Poverty to turn the Multidimensional Approach feasible since the seminal work of Cerioli and Zani. Other alternative approaches such as those considering the level of psychological well-being as part of the poverty concept are sometimes irregular contributions that could be – like the multidimensional approach - a path for economic research in the next decades, in some cases with the collaboration of other social sciences. Our contribution, as presented in Chapter 3, fits on this path.

# CHAPTER 2 - POVERTY MEASURES: MAIN INDICES AND ITS LIMITATIONS

The intrinsic work to measuring poverty is complex, mainly for two reasons: The vagueness of its concept (since there is not one consensual and universal definition) and the fact of being a social experience. Both these reasons have lead to the existence of very different ways of gathering data and organizing surveys. In addition, the number and the diversity of approaches to measuring poverty are also considerable.

The main purposes of this chapter are to understand the evolution of the poverty measures, to make good use of what have been learnt in the process, and to figure out the limitations that characterize the state of the art in this field, in order to grasp some clues for a suitable and valid contribution.

Sections 2.1 and 2.2 introduces the subject of poverty measures and describes the basic issues concerning the measurement of poverty, as if these issues would constitute the topics to be taken into account, or the questions to be answered, by each poverty approach.

Section 2.3 examines some monetary indices and describes the axiomatic characteristics that are desirable for a monetary poverty measure. Although very popular, several weaknesses are argued about these measures.

Section 2.4 describes a subjective index of relative deprivationn index, based on a concrete realization of the relative notion of poverty proposed by Peter Townsend since the 1960s.

Section 2.5 is devoted to the multidimensional poverty indices, running through the capability and social exclusion indices, vulnerability indices, participatory methods, and the FST indices.

Section 2.6 examines aggregation paths and weighting methodologies to solve the aggregation problem in the construction of poverty indices.

Section 2.7 covers the reflection about what clues for a contribution are left out by the state of the art in the poverty measures issue.

## 2.1 What is a poverty measure?

Almost every one has an idea about what it means to be poor, and, simultaneously, finds it difficult to define poverty. Indeed, there is no consensus about what is a decent standard of living.

Social economists, among other social scientists, have been working for decades to find a good poverty measure, and many ways of doing it have been proposed. As a consequence, there is not only one way to classify the large variety of poverty measures proposed in the Economic literature, given that many features may be considered in this hard task.

The main importance of studying poverty measures is related with the fight against poverty. Considering that investing in this fight brings better results when tackling its sources, we distinguish from one dimension measures - which are able to provide an idea of the degree of poverty at a national level and to make an easy international comparison - from multidimensional measures - which incorporate more qualitative information and permit a comprehensive planning and a deeper analysis.

According to Veit-Wilson (1987), «the principal problematic issue in all poverty measures is the source of the standards of needs and deprivation». This topic will be an important portion of our reflection throughout the study.

As pointed out by Zheng (2001:126), issues like «multi-dimensional poverty measurement and partial poverty orderings which arise from the multiplicity of poverty measures, poverty lines and equivalence scales» have to be considered in order to define a poverty measurement tool. Here, before presenting the poverty measurement tools that we will use to assess poverty in Portugal, it is important to generally characterize the characteristics that underly each family of poverty measures.

Laderchi *et al.* (2003) identifies seven basic issues concerning to the definition and measurement of poverty. Different approaches handle these issues in different ways.

a) *What is the space of poverty*?

Depending on the approach, the answer to this question involves only material aspects of life or encompasses other issues, such as political freedom or institutional connections.

*b) Universality of the definition of poverty*

May we extend the poverty measurement tools developed for one country, in a specific time period, to other societies?

*c) Subjective or objective methods*

In general, we can think poverty as an objective problem that need to be understood from outside. However, the opinions of poor people about their conditions may constitute valuable information to be incorporated as important subjective aspects in measuring poverty.

*d) How to discriminate the poor?*

Choosing an adequate poverty line is not a trivial task. For instance, choosing between relative or absolute poverty lines "is ultimately a matter of political and cultural sensitivity" (ibidem:5). Consequently, in more developed countries the political preference for relative lines is justified by the fact that everybody has access to minimum resources to survive, while an absolute line makes more sense where a considerable part of the population does not have access to these minimum resources.

*e) Poverty measuring at individual or household level?*

There is a discussion about the more accurate level to measure poverty, if it should be at the household level or at the individual level. Most authors agree with the latter. As a result, considering some household intra-allocation is important in order to translate information about family income into personal income, such as equivalence scales, which may be used to satisfy the unobserved intra-household allocation.

*f) How to deal with multidimensionality?*

The multidimensionality of poverty is considered in very different ways depending on the approach adopted. For instance, those following Sen´s capabilities advocates for the use of multidimensional measures of poverty. However, how to select the relevant dimensions is not a trivial task and, additionally, as Silber (2007) points out, there are different strategies to aggregate different dimensions.

*g) Time horizon of poverty measure*

There is a discussion about the temporal prospect over which poverty should be measured. This discussion encompasses issues about poverty as a chronic phenomenon or as a transitory phenomenon.

After the presentation of these issues, we are now able to present and discuss some major approaches to the measurement of poverty, including the one-dimension approaches, namely the monetary approach, and the multidimensional approaches, such as the capabilities, the social exclusion, the vulnerability, participatory approaches and the fuzzy set approach.

## 2.2 Data gathering and other poverty measure issues

It is important to note the current practice of international institutions in gathering data to be used in poverty studies. In the 1970s, the shift from sociological to economic quantitative approach on poverty had a huge impact on the study of poverty. The unit of analysis matters, whether it is individual, family, or household, in identifying the progress in growth, designing healthcare programs, and evaluating which government intervention strategies will help in alleviating people from poverty (Atkinson, 1985). As observed, systematic household surveys became the basis of econometric studies, looking at consumption, income and eventually other measurable relative variables (e.g. capability, functioning, and deprivation). In the studies on global poverty (Ravallion 2003; Ravallion and Chen 1997, 2001), the use of time-series and cross-country comparisons have used household surveys and statistical records conducted by national governments to create data sets for regression analysis. Households are ranked either by consumption or income per person with household size and sample expansion factors being controlled. Although this increased comparability, it has also bred discontentment among scholars because it maintains the monetary approach in measuring poverty (poverty defined by the single variable income). While these studies are measuring individual progress on being poor, monetary data usually pertain to households without being able to measure other resources that affect poverty, such as sanitation, health and clean water. Although the individuals make up the household, it is difficult to ascertain

whether the individuals receive these services (Laderchi *et al.* 2003), *i.e.*, the unit of analysis does not seem to match with what we measure[18].

In choosing poverty measures, most studies employ the *headcount*, or the proportion of the population under poverty (Atkinson, 1987). The simple reason is its simplicity (Ravallion 1996). However, this has been criticized (Foster 1984; Sen 1976, 1979) and new alternative poverty measures were developed. For instance, the income gap ratio is increasingly being used, which is defined as the gap between the poverty line and the average income of the poor expressed as a proportion of the poverty line. These indices attempt to become neutral to the inequality within poors, in which most indices focused on alternative poverty gap index (see Foster *et al.* (1984); Clark *et al.* (1981); Sen (1976); Watts (1969) for different poverty gap indices).

Martin Ravallion's (1996) work about measuring and modeling poverty may be considered the last essential one on the Economics of Poverty of the twentieth-century. The paper is an extended comment on some practices in poverty analysis using survey data and a critical description of the state of the art in the end of the century. Although his many comments go mainly to some practices in the analysis of poverty in the studies that use data, he does not ignore the fundamental issues, discussing some options taken by the investigators that influence the path to a better comprehension and explanation of the poverty phenomena. The measurement issues are commented while some arguments are presented to support several methodological proposals - as the arguments for and against the discontinuous variation registered by some measures around the poverty line and the implications of that discontinuity for the policy against poverty – as well as while conceptual and empirical problems raised by the traditional approach are presented – as the sensitivity to the distribution of the poverty measures, the consequences of the poverty lines for the policy (namely the perverse consequences of the relative poverty lines) and still while some own proposals - as the favorable argument for social indicators and the presentation of the necessary ingredients for a credible approach to poverty measurement. These include real expenditure per single adult on market goods, non-income indicators such as access to non-market goods, indicators of intra-household distributions such as child nutritional status, and indicators of personal characteristics which impose constraints on the ability of an individual such as physical handicap (ibidem, 1996). His comments go still far away to the modeling of

[18] As recognized by Rodrigues (2012, p.4)

poverty. He discusses what can be learned from a regression of poverty, the links between income poverty and human development, poverty dynamics and the economic geography of poverty. Data-related issues are also commented, with a critic description of what is done currently and several proposals of what should be done for a better performance, and how errors should be dealt with. Conceptual and empirical problems raised by the so called monetary approach should be struggled with complementary measures that grasp what is not grasped (non market goods and heterogeneous distribution inside the households are some examples). Another fundamental conclusion is that the exit from poverty may be very dependent on individual characteristics, the household and the environment (community).

## *2.3 Monetary poverty indices*

The monetary approach for the measurement of poverty was the first method proposed in the economic literature and the only one until the 1970s. It is still very popular, not only among the policy organizations as also among the academic empirical papers[19].

Considering the axiomatic approach used by Sen (1976) to derive a new measure of poverty, many authors adopted a similar strategy. Zheng (1997) surveys exhaustively and remarkably all the most important axioms, identifying a core of desirable axioms. The set of core, desirable axioms should correspond to desirable properties of poverty measures. Zheng also brilliantly analyses the relationship among axioms and poverty measures, clarifying the interrelationships and justifying the core axioms, namely the focus axiom, symmetry, replication invariance, continuity, increasing poverty line, regressive transfer, weak transfer sensitivity and subgroup consistency. According to Zheng:

«The focus axiom is very important for us to construct a good poverty measure. It says that poverty measurement primarily concerns the poor, not the nonpoor. *Symmetry* allows the use of an index number to represent the poverty level and its changes. *Replication invariance* makes the comparison of poverty levels between different population sizes possible. *Continuity* concerns the inaccuracy of income data, the smoothness of crossing the poverty line as well as the manner in which poverty changes as the poverty line changes. *Increasing poverty line* requires the poverty level to increase as the poverty line rises. The regressive transfer axiom

[19] Two examples - among many others – of very recent one-dimension poverty measurement studies are Begum et al. (2012) and Maasoumi and Mahmoudi (2012).

ensures that the poverty measure is concave toward the origin: a transfer of income from anyone poor to anyone richer will increase the poverty value. The weak transfer sensitivity axiom requires a poverty measure to put more weight on a transfer down in the distribution. Finally, *subgroup consistency* imposes 'subgroup monotonicity' in the sense that any local effort in reducing poverty will be recorded in the overall change in the poverty level» (1997:140-141).

As we can verify, these core axioms were previously set to the development of multidimensional indices, what makes them a reference, but merely for monetary indices. In order to present them in a formal formulation (based on Zheng, 1997), let us consider income distributions characterized by vectors, $x = (x_1, x_2,\ldots,x_n)$, with $x_1 \leq x_2 \leq \ldots \leq x_n$. These vectors are drawn from the income space $D$, where $x_i \in$ D (being D some nondegenerate real interval). For some known poverty line $z \in$ D and distribution $x \in$ D, each individual is either poor or non poor. Let us also consider that a:

- Poverty measure is a function $P(x; z)$: $D$ x D $\rightarrow R_+$ whose poverty value indicates the degree of poverty intensity associated with the distribution $x$ and the poverty line $z$, where $R_+$ is the non-negative real number set;
- Poverty index is a numerical number that may be assigned to each income distribution for a given poverty measure and poverty line.

Considering these definitions, the description of the core axioms is as follows:

Focus Axiom:

$P(x; z) = P(y; z)$ whenever $x \in$ D is obtained from $y \in$ D by an increment to a nonpoor person.

Interpretation: The poverty measure is not dependent of the income distribution of the nonpoor.

Symmetry Axiom:

$P(x; z) = P(y; z)$ whenever $x \in$ D is obtained from $y \in$ D by a permutation.

Interpretation: Each individual has the same importance for measuring the intensity of poverty.

Replication Invariance Axiom:

$P(x; z) = P(y; z)$ whenever $x$ is obtained from $y$ by a ($k$-) replication.

Interpretation: Since some two income distributions with different sizes can be replicated to equal sizes, their poverty levels can be directly compared.

Continuity Axiom:

$P(x; z)$ is continuous as a function of $x$ on D for any given $z$.

Interpretation: The income function has continuity.

Increasing Poverty Line Axiom:

$P(x; z) < P(x; z')$ whenever $z < z'$.

Interpretation: If the poverty line level is different for two equivalente populations, the one with the higher poverty line must also have higher poverty level.

Regressive Transfer Axiom:

$P(x; z) > P(y; z)$ whenever $x \in$ D is obtained from $y \in$ D by a regressive transfer, with at least the donor being poor.

Interpretation: A disequalizing transfer in which someone cross the poverty line should increase the poverty value.

Weak Transfer Sensitivity Axiom:

$P(x; z) > P(x'; z)$ whenever $x$ and $x' \in$ D are obtained from $y \in$ D by transferring income $\delta > 0$ from poor income $y_i$ to $y_j$ and from poor incomes $y_k$ to $y_l$ respectively with $y_j - y_i = y_l - y_k > \delta$, $y_k > y_i$ with no one crossing the poverty line after the transfers.

Interpretation: *Ceteris paribus*, the poverty measure is supposed to give further importance to transfers in the bottom of the income distribution.

Subgroup Consistency Axiom:

$P(x; z) < P(y; z)$ whenever $x = (x', x'') \in$ D is obtained from $y = (y', y'') \in$ D with $n(x') = n(x'')$, $n(y') = n(y'')$ and $P(x'; z) < P(y'; z)$, $P(x''; z) = P(y''; z)$.

Interpretation: *Ceteris paribus*, the poverty measure is consistent with a change in a subgroup's poverty level.

As a final note on this axiomatic, we shall emphasize that the attractiveness of the core axioms is not based on the implication of each axiom isolatedly - as they should not be assessed separately - but based upon their interactions and, therefore, when taken together, their independence and their consistency with the perception of poverty.

Concerning now the types of indices, especially on the perspective given by Laderchi *et al.* (2003), other important issues about the definition and the measurement of monetary poverty shall be considered.

The first is about the choice between consumption and income as the welfare indicator. As Coudouel *et al.* (2002) state, researchers generally take as conclusion that consumption is a better welfare indicator than income for three main reasons: consumption is a better result indicator; its measurement may be more precise than income; it illustrates more accurately the capability to achieve basic needs. Meyer and Sullivan (2003) also argue in favor of consumption as a better indicator because it measures well-being in a better way than income, especially for low resources families. Slenick (1993) and Cutler and Katz (1991) argue that consumption captures permanent income. Meyer and Sullivan (2006:9) point that «income measures fail to capture disparities in consumption that result from differences across families in the accumulation of assets or access to credit. Also, consumption reflects the insurance value of government programs, better accommodates illegal activity and price changes, and is more likely to reflect private and government transfers». Income measures have also some advantages. As Meyer and Sullivan (2003) claim, in practice, the surveys using income measures are larger than those using consumption, because consumption data are much more costly to collect.

However, the major weaknesses of both consumption and income are that they don't consider social income (or public goods as schools, security, health services). In Thorbecke (2008:4) words, «the drawback of the income approach is that some (non-monetary) attributes cannot be purchased because markets do not exist, for example, with some public goods». He also arguments that nothing assures that individuals with an income above a monetary poverty line will allocate resources «so as to purchase the minimum basic need bundle». For instance, the household head can buy more alcohol products and less food. Duclos and Araar (2006:5) point out the use of money or consumption as proxies for utility in order to solve a problem of utility and well-being measures in what they call "welfarist approach" to poverty. In this context, they name some weaknesses of this choice. First, «Economic theory tells us little about how to use consumption or income to make consistent interpersonal comparisons of well-being. Besides, the consumption and income proxies are really able to take full account of the role for well-

being of public goods and non-market commodities, such as safety, liberty, peace, health» (ibidem).

Secondly, the choice of a poverty line may rely over an absolute poverty line, a relative or a hybrid one (Madden, 2000). An absolute poverty line can be defined as that monetary value that is changed (by some inflation index) along the time in order to maintain the purchasing power, for instance that permits to buy a minimum basket of goods previously determined by the researcher. For instance, the World Bank uses an absolute line set at US$1.08 in 1993 purchasing power parity terms. A relative poverty line is a value fixed relative to some characteristic of income (consumption) distribution. For instance, in European Union, the poverty line is settled as a household income below 60% of the median household income. Absolute poverty lines are used, predominantly, in less developed countries. On the other hand, relative poverty lines are more typical in highly developed countries. A relative approach «recognizes the social nature of economic derivation and provides a way to keep the poverty line up to date with overall economic changes in a society. Compared with absolute poverty lines, relative poverty lines (...) are easy to understand, easy to calculate and easy to update; they avoid the difficulty of periodic reassessments needed for absolute poverty lines. Besides, poverty lines determined by an absolute approach such as 'expert budgets' also contain large elements of relativity» (Zheng, 2001:337). The definition of an absolute poverty line has some problems: first, it is not an easy task to define which goods and services are essential, given that essential is not an absolute concept, it varies according to regions and cultures, for instance «Comparisons among regions and through time require adjustments and compensations for inflation and changes in quality of consumed goods, and the construction of parity standards of purchasing power». (Schwartzman, 1998:5)

However, this relativity is not exclusive of absolute poverty lines. As Schwartzman states (1998:6), in relative poverty lines, «different and more or less arbitrary poverty thresholds can be defined - persons earning below a given percentage of the national or regional income, or placed at a given distance below the national average». Why to choose 60% of the median income, as EU adopt and not 40% or 50%? So, the choices about a poverty line, relative or absolute, always involve arbitrary decisions.

However, it is important to assert that, whatever way we choose to discriminate poor and non-poor, major difficulties rely on the fact that «poverty in itself is *not* an economic category» (Laderchi *et al.*, 2003:13), what makes a hard work to find a

theoretically consistent poverty line. Finally, this approach neglects social interactions between individuals, and any interrelation is considered only from equivalence scales. So, following Laderchi *et al.* (2003) we may state that (a) this approach is *objective*, (b) the assessment of poverty is *external* (without participation of the poor people) and (c) it corresponds to an *individualistic* perspective of poverty.

In this approach, we can find the most popular poverty measures in literature:

a) **Headcount Ratio**

$$H(Y, Z) = q/N \tag{7}$$

where $Y$ is income, $Z>0$ is the poverty line, $N$ the number of individuals in the population and $q$ the number of poor.

This measure has the following advantages: it is very popular, simple to calculate and easy to understand. However, the headcount ratio fails to consider discrepancies in welfare amid differently poor individuals, not taking into account severity or depth of poverty. For instance, it does not matter that all poor have an income just below poverty line or if they all have an almost null income.

b) **Income Gap**

$$I(Y,z) = \frac{\sum_{i=1}^{q} Z - Y_i}{qZ} \tag{8}$$

where $Z - Y_i$ is the poverty gap for individual $i$. The Poverty Gap Ratio can be used for evaluating the potential fiscal cost for eliminating poverty by transfers to the poor. Summing all the poverty gaps in the population and taking the average provides an estimate of what would be the minimum cost of eliminating poverty in the society, assuming perfect targeting. A shortfall of the poverty gap measure is that it may not adequately capture differences in the severity of poverty. If we want to understand the impact of policies over the poor, it is interesting to analyze if the poorest performs better after the policy.

c) **Sen`s Poverty Index**

$$Sen(Y,Z) = H(y,Z)\{1-[1-I(Y,Z)][1-G_p \frac{q}{(q+1)}]\}, \quad (9)$$

with $G_p$ being the Gini index among the income of the poor individuals.

d) **Foster-Greer-Thorbecke Indices**

The Foster-Greer-Thorbecke (FGT) measurement (Foster *et al.* 1984) combines the Headcount ratio, the Total Poverty Gap and the inequality among the poor. It became very popular in the literature and amid many institutional organizations, being defined by

$$FGT_{\alpha}(y;z) = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{(z-y_i)}{z}\right)^{\alpha}. \quad (10)$$

This measure can be materialized for a specific $\alpha$, a parameter of poverty aversion, *i.e.*, a largest value for $\alpha$ gives a greater weight to the poorest poor; $y$ stands for the household income, $z>0$ is a predetermined poverty line, $n$ is the total number of households and $q$ is the number of (poor) households not having income greater than $z$. The expression $z$-$y_i$ is the income shortfall of the $i$-th household. The FGT takes the weights to be these shortfalls and considers deprivation as depending on the difference between the poverty line and the income of the (poor) household[20].

The axioms of Monotonic Welfare[21] and Relative Equity[22], as well as the Monotonicity Axiom and the Transfer Axiom, as defined by Sen[23] (1976, 1979), are satisfied by this

[20] Interesting applications of the FGT (with $\alpha$ = 0, 1, 2) for the Portuguese case may be found at Rodrigues (1999), Rodrigues (2001), Alves (2009), Rodrigues (2009), and Bastos et al. (2010) for the child poverty.

[21] Monotonic welfare axiom: «The relation > (greater than) defined on the set of individual welfare numbers $\{W_i(\underline{y})\}$ for any income configuration $\underline{y}$ is a strict complete ordering, and the relation > defined on the corresponding set of individual incomes $\{\underline{y}_i\}$ is a sub-relation of theformer, i.e., for any i, j: if $\underline{y}_i > \underline{y}_j$, then $W_i(\underline{y}) > W_j(\underline{y})$».

[22] Relative equity axiom: «For any pair $i, j$: if $W_i(\underline{y}) < W_j(\underline{y})$, then $v_i(z, y) > v_j(z, \underline{y})$», which means that the less the welfare of a household the greater the weight assigned to that household.

measure. Depending on the value of $\alpha$, the index captures different features of poverty, taking concrete interpretations for several values of $\alpha \geq 0$: For $\alpha=0$ it corresponds to the headcount ratio $H(Y, Z)$; for $\alpha=1$ it becomes an Income Gap measure and it can be written as $H(Y, Z) \cdot I(Y, Z)$, *i.e.*, the headcount ratio times the income gap ratio, taking into account how individual incomes are far from the poverty line; for $\alpha=2$ the FGT index is useful to understand the problem of the impact of policies over the poor, when it may be useful to analyze if the poorest performs better after the policy.

e) **Watts Index**

The Watts Index is defined as:

$$W(Y,Z) = \frac{1}{N} \sum_{i=1}^{q} \log(\frac{Z}{Y_i}) \tag{11}$$

The Watts index is attractive in that it satisfies the following axioms: *focus* (the measure of poverty do not vary with non-poor incomes); *monotonicity* (income gains of poor reduce poverty); *transfer* (income transfers to less poor persons increase poverty).

The judgment over the quality of these indices is generally done through an axiomatic approach. Regarding this fact, Silber (2007) points out that the Watts index has some interesting properties that Sen and FGT indices do not have. Specifically, it satisfies the axioms of *continuity* (the poverty index is a continuous function of individual incomes), *replication invariance* (the index does not change if it is computed based on an income distribution), and *weak transfer sensitivity* (the measure gives more emphasis to transfers taking place lower down in the distribution, other things being equal), the latter being satisfied by FGT indices only for $\alpha>2$ (Zheng, 1997). Basically, all these indices suffer from the same original sin problems: they consider only one dimension, income or consumption. As so, they are targets of all the criticism that affect indices of the monetary approach[24].

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[23] Monotonicity Axiom: «Given other things, a reduction in income of a person below the poverty line must increase the poverty measure». Transfer Axiom: «Given other things, a pure transfer of income from a person below the poverty line to anyone who is richer must increase the poverty measure».

[24] It is consensual, nowadays, within academia, that the human needs must be described through a multidimensional set, even when considering that its content is not consensual (shortage perceptions, deprivations, physical damages, among others contents). We will discuss this topic in the next chapter.

## 2.4 A subjective index of relative deprivation

Desai and Shah (1988) presented a concrete realization of the relative notion of poverty proposed by Peter Townsend (1962, 1979, and 1985). They suggested a technique for identifying and measuring poverty, basing their measure of poverty on the distance between the individual's consumption experiences (in terms of events) to the norm (the modal frequency of an event). The result was a subjective index of relative deprivation, technically attuned by Muffels and Vriens (1991), namely by the specification of the distance function (relative deprivation) and the use of principal component analysis in the creation of the index as a combination of partial indicators. This index is remarkably summarized by Pereirinha (1996), whose work brings about a clearer rationale for the index. The deprivation index, $D_j$, is defined as

$$D_j = \frac{1}{I}\sum_{i=1}^{I} \rho^R{}_{ij}\,\xi^R{}_{ij}\,\delta^R{}_{ij} \tag{12}$$

where the number of consumption events range from 1 to $I$, and the 3 functions on the following sum function are respectively the weighting factor (deprivation feeling), the subjective need function (measure of subjective evaluation), and the distance function (relative objective deprivation) related to the event $i$ for individual $j$ who belongs to the reference group $R$.

On one hand, this index has the advantage of showing the possibility of establishing a poverty line using a relative approach, where information about deprivation feeling and subjective and objective measures of deprivation is incorporated in order to construct an index, and permitting to contextualize the deprivation measure within a reference group. It would also be possible to use this index as a point of departure for a more comprehensive concept of poverty, rather than centered on a monetary or consumption-based concept, especially if it would include variables with a more relational penchant variables.

On the other hand, this index is fully fitted to the critique over the relative and subjective approaches describeb in the previous chapter.

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Further discussion can be found at Doyal and Gough (1991), Young Foundation (2006) and TESE (2009), with a particular focus on the Portuguese case in the latter.

## *2.5 Multidimensional poverty indices*

### 2.5.1. Capabilities and Social Exclusion Approaches

In this Sub-Section, we will describe two important approaches that try to overcome the problems of the monetary approach: The capability and the social exclusion approaches. The capability approach was firstly proposed by Amartya Sen (1983, 1985b, 1985c, 1993, 1999, 2004), who criticizes the monetary approach and proposes a different way of understanding poverty. Within this approach, poverty is seen as a complex phenomenon, unlike within monetary approach. Therefore, in this subsection we will present the main characteristics of capability approach. The social exclusion approach also proposes a more broad view of poverty and has its origins in the European Union, in the 1980s. So, after presenting the main characteristics of social exclusion and capabilities approaches, we will present the poverty indices that can be computed with elements of both approaches. The presentation of the indices are made together since it is difficult to link a particular poverty indicator with just one approach, because both approaches are multidimensional and, in empirical work, have similarities in terms of calculated indices.

#### 2.5.1.1 Capabilities

This approach is proponed initially by Sen and focuses on indicators of freedom to live a valued life. According to Alkire, the capability approach is defined as «a normative framework for assessing alternative policies or states of affairs or options – whether in welfare economics, development, or poverty reduction» (2008, p. 90). In this approach, monetary resources may not be a good indicator of capabilities outcomes because different individuals transform these capabilities into valuable achievements (*functionings*) in different ways. (Laderchi *et al.*, 2003:14). The monetary resources are tools for the achievement of well-being, but they are not the only ones. In this approach, public goods and the personal characteristics of people that permit an individual choice within capability set in order to obtain some *functionings* are considered. As Thorbecke (2008:5) states, «the concept of capability presumes that individuals are well enough endowed that they have the freedom to choose an appropriate non-poor functioning».

Duclos and Araar (2006:8) provide an example that clarifies the distinction between capability and functioning, comparing the use of monetary income or consumption in the monetary approach: «Income shows the capability to consume, and "consume

functioning" can be understood as the outcome of the exercise of that capability. There is consumption only if a person chooses to enact his capacity to consume a given income (...) in the capability approach, poverty arises from the lack of incomes and capabilities, which are imperfectly related to the functionings actually achieved».

The capability approach is very difficult to be put in practice and several difficult choices are needed. The first concerns defining basic capabilities. There is not a consensus about which ones are the basic capabilities; there is only consensus around some criterion that should be incorporated (health, nutrition and education indicators). However, Alkire (2008) argues that this difficulty arises from the fact that researchers, frequently, do not explain the criteria used to choose some particular dimension of capability in their researches. Sen (2004, p. 77) advocates for a more flexible way of choosing dimensions in capability approach, arguing that "the problem is not with listing important capabilities, but with insisting on one predetermined canonical list of capabilities, chosen by theorists without any general social discussion or public reasoning". On the other hand, Nussbaum (2000), for instance, argues in favor of more fixed list, and proposes herself a list of Central Human Capabilities (life, bodily health, bodily integrity, senses, thought, imagination, emotions, practical reason, control over one's environment, other species, affiliation).[25] In practice, researchers end measuring *functionings* (life expectancy and nutrition level, for instance), not capabilities. The second issue raised by Laderchi *et al.* (2003:18) is the measurement of capabilities: «the crucial issue is, of course, that capabilities represent a set of potential outcomes and as such are problematic to identify empirically». Alkire (2008) discuss how researchers select capabilities dimensions and points out that data availability should be considered as a criterion, but not the only one in choosing the relevant dimensions in empirical work.

In this approach, defining the poverty line is not an easy task because it involves defining a poverty line for each capability dimension. For example, the Human Poverty Index (HPI) developed by the UNDP, an index inspired in the capability approach, establishes the following poverty cut-off points for developed countries: life expectancy below 60, lack of functional literacy among adults, long term unemployment rate and population below an income poverty line of 50% of median disposable household income. Unfortunately, these choices are arbitrary. Other attempts, like the one at

[25] For a more detailed discussion over the issue of a fixed or flexible list of capabilities, see Alkire (2002) and Robeyns (2005). For authors proposing another list of capabilities, see Alkire (2008)

Callander et al. (2012) try to list how a Freedom Poverty Measure should be built - in this case using income, health and education variables – but not specifying what variables nor quantifying how the variables should be incorporated in the measure.

Aggregation issues are very important in this approach, as in every approach that considers multidimensionality. Silber (2007) describes some strategies in order to aggregate different dimensions. These include, for instance, the use of factor analysis, fuzzy sets applications and simple weighted averages.

### 2.5.1.2 Social exclusion

Pereirinha (1996:210-213) distinguishes social exclusion from poverty essentially by 3 aspects. First of all, poverty is more related with distributional aspects, while social exclusion is more related to relational aspects. Secondly, the concepts of poverty and deprivation are more used in a static dimension, while the concept of social exclusion is more frequently used in a dynamic dimension. Finally, in the concept of poverty is highlighted the terms of living standards, while in the social exclusion concept is highlighted the right for a minimum level of resources.

As Laderchi *et al.* (2003) state, the European Union defines social exclusion as a «process through which individuals or groups are wholly or partially excluded from full participation in the society in which they live». It can be understood as the situation in which a person cannot participate in normal activities of citizens in a society (Burchardt and Le Grand, 1999).

We can identify three main characteristics of social exclusion. The first is *relativity*, because some group is excluded from a particular society. The second element is *agency*, *i.e.*, people are excluded as a result of some action. For instance, Stern, Dethier and Rogers (2005, p. 104) say that individuals «may be excluded from work by the *actions* of other workers, unions, employers, or government». The third element of social exclusion is *dynamics*, meaning that future prospects - including children's - are very important in determining this condition. Room (1999) analyses social exclusion as a reconfiguration in the concept of poverty in the 1990s. He points out five elements in this reconfiguration: «from financial to multi-dimensional disadvantage; from static to dynamic analysis; from a focus on the resources of the individual or household to a concern also with those of the local community; from distributional to relational dimensions of stratification and disadvantage; from a continuum of inequality to catastrophic rupture» (Room, 1999:2).

The main advantage of this approach is that it emphasizes the dynamic nature of poverty, emphasizing the process through which the individuals become poor. Here, multidimensionality is also a central question and indicators includes dimensions like unemployment, access to housing, democratic rights and social contacts (Laderchi *et al.*, 2003). As a context specific approach, social exclusion has to identify in each context what is a "normal" activity before identifying exclusion from that activity. Another aspect of social exclusion is that it focuses on distributional issues, where the situation of the excluded can improve only if some redistribution of opportunity and outcomes takes place, what is not a forecast of monetary and capability approaches. One weakness of this approach relies on the vagueness of the "social exclusion" concept. As Micklewright (2002:3) states, «exclusion is a concept that defies clear definition and measurement». Consequently, in applied works many different dimensions and norms are used and there are no criteria that classify one choice as better than other.

### 2.5.1.3 Capability and Social Exclusion Poverty Indices

As mentioned before, it is very difficult, in the environment of an empirical work, to truly identify the capabilities that determine poverty. Even more difficult is to determine the poverty line for each dimension. Actually, nearly all works end measuring functionings. In practice, multidimensional poverty indices try to encompass the will that is present in the capabilities or social exclusion approaches, depending on the dimensions that are incorporated in the analysis. As an example, there is the HPI-2 proposed by the UNDP in 1998. The objective for this index is to capture the multidimensionality of poverty through a single compound measure. HPI-2 gives equal weight to four measures of deprivation, chosen to represent four dimensions of life: *income* (proportion of the population living below 50% of national median income); *life expectation* (proportion of the population not expected to live to age 60); *education* (proportion of the 16-65 years old population functionally illiterate); *social inclusion* (proportion of long-term unemployed individuals in the labor force). Thus, HPI-2 combines variables of capabilities and social exclusion, aggregating those dimensions through a simple average of the four indicators considered.

Another example of trying to capture simultaneously aspects of poverty and social exclusion is the set of indicators known as *The Laeken Indicators*, established at the European Council of December 2001. This set of indicators, developed as part of the Lisbon Strategy of the European Union, consist of a basket of indicators classified in

three categories: «Primary indicators would consist of a restricted number of lead indicators which cover the broad fields that have been considered the most important elements in leading to social exclusion; Secondary indicators would support these lead indicators and describe other dimensions of the problem. (...) There may also be a third level of indicators that Member States themselves decide to include in their National Action Plans on Social Inclusion, to highlight specificities in particular areas, and to help interpret the primary and secondary indicators» (European Union, 2001:3). The Laeken indicators are as follows[26]:

- Primary Indicators: At-risk-of-poverty rate, Inequality of income distribution S80/S20 quintile share ratio, At-persistent-risk-of-poverty rate by gender (60% median), Relative at-risk-of-poverty gap, Regional cohesion (dispersion of regional employment rates, Long term unemployment rate, Persons living in jobless households, Early school leavers not in education or training, Life expectancy at birth, Self defined health status by income level);
- Secondary Indicators: Dispersion around the at-risk-of-poverty threshold, At-risk-of-poverty rate anchored at a moment in time, At-risk-of-poverty rate before social transfers by gender, Inequality of income distribution (Gini coefficient), At-persistent-risk-of-poverty rate by gender (50% median), Long term unemployment share, Very long term unemployment rate, Persons with low educational attainment.

So, as we can see from above, the indicators cover four dimensions of social inclusion: financial poverty, health, education and employment.

As The European Union (2001) has noted, there is not a consensus around the methodology that should be implemented to aggregate these different indicators into a single one. Silber (2007) proposes an interesting systematization to understand the multidimensional case of poverty measurement. There are basically three alternatives to construct multidimensional poverty indices:

a) First to aggregate poverty dimensions into a unique indicator, then to define a poverty line for this indicator and to compute its value;

b) First to define a poverty line for each dimension, then to aggregate the dimensions for each individual and then to aggregate the individuals;

[26] For a detailed description of each indicator, see European Union (2001) and European Commission (2003).

c) First to define a poverty line for each dimension, then to aggregate the individuals and then to aggregate the dimensions.

Silber (2007) points out that strategy (a) encompasses a series of techniques in order to aggregate different dimensions. Using traditional multivariate data analysis, we can name, for instance, Klasen (2000), where the Principal Component Analysis[27] is applied. The weakness of this strategy is that it does not have a model supporting the results. There are some alternatives that overcome this weakness, such as Factorial Analysis (Lelli, 2001), MIMIC Model (Kuklys, 2005), and Structural Equations Model (Waglé, 2005). Another interesting technique leading with multidimensional poverty is the Information Theory (Deutsch and Silber, 2005).

Despite all the advantages of these techniques, any of them present an authentic multidimensional poverty index, once that they just aggregate different dimensions into a singe measure. This disadvantage leads us to discuss strategies (b) and (c).

In the case where we first identify a poverty line for each poverty dimension, then aggregate dimensions and after that we aggregate individuals, the most prominent strategy is the axiomatic framework to multidimensional poverty proposed by Chakravarty *et al.* (1998), Bourguignon and Chakravarty (2003) and Tsui (2002). These authors propose a generalization of the FGT index, while Chakravarty and Silber (2008) have derived a multidimensional generalization of the Watts index.

Finally, there are some indices that first define poverty lines for each dimension, second aggregate individuals and then aggregate dimensions, as it constitutes an example the fuzzy set family of approaches to multidimensional poverty measurement. Applying Fuzzy Set Theory for multidimensional poverty is an adequate strategy since an individual can be entirely or partially poor according to some criteria and simultaneously non-poor by other criteria (Silber, 2007). Among this family we can find the Totally Fuzzy Approach (TFA) (Cerioli and Zani, 1990), the TFR (Cheli and Lemmi, 1995) and that of Dagum and Costa (2004). The literature on this family of approaches has been growing in last years and the main challenge of the different papers is to justify the weighting of the dimensions.

[27] The Principal Component Analysis is a vector space transform used to reduce multidimensional data sets to lower dimensions for analysis.

## 2.5.2 Vulnerability indices

The vulnerability approach is concerned not only with the situation of individuals at the present time, but how this situation affects the well-being of the individual in the future. As Christiaensen and Boisvert (2000) state, «vulnerability is about having a high probability of suffering future shortfall». Chaudhuri *et al.* (2002:4) define vulnerability «within the framework of poverty eradication, as the ex-ante risk that a household will, if currently non-poor, fall below the poverty line, or if currently poor, will remain in poverty».

In this approach, the concept of *uncertainty* is crucial. Calvo and Dercon (2008:216) criticize the traditional poverty approaches that ignore uncertainty. They define vulnerability as the «*threat of poverty*, measured *ex-ante*, before the veil of uncertainty has been lifted». The authors argue that a poor family - according to traditional poverty measures - can choose be in poverty, because they can trade-off income for risk. So, they accept to earn less income, but to have a less risky income profile over time, a situation defined by Wood (2003) as the 'Faustian bargain'. Calvo and Dercon (2008) propose some vulnerability measures and discuss if they respect some reasonable axioms. Others authors try to measure vulnerability, as Suryahadi and Sumarto (2003), who postulate that a vulnerable individual is not sufficiently above the poverty line to feel safe and discard the risk of poverty. Elbers and Gunning (2003:2) show that «a household can be chronically poor because its response to risk lowers consumption permanently». Vulnerability is understood as the likelihood to isolate well-being from income shocks (World Bank 2001, p. 139; Amin, Rai and Topa 2003, p. 60) or in terms of exposure to adverse shocks to welfare (Cunningham and Maloney, 2000). These two last visions of vulnerability have some implications to poverty measurement, diverging from the proposed by Chaudhuri *et al.* (2002). According to this author, «our definition would include among the vulnerable, households who are currently poor and have a high probability of remaining poor even if they do not experience any large adverse welfare shocks. On the other hand, our definition would exclude those households among the non-poor who face a high probability of a large adverse shock but are currently well-off enough so that even were they to experience the shock, they would still remain non-poor» (Chaudhuri *et al.*, 2002:4).

Following Calvo and Dercon (2008), suppose a world where future outcomes differ across $m$ states of the world. Each state $i$ is characterized by an outcome level $y_i$ and a

probability $p_i$. Within this framework, Calvo and Dercon (2008) propose the following vulnerability measure.

$$V^* = V(z, p, y) \tag{13}$$

where $z$ is a poverty line, $p$ is a vector of probabilities associated with different states and $y$ is a vector containing every $y_i$ outcome levels. Applying a specific function $V$ of individual vulnerability, they propose:

$$V_{(\alpha)} \equiv 1 - E[x^{\alpha}], \qquad 0 < \alpha < 1 \tag{14}$$

where $x_i = \min(z, y_i)/z$ is the rate of coverage of basic needs.

Chaudhuri (2003) propose a conceptualization of vulnerability to poverty in terms of expected poverty. Therefore, he defines a poverty index for a household $h$ at time $t$ as:

$$p_{ht} = \frac{u(z) - u(c_{ht})}{|u(z)|} \tag{15}$$

where $z$ is a poverty line, $c_{ht}$ is the consumption level of household $h$ at time $t$ and $u$ *(.)* is an increasing function. Following Chaudhuri (2003), if u (.) takes the form:

$$u(c) = z^{\alpha} - (\max\{0, z - c\})^{\alpha} \tag{16}$$

and α is an integer value, the poverty index reduces to the FGT family of poverty measures.

Ligon e Schechter (2003:C99) proposes a different functional form for function *u (c),* a constant relative risk aversion utility function (CRRA*)* «the utility function most often used in the empirical literature concerned with behaviour under risk»:

$$u(c) = \frac{c^{1-\rho}}{1-\rho}, \quad \rho > 0 \tag{17}$$

where $c$ is the consumption level and $1/\rho$ is the intertemporal substitution elasticity between consumption in any two periods; *i.e.*, it measures the willingness to substitute consumption between different periods. Note also that $\rho$ is the coefficient of relative risk aversion. So, as $\rho$ increases, the utility function becomes increasingly sensitive to both risk and inequality.

The Amin *et al.* (2003:65) measure of vulnerability is based on a risk-sharing test. According to the authors: «a key feature of efficient risk sharing within the village is that changes in log marginal utility of consumption must be equated across households at each date and state.» They assume that households have a constant absolute risk aversion (CARA) utility function. Denoting $c_{h,t}$ for consumption for household $h$ at time $t$, $n_{h,t}$ for the (age–sex adjusted) number of male adult equivalents in the household at time $t$, $\zeta_{h,t}$ for a preference shock and $\sigma$ for the coefficient of absolute risk aversion, according to the authors, to get efficient risk sharing implies the following condition for household $h$:

$$\Delta\left(\frac{c_{h,t}}{n_{h,t}}\right) = -\frac{1}{\sigma}\kappa_t - \frac{1}{\sigma}\Delta \ln \xi_{h,t} \tag{18}$$

where $\kappa_t$ is the first difference in logarithms of the appropriately discounted multiplier associated with the aggregate resource constraint. Amin *et al.* (2003:65) argues that, under some hypothesis over preferences shocks, «changes in per-adult-equivalent consumption over time should comove across households. Household consumption should only be affected by aggregate fluctuations in the village, and not by idiosyncratic shocks to the household's own income or resources. Our estimation strategy focuses on identifying individual households within each village that are vulnerable to idiosyncratic risk».

One operational problem of every measure in this approach is that some indices rely on the definition of probability for different future states, what in practice is difficult to ascertain. Chaudhuri *et al.* (2002:5) point out that it is more difficult to assess

vulnerability than to measure poverty: «While the poverty status of a household is concurrently observable - *i.e.*, with the right data we can make statements about whether or not a household is *currently* poor - the level of vulnerability is not. We can *estimate* or *make inferences* about whether a household is *currently* vulnerable to future poverty, but we can never directly observe a household's current vulnerability level».

Another difficulty with the implementation of practical measures of vulnerability is that, although the authors recognize that vulnerability should be a multidimensional concept, data restrictions lead some authors, as Chaudhuri *et al.* (2002), to implement vulnerability to poverty focusing in only one dimension, generally consumption expenditure. This strategy makes the approach targeted by the same criticism argued against the monetary approach.

### 2.5.3. Participatory methods

The distinguished feature of this approach is the *internality*, *i.e.*, the approach takes into account the potential poor people's opinion about poverty and its magnitude. Norton *et al.* (2001:6) define Participatory Poverty Assessment (PPA) as «an instrument for including poor people's views in the analysis of poverty and the formulation of strategies to reduce it through public policy». In this approach, different tools can be used depending on the context (social mapping, livelihood analysis, semi-structured interviews), an advantage in relation to other approaches. A problem that Laderchi *et al.* (2003) points out with this method is that although people themselves implement the method, analysis is conducted by external researchers that could be biased highlighting certain aspects of answers.

Another problem is that participatory methods can mask the heterogeneity in a community and the different behavior of communities and groups along the research. For instance, the less powerful group can be afraid of talk about their opinion regarding some issue. Finally, because in general we have small samples, it is difficult to implement statistical inference techniques. On the other hand, Participatory Approaches permit identifying dimensions of poverty that researches generally neglects. Booth (1998 apud Chambers, 2008:143), among others, highlights some issues that emerges in this approach: «a sense of isolation, from services, markets, government institutions and information, with physical isolation as a key factor; security of life and livelihood as a primary concern, intra-household poverty dynamics». He also highlights other positive features of this approach: questions concerning gender relations, violence and insecurity

can be incorporated in the analysis, as well as other aspects that external researchers do not have *a priori* knowledge.

### 2.5.4 Totally fuzzy and relative approach and Dagum and Costa

Following D'Ambrosio *et al.* (2009) we will give some insight of Fuzzy Set Theory and points out its importance to multidimensional poverty measures. Let there be a set X and let $x$ be any element of X. A fuzzy set or subset A of X is characterized by a membership function $\mu A(x)$ that will link any point of X with a real number in the interval [0,1]. If A is a fuzzy subset, $\mu A(x) = 0$ if the element x does not belong to A and that $\mu A(x) = 1$ if x completely belongs to A. But if $0 < \mu A(x) < 1$, $x$ belongs only partially to A and the value of $\mu A(x)$ denotes the degree of membership of $x$ to subset A.

So, the idea of fuzzy set is directly applied to poverty studies, where there is difficult to set who is poor and who is not in a dichotomous way. So, incorporating fuzzy set theory into poverty analysis permits to overcome this difficult. As stated by D'Ambrosio *et al.*, «this is especially true when one takes a multidimensional approach to poverty measurement, because according to some criteria one would certainly define her as poor whereas according to others one should not regard her as poor» (2005:4).

So, here we will present two poverty measures that apply fuzzy set theory to poverty measure in a multidimensional approach.

#### 2.5.4.1 Totally fuzzy and relative approach

The TFR Approach proposed by Cheli and Lemmi (1995) define a particular membership function for each attribute $j$. To present this approach, we strongly rely here in Deutsch and Silber (2005): «Let $\Xi_j$ represent the subset of individual (households) who are deprived with respect to indicator $j$ with $j = 1, \ldots, k$. Let $\xi_j$ be the set of dichotomous, polytomous or continuous variables $\xi_{1j}, \ldots, \xi_{nj}$ which measure the state of deprivation of the $n$ individuals with respect to indicator $j$ and let $F_j$ be the cumulative distribution of this variable». If the degree of membership increases with the value taken by the variable $\xi_j$, we define the membership function as:

$$\mu_{\Xi j}(i) = F_j(\xi_{ij}) \tag{19}$$

According to Chelli and Lemmi (1995), this approach is «less arbitrary» than the TFA originally proposed by Cerioli and Zani (1990) - especially for polytomous and continuous variables – as it has a connection to the empirical evidence. Moreover, on the theoretical level, the TFR approach has the advantage of being completely consistent with a relative conception of poverty (the one which is taken in most developed countries), according to which one is usually poor with respect to some other individuals. These authors have, however, stressed that when the risk of poverty is very low, that is, a high proportion of individuals will not be considered as poor, the value taken by the indicator of poverty may be too high for those who turn out not to be poor. They therefore proposed the following solution.

Let $\xi_{j\,(m)}$, with $m = 1, \ldots, s$, refer to the various values, ordered by increasing risk of poverty, which the variable $\xi_j$ may take. Thus $\xi_{j(1)}$ represents the lowest risk of poverty and $Y_{j(s)}$ the highest risk of poverty associated with the deprivation indicator $j$. The authors propose then to define the degree of poverty of individual (household) $i$ as

$$\mu_{\Xi j}(i) = 0 \cdots if \cdots \xi_{ij} = \xi_{j(1)} \tag{20}$$

and

$$\mu_{\Xi j}(i) = \mu_{A\Xi}(\xi_{j(m-1)}) + \frac{F_j(\xi_{j(m)}) - F_j(\xi_{j(m-1)})}{1 - (F_j(\xi_{j(1)})} \cdots if \cdots \xi_{ij} = \xi_{j(m)}, m > 1 \tag{21}$$

where $\mu_{\Xi j}\ (\xi_{j(m-1)})$ denotes the membership function of an individual for which the variable $\xi_j$ takes the value m and $F_j$ is the distribution function of the variable $\xi_j$.

The next step in the analysis is to decide how to aggregate the various deprivation indicators. Let $\mu_{\Xi j}\ (i)$ refer as before to the value taken by the membership function for indicator $j$ and individual $i$, with $j = 1$ to $k$ and $i = 1$ to $n$. Let $w_j$ represent the weight one wishes to give to indicator $j$. The overall (over all indicators $j$) membership function $\mu_{P\ (i)}$ for individual $i$ is then be defined as

$$\mu_P(i) = \sum_{j=1}^{k} w_j \mu_{\Xi j}(i) \tag{22}$$

For the choice of the weight $w_j$, Cerioli and Zani (1990) as well as Cheli and Lemmi (1995) have proposed to define $w_j$ as:

$$w_j = \frac{\ln(1/\mu b_{\Xi j})}{\sum_{j=1}^{k} \ln(1/\mu b_{\Xi j})} = \frac{\ln(\mu b_{\Xi j})}{\sum_{j=1}^{k} \ln(\mu b_{\Xi j})} \tag{23}$$

where $\mu b_{\Xi j} = \sum_{i=1}^{n} \mu_{\Xi j}(i)/n$ represents the fuzzy proportion of poor individuals (households) according to the deprivation indicator $\xi_j$. One may observe that the weight $w_j$ is an inverse function of the average degree of deprivation in the population according to the deprivation indicator $Y_j$. Thus the lower the frequency of poverty according to a given deprivation indicator, the greater the weight this indicator will receive. The idea, for instance, is that if owning a refrigerator is much more common than owning a dryer, a greater weight should be given to the former indicator so that if an individual does not own a refrigerator, this rare occurrence will be taken much more into account in computing the overall degree of poverty than if some individual does not own a dryer, a case which is assumed to be more frequent.

Finally, the TFR Approach materializes an index by defining $P$ as the average value of the membership function. Given the computation, for each individual $i$, of the value of his membership function $\mu_{\Xi j}(i)$, that is, his "degree of belonging to the set of poor," the TFR Approach defined by Cerioli and Zani (1990) defines $P$ as

$$P = \frac{\sum_{i=1}^{n} \mu_P(i)}{n} \tag{24}$$

(Deutsch and Silber, 2005:150)

### 2.5.4.2 Dagum and Costa (2004) poverty index

We strongly rely here in the Dagum (2004) work. Let $\boldsymbol{B}$ stand for a subset of households in $\boldsymbol{A} = \{a_1, \ldots, a_i, \ldots, a_n\}$ such that, any household $\mathbf{a_i} \in \mathbf{B}$ presents some degree of poverty in at least one of the **m** attributes included in the m-order vector of attributes $\mathbf{X} = (\mathbf{X_1}, \ldots, \mathbf{X_j}, \ldots, \mathbf{X_m})$. Then, the subset **B** is a fuzzy subset of **A** and can be partitioned as follows:

$$\mathbf{B} = \{\mathbf{B}^{*}, \mathbf{B}^{**}\}, \qquad \text{s.t.,} \qquad \mathbf{B}^{*} \cup \mathbf{B}^{**} = \mathbf{B}, \qquad \mathbf{B}^{*} \cap \mathbf{B}^{**} = \varnothing \tag{25}$$

where $\mathbf{B}^{*}$ is the subset of households that are totally poor in all of the **m** attributes, and $\mathbf{B}^{**}$ the subset of households that are partially or totally poor in at least one attribute but not totally poor in all of them.

Let

$$\mathbf{x_{ij}} = \mu_{\mathbf{B}}(\mathbf{X_j}(\mathbf{a_i})), \qquad \mathbf{0} \leq \mathbf{x_{ij}} \leq \mathbf{1} \tag{26}$$

stand for the degree of membership to the fuzzy set **B** of the $i$-th household ($i = 1, \ldots, n$) with respect to the $j$-th attribute ($j = 1, \ldots, m$), such that, (i) $x_{ij} = 1$, iff the $i$-th household does not possess the j-th attribute; (ii) $x_{ij} = 0$ iff the $i$-th household entirely possesses the $j$-th attribute; and (iii) $0 < x_{ij} < 1$ iff the $i$-th household possesses the j-th attribute with an intensity belonging to the open interval (0,1).

Let $\mu_{\mathbf{B}}(\mathbf{a_i})$ stand for the poverty ratio of the i-th household, *i.e.*, the degree of membership of the $i$-th household of the fuzzy set $\boldsymbol{B}$. It is defined as the weighted average of $x_{ij}$,

$$\mu_{\mathbf{B}}(\mathbf{a_i}) = \sum_{\mathbf{j=1}}^{\mathbf{m}} \mathbf{x_{ij}} \mathbf{w_j} \Big/ \sum_{\mathbf{j=1}}^{\mathbf{m}} \mathbf{w_j}, \tag{27}$$

where $w_j$ is the weight attached to the $j$-th attribute. It follows from the definition of $x_{ij}$ in (i), (ii) and (iii) above, that,

$$0 \leq \mu_B(a_i) \leq 1, \tag{28}$$

The expression $\mu_B(a_i)$ measures the degree of poverty of the $i$-the household as a weighting function of the $m$ attributes. Hence, it measures the relative deprivation, degree of social exclusion, and insufficient capability of the $i$-th household to reach a living standard of the society to which it belongs.

The weight $w_j$ attached to the $j$-th attribute stands for the intensity of deprivation of $X_j$. It is an inverse function of the degree of deprivation of this attribute by the population of households. The smaller is the number of households and the amount of their deprivation of $X_j$, the greater the weight $w_j$. For example, if one attribute is having safe drinkable water provided by a public utility service and the other is having a car no more than five year old, certainly fewer households will be deprived of the former and they will feel more intensively this deprivation. So, in computing $\mu_B(a_i)$, more weight should be attributed to absence of drinkable water than to not having a new car.

Following Cerioli and Zani (1990:277) we adopt a weight that fulfils the above property, *i.e.*:

$$w_j = \log\left[\sum_{i=1}^{n} g(a_i) \Big/ \sum_{i=1}^{n} x_{ij} g(a_i)\right] \geq 0, \quad \sum_{i=1}^{n} x_{ij} g(a_i) > 0, \text{ and } \sum_{i=1}^{n} g(a_i) = n. \tag{29}$$

The requirement that $\sum_{i=1}^{n} x_{ij} g(a_i) > 0$ means that we do not consider an attribute $X_j$ such that $x_{ij}=0$ for all $i$. This would be an irrelevant attribute and should be excluded because there is not any deprivation in $X_j$.

If the set $A$ contains the total population of households, then $g(a_i) = 1$, and

$$w_j = \log n \Big/ \sum_{i=1}^{n} x_{ij} \geq 0. \qquad (30)$$

The weight $w_j$ is zero when $\sum_{i=1}^{n} x_{ij} = n$, *i.e.*, when the *j*-th attribute is not possessed by any of the $n$ households, hence, $x_{ij} = 1$, $i=1, ..., n$.

The fuzzy poverty index of **A** is a weighted average of $\mu_B(a_i)$,

$$\mu_B = P = \sum_{i=1}^{n} \mu_B(a_i) g(a_i) \Big/ \sum_{i=1}^{n} g(a_i) = \frac{1}{n} \sum_{i=1}^{n} \mu_B(a_i) g(a_i). \qquad (31)$$

The expression $g(a_i) \Big/ \sum_{i=1}^{n} g(a_i)$ is the relative frequency, represented by the sample observation $a_i$ in the whole population. For the particular case of a purely random sample or a census of $n$ households, the weight is constant, and $g(a_i) \Big/ \sum_{i=1}^{n} g(a_i) = 1/n$, hence,

$$\mu_B = P = \frac{1}{n} \sum_{i=1}^{n} \mu_B(a_i) \qquad (32)$$

## 2.5.5 Rasch models and multidimensional poverty measurement

Rasch (1960) suggested an approach for testing construction in psychology. Its large acceptance and success in the psychological science would make it known as "Rasch models". These models are used, particularly in psychometrics, and more recently in medical industry and market research, for examining data from behavioral variables, with the objective of getting measurements from categorical response data. It provides diagnostic information regarding how well the criterion is met, where the probability of of a specified response is modeled as a function of person and item parameters. These models, a family of latent trait models, have been studied as an alternative for economic

poverty studies (Moisio 2004, Silber 2007) and were used by Gailly and Hausman (1984), Dickes et al. (1984) and Fusco and Dickes (2006), considering poverty as a latent construct and a positive answer to an item as a deprivation. In this case, a poverty index can be estimated if the set of items retained on a theoretical ground as indicators of poverty are conformed to the Rasch model, where the estimation of the index correspond to the sum of the dichotomoud items, *i.e.*, the score calculated as the simple aggregation of responses to the items comprise an adequate statistics on the latent trait. In these terms, Fusco and Dickes (2006) applied the Rasch model to EU-SILC data from Luxembourg using 29 dichotomous items. The analysis carried out in this study allowed the not surprising conclusion that poverty is a multidimensional phenomenon. The authors also conclude that «we need a representation of different hierarchical poverty scales when trying to assess poverty on the basis of our starting list of 29 items».

The Rasch models have a particular characteristic, which is that the unweighted sum of the indicators with regard to the Rasch model postulations provides the poverty score. Nonetheless, the item parameters are estimated through conditional maximum likelihood methods, which can only be used when the number of households tends to infinity, and it is inconsistent for the individual score of deprivation.

Another feature of the model is that it is extremely restrictive on the characteristics of the items, as it imposes uniformity in the correlation between any pair of items.

## *2.6 Aggregation paths and weighting methodologies*

Different aggregation paths have been followed over the last decades. In the first decades, namely through the pioneering work in the field of resource-based poverty lines led by Rowntree (1901) and, with more accuracy and precision by Townsend (1979), basically we had the classic sum of zeros (for non-poors) and ones (for each individual considered poor) as the mainstream practice, with the headcount ratio and the income gap being the most popular indices, followed by the FGT indices since the second half of the 1980s.

Already making a bridge for the undercoming multidimensional approaches, Muffels (1991), following the work of Desai and Shah (1988), considered a different solution for the aggregation problem. Allowing the incorporation of information from several variables in each of the three functions that compose the index suggested, these

functions are, in turn, probabilistic functions. In the end, the index results in the sum of the product of the three considered functions. The conviction that people attribute more significance to the absence of some item in dimensions where the absences are not preponderant stimulated the consideration of frequency-based weights. This higher significance is reflected in higher weights, considered by Desai and Shah (ibidem) as a fair and impartial measure of the so called «subjective feelings of deprivation». Instead of setting what is more or less relevant for poverty, this approach relies exclusively on the relative deprivation as the path for solving the weighting problem, what raises some ethically arguable questions and could be a source of some instability on the results for the indices.

With the development of multidimensional poverty indices, the problem of aggregation took further steps, and multiple paths were suggested[28]. One of these steps was the employment of principal component analysis to solve the weighting problem. The use of this technique is frequently promoted to overcome worries with double counting, despite attaching lower weights to attributes with lower correlations and being difficult to understand the obtained linear combination as an index of poverty.

Motivated by a critique of paternalism on weighting schemes that apply the same weights for all individuals, an approach in which the selection of the weighting scheme is different for each individual surged with Melyn and Moesen (1991), defined as maximizing the well-being of each individual subject to some lower bounds constraints for the non-best dimensions for the individual. As the lower bounds are also seen as a paternalist intervention, Despotis (2005) proposes the same approach, but carried out by minimizing the sum of the absolute values of differences between the individual weights and the weights for the group or the society. In our view, the constraints are an arbitrary interference and, in general terms, this approach raises many difficulties for a comparison of individuals and countries.

Several popular indices, such as the HDI, implement an arbitrary weighting scheme. The simplicity of this approach can be important for its popularity, but, basically, it implies a lack of plausibility in the conceptualization of the weighting scheme.

[28] For a brilliant and complete survey on weights in multidimensional indices, with a critical view pointing out advantages and drawbacks, see Decancq and Lugo (2010). In this subchapter, a significant portion of our review relies on that paper.

An alternative for the simple arbitrariness is to take on the opinions of a large set of experts to set the weights[29]. Once again, it emerges the critique of paternalism, given that, somehow, there is an imposition of ideas from one group (of experts) to be taken as suitable for the whole society[30].

In the measure of living standards suggested by Fleurbaey and Gaulier (2009), based on Gross Domestic Product (income) data for comparisons between 24 OECD countries, some adjustments were introduced for this variable - namely for flows of income, labor, risk of unemployment, health life expectancy, household demography and inequalities – through a sort of price-based approach for setting weights. The adjustments were based on the calculation of the equivalent variation of income that would make each population indifferent between its current situation and a reference situation with respect to the non-income dimension. A critique of this approach, in a book from Sen (1997) assessing an assortment of approaches to measuring inequality, argues that the application of implicit prices (supposing that they are obtainable) is not suitable for the purpose of well-being comparisons, seeing that those were not designed to be employed in this way.

De Kruijk and Rutten (2007) solve the aggregation problem by adopting a weighting framework that is formulated directly from population preferences, using therefore a survey-based approach to weighting dimensions, that is, a household survey in which stated preference weights from randomly sampled respondents are employed as a substitute of implicit weights adopted by experts. This approach consists in asking individuals to rank dimensions, being these rankings transformed into priority weights, where, for each respondent, the weight attached to each dimension is calculated as a function of the total number of dimensions and the specific ranking of that dimension. This stated-prefeence approach was possible because the database used had questions that permitted the derivation of individual valuations. This is a quite rare characteristic within available databases, and, as more and more databases with this sort of data turn out to be more broadly accessible, it would be justifiable to use stated-preference weights as a solution for the aggregation problem.

[29] We would like to highlight the Minimum Income Standard for the UK, put into practice by the Centre for Research in Social Policy at Loughborough University, as a particularly well-designed programme of research within this alternative. This programme joins the consensual negotiation of budgets with budgets based on research evidence and expert judgements. A detailed reflection over the Minimum Income Standard and a description of its application in 10 countries can be found at Veit-Wilson (1998).

[30] «Those who wished to superimpose other judgements were dismissed as "ipsedixitists"» (Collard, 2003).

## 2.7 Motivation for a contribution

Let us imagine that our task would be that of measuring the deprivation of stature of a certain population. After defining a stature threshold, one expert could measure it as the proportion of short people, and it could be the headcount index. Another expert could measure it as the sum of differences of height between the threshold and each short person, and it could be the shortness gap ratio. We could imagine a whole story until some FGT shortness index being named in the constitution of a big country. Fortunately or not, the poverty measures's story is not only more complex, but also much more captivating.

Poverty is not as easy to measure as the shortness, as there is not only one dimension to be considered and it is difficult and expensive to measure each dimension for each person. Nevertheless, the above story would be similar to, more or less, the story of poverty measures until not many years ago. Until the 1970s, the one-dimension resource-based poverty indices were consensual, and only very recently the consensus has been definitely shifted to a multidimensional paradigm[31]. Gradually, it became usual to set a poverty line as a proportion of the median income. This methodology for setting poverty lines does not appear to allow relevant interpretations to the poverty indicator, especially in terms of absolute poverty. Since the Sen's critique (1976) over the monetary poverty indices, many contributions have been presented in the economic literature in order to suggest improvements to, and sometimes to reinvent, the poverty measures.

After the axiomatic approach developed around the monetary indices, the next step taken was driven by the aspiration from academics of avoiding, or keeping off from, the unidimensional space[32]. The capability approach did not result into new indices very quickly. Before that, the seminal work of Cerioli and Zani (1990), where a fuzzy poverty index was presented, functioned as an open window for new multidimensional poverty indices. Very important in this path was the ground-breaking work of Tsui (2002) exploring the axiomatic foundation of multidimensional poverty indices. Also the innovative work of Bourguignon and Chakravarty (2003), suggesting a poverty line for each dimension as a basis for the multidimensional measurement of poverty, was an

[31] We could say that the article by Ferreira (2011) is the hallmark of transition to the paradigm of multidimensional poverty measures.

[32] One interesting kind of exception is when the authors try to pick up valuable information from both monetary and multidimensional measurement of poverty, as in the case of Roelen et al. (2012).

original effort. However, we may not be very wrong if we state that the academic consensus in this area is limited to the acception of poverty as a multidimensional phenomenon.

Concrete steps have been taken in the last years, as the suggestion of further and specific multidimensional poverty indices. We would highlight two contributions here: Dagum and Costa (2004) and Alkire and Santos (2010). The former especially for its application of deprivation weights, the latter as being the basis for a first important bridge to the dissemination of multidimensional poverty indices outside academia and the economic literature, namely its consideration and application by the UNDP (2010).

These indices are yet far from being consensual, especially when the topic is aggregation. Sen (1979) separates the measurement of poverty into two different issues: identification and aggregation. This straightforward division is difficult to uphold in practical terms. The latter issue is related with the «how are the poverty characteristics of different people to be combined into an aggregate measure» issue, pointing out a solution while derivating axiomatically a poverty measure, namely through the so called axioms R (ranked relative deprivation) and A (normalized absolute deprivation) and its variations. This point states generically a few basic characteristics that any measure of poverty can be expected to verify and stands for the axiomatic approach to the measurement of multidimensional poverty.

The other approach has two categories, considering the aggregation methods applied. One category is based on aggregate indicators of welfare. In our opinion, most of the indices of this category raise noteworthy issues over the aggregation process. For instance, the indices proposed by Chakravarty et al. (1998), Tsui (2002) and Bourguignon and Chakravarty (2003) were pioneering, although involving ethically arguable and practically debatable questions, such as those involving the definition of a threshold for each dimension of poverty. Somehow this is simply applying the concept of poverty line for each dimension followed by an amalgamation of these poverty lines and respective one-dimensional gaps into an index, what turns it vulnerable for the critique over the poverty lines.

A second category, where the FST takes special importance, focus on individual data and considers the total deprivation in terms of each attribute separately, aggregating the different indices. Here we also find some arguable questions, specifically over the weighting scheme of the attributes.

All these and many other issues, including the critique after the poverty measures presented in this chapter, may take us to the following questions: Is there room for adding valuable contributions? Considering the the existing indices, are there ways in which we can improve it and do better? Our answer is positive as we find here the proper motivation for a contribution. On the one hand, monetary indices do not incorporate the multidimensionality of the poverty phenomenon; on the other hand, the multidimensional indices inspire us to upgrade the existing indices presented in the literature to an index that address more adequately, i.e., with a more suitable weighting scheme, to the question of poverty measurement.

Along the remainder of this thesis we will adopt the methodology developed by Dagum and Costa (2004), supplemented with the decomposition methods of Mussard and Pi Alperin (2005). The examination carried out on this chapter of poverty indices and the solutions for the aggregation problem will be important to positionate our contribution, what will be presented in the next chapter.

We consider the Dagum and Costa (2004) index a good basis to develop our ideas about the measurement of multidimensional poverty, given that its structure correspond approximately to what we think is adequate for poverty measurement. However, the weighting scheme constitutes a motivation for a contribution. Our aim is to create a weighting scheme delineated to ensure that deprivations are weighted according to the hierarchy of human needs, turning, thus, the poverty measure more adequate to the measurement of a social phenomenon.

# CHAPTER 3 – A METHODOLOGICAL CONTRIBUTION TO POVERTY MEASUREMENT

Poverty is such a complex and multidimensional phenomenon that it is not possible to present a comprehensive measurement, nor even a comprehensive set of measurements, because many fundamental dimensions of poverty, such as participation in the community, are not easily available or even quantifiable. Anyway, many authors have been trying to do their best in order to capture the finest possible approximation to the meaning of the word "poverty".

The state-of-the-art in poverty measurement consists in using fuzzy set theory in a multidimensional analysis of deprivation. Although over the last decades a lot of work has been produced concerning the measurement of poverty, with many different measures being proposed and implemented empirically, there are still some gaps that can be overcome by a new poverty index. Consequently, this idea claims for a more universal criteria in defining dimensions, in order to guarantee comparability across regions and countries in multidimensional poverty levels. The search of such universal criteria is not an easy task, but it is possible to propose stronger criteria than the existing in the poverty measurement literature.

In this chapter we propose a new measure that incorporates fuzzy logic in a multidimensional framework, but the originality here is linked with the way that we proceed to aggregate the different dimensions in order to obtain our proposed index.

## *3.1 The weighting scheme*

The conception of the poverty phenomenon as dependent on many variables is practically consensual in the recent economic literature. Many relevant variables, such as those concerned with education, health and other life conditions, are ordinal variables. Besides, in order to build a poverty index, it is crucial to formulate a weighting scheme that properly averages out the attributes of deprivation considered.

This subchapter focuses on the weighting scheme problem, where an alternative specification is proposed. Although all multidimensional indices have a specific method to aggregate dimensions, we consider that the method proposed here is more proper for measuring poverty.

Poverty fuzziness emerges logically when we consider poverty as a multidimensional observable fact. In this context, the FST has the advantage of, when compared with the traditional approach, avoiding the employment of subjective threshold values. Actually, it represents an effectual tool for analysing poverty in a multidimensional perspective. Nevertheless, in many cases, the methods proposed in the economic literature contain some arbitrariness affecting the choice of the weights through which we aggregate the information given by the diverse poverty indicators. In other methods it is considered a framework of endogenous weights (Dagum and Costa 2004, Betti et al. 2008, Peñaloza 2011). We consider it as a non-universal kind of treatment of the dimensions considered, making the structure of the index depend on the dispersion of the data and on a large concentration of households in the lower groups of deprivation attributes.

Within multidimensionality approach, we propose a fuzzy set-based indicator, where the fuzziness lies on the fact that the level of deprivation of any household is interpreted as its degree of membership in the fuzzy subset of the poor. When this membership is associated to a poverty indicator of the [0, 1] interval type, it takes distinct values in the whole range of this interval. As it uses all the information supplied by continuous variables, it takes advantage of all the useful information on its construction. Thus, we assume that, instead of saying that the household or individual is poor or not, we prefer alternatively to assert the household's degree of membership to poverty.

In various weighting schemes proposed in the economic literature, as in Filippone et al. (2001:2), «the importance of an item for the measurement of poverty should directly depend on how representative it is of the community's life style». The choice of this principle for choosing the weighting framework contains some drawbacks that affect the poverty indicator.

First, it implicitly considers that poverty is a completely relative concept. According to Sen, «attempts to make relative deprivation the *sole* basis of such specification» are «doomed to failure since there is an irreducible core of absolute deprivation in the concept of poverty» (1992:24).

Second, it makes the weighting scheme exceedingly dependent on the database. This characteristic jeopardizes the comparability of results involving diverse economies or between different studies.

Our index is drawn from a multidimensional approach to poverty measurement. According to our proposal, the importance of an item for the measurement of poverty should depend on its importance in the Maslow's hierarchy of needs. Instead of any arbitrary statistical-based scheme, this method puts more significance on what is, in point of fact, more important for human beings. Another reason for this choice is that this hierarchy permits us to operationalize a weighting scheme.

## *3.2 Human needs theories*

Sven Hamrell, Executive Director of the Dag Hammarskjöld Foundation, in the Foreword of the book "Human Scale Development" (Max-Neef, 1991), considered the nature of human needs an «unavoidably controversial» issue. Having this in mind, we will discuss 5 major theories developed in the last decades, in different fields of social sciences, more or less directly related with human needs:

- A theory of human motivation, proposed by Abraham Maslow (1943);
- ERG theory of motivation, suggested by Clayton Alderfer (1969);
- Fundamental human needs, proposed by the school of Human Scale Development in the 1980s;
- A Theory of Human Need, suggested by Len Doyal and Ian Gough (1991);
- Having, Loving, Being, examined by Erik Allardt (1993).

### 3.2.1 Maslow's theory of human motivation

Maslow (1943) formulated a holistic-dynamic, positive theory of motivation, satisfying 13 pre-established basic theoretical prepositions, in accordance with known experimental evidence, and derived directly from observation and clinical experience. According to this theory, there are five sets of basic needs - these functioning as individual purposes of action - which are ranked and related to each other. As the dominant purpose is achieved, the subsequent need comes out. As a corollary, this theory is, in broad terms, in accordance with the consumer's theory assumption that

more goods are better (here meaning that humans tend to want something all the time). Consequently, human actions are directed for the fulfillment of needs, normally (with exceptional cases) subject to a basic need hierarchy, being preconditions of the basic needs the freedom to do what one wishes so long as no harm is done to others and freedom to express one self.

At the bottom of the hierarchy, there are the physiological needs, and when these are satisfied, higher needs come out and, when these are in turn satisfied, once more still higher needs come out, and so on. The second stage stands for the safety and health needs: security; stability; dependency; protection; freedom from fear, anxiety and chaos; need for structure, order, law and limits; adequate health. A third stage stands for the belongingness and love needs: giving and receiveing affection, relations with friends and mates, a place in the group or family. The fourth stage stands for the esteem needs: self-respect (desire for strength, achievement, adequacy, competence, independence, freedom) and the esteem of others (desire for reputation, status, glory, dominance, recognition, attention, importance, appreciation). Still, if all these needs are satisfied, a fresh dissatisfaction will occur, and a fifth level stands for self-actualization: doing what the individual is fitted for, desire for fulfillment.

### 3.2.2 ERG theory of motivation

Alderfer (1969) developed an alternative theory to Maslow's theory, based on a classification of three classes of human needs: existence, relatedness and growth (ERG). Although assuming different-level needs, it does not assume a lower-level fulfillment as a precondition for the coming out of higher-level needs.

The first class of needs – existence needs – include both physiological and physical safety needs. At a second level we found the relatedness needs, which enclose interpersonal relationships, public recognition, and reputation. The third level relates to growth needs, which add in need for self-development, personal advancement and desire for achievement.

The ERG theory affirms that several needs may be simultaneously operational, and argues for a frustration-regression aspect, that is, if a higher need aggravates, the individual may revert to increase the satisfaction of a lower-level need. This theory is flexible as it identifies the needs as ranges rather than as a hierarchy.

### 3.2.3 Fundamental human needs

The school of Human Development Scale, mainly developed by Max-Neef et al. (1991) developed a theory centered on fundamental human needs. According to this theory, there is a set of human needs that are finite (more is better until an upper limit), ontological and understood as a system (interrelated and interactive). In this system, where there are 9 non-hierarchical needs: Subsistence, protection, affection, understanding, participation, leisure, creation, identity and freedom. These needs are seen as simultaneous and complementary. Each need is defined as consistent with the categories of being, having, doing and interacting. For instance, the need of leisure may correspond to (being) imaginative and calm, (having) games and parties, (creating) relaxing and having fun, and (interacting) with landscapes or intimate spaces, for example.

### 3.2.4 Doyal's and Gough's theory of human need

Doyal and Gough (1991) developed a concept of need which is grounded in both philosophy and social science. They have established an hierarchical approach, with a structure of social indicators - discarding cultural relativism and subjectivism – in which there are objective and common needs for health and autonomy, and a right to optimal fulfillment, that are applicable for all individuals. The suggested structure demonstrates what corresponds, in practice, to such an optimal fulfillment. According to their view, the needs of an individual represent the costs of being human within society, and the individuals who do not have their needs satisfied, *i.e.*, to have both personal autonomy (cognitive skills, mental health, and potential to take part in activities of the community and joint choice-making) and physical health, will not function well in community. The satisfaction of these needs is achieved through intermediate needs that can be grouped as follows:

- Nutritional food and clean water;
- Protective housing;
- A non-hazardous work environment;
- A non-hazardous physical environment;
- Appropriate health care;
- Security in childhood;

- Significant primary relationships;
- Physical security;
- Economic security;
- Appropriate education;
- Safe birth control and child-bearing.

These intermediate needs were included in this list due to their universal and positive contribution to physical health and autonomy, and are required in a standard of critical optimum levels of health and autonomy, called as *minimum optimorum*, *i.e.*, the minimal input of intermediate need-satisfaction that guarantees the optimum output of basic need satisfaction.

The theory of human need also considers how rights to need-satisfaction can be specified and delivered, and devise indicators of positive and negative rights in relation to yardsticks of what might feasibly be achieved for countries at different levels of economic development.

According to this theory, those with more internal prosperity and capabilities have more probability of avoiding poverty.

### 3.2.5 Having, loving, being

In the 1980s there was a Scandinavian model not only for the welfare state but, as well, for the welfare research (Allardt 1993, Erikson and Uusitalo 1987, Esping-Andersen 1990). Taking the Swedish Level of Living Survey of 1968 as the starting point for comparison, Allardt (1993) considers the Comparative Scandinavian Welfare Study of 1972 as more adequate framework to measure and study the living conditions and poverty in Sweden, as its system of indicators is broader and more flexible, permitting the addition of new items and measures in future studies. The largest advantage of the comparative model is its focus on the level of need satisfaction, rather than the focus on resources. The comparative model is also more adequate for the sociological study of well-being as it takes account of objective and subjective items, including having-, loving- and being- related indicators.

### 3.2.6 Critical reflection

Concerning our aim of measuring poverty within the multidimensional approach, we consider that the Maslow's theory of human motivation is more adequate to undergo theoretically our operational choices. First of all, this theory is scientifically validated, supported on social psychology theory, observation, experimental evidence and clinical experience. Second, it considers a wide range of sorts of human needs as meaningful, incorporating a huge variety of dimensions on it. This characteristic is important as a basis for a multidimensional approach. Third, it assumes a hierarchy of human needs, instead of treating what is different as equal. Fourth, the theory has been established and validated over the decades by diverse kinds of empirical studies (*e.g.*: Lollar 1974, Oleson 2004, Williams and Page 1989, among others[33]). Finally, it faces and tackles the problem of human needs studying it directly, *i.e.*, through the study of human beings, their motivations and their needs. Although not being a fresh theory, we consider it as adequate for our purpose. It does not have a complete adherence to reality, but it is not expected anyway, as it explains the behavior of most people most of the time and that is enough to play well its role.

The ERG theory of motivation is more flexible and admits a frustration-regression aspect. Nevertheless, it is based on information of one single group of workers (banking workers) and has a less stratified classification of human motivations.

The fundamental human needs approach is interesting as it brings attention for disparities over the world, but it is not sufficiently supported on scientific rationale to be considered in our analysis.

Notwithstanding its huge qualities, the human need theory of Doyal and Gough is too much centered in two needs, health and autonomy, and more normative than descriptive, what makes it interesting on a philosophical point of view, but not as much for our purpose of measuring poverty. We agree with, and adopt in this study, the principle that human beings have universal and objective needs, but not only for health and autonomy. For instance, an individual who is healthy and autonomous in a violent area can suffer a deeper deprivation and to lack much more opportunities - as his freedom is limited and the risk of being injured or killed is significantly higher - than a healthy and autonomous individual in a calm area.

[33] It also finds theoretical support, even nowadays (*e.g.*: Kesebir et al., 2010).

Finally, the Allardt examination of a comparative survey in Sweden concludes that a need satisfaction set of indicators is more adequate for measuring well-being than a resources set, which is quite a defensable idea form our point of view. Anyway, it does not develop a theory to support a specific choice of indicators.

Attending to this critical reflection, we move forward considering the Maslow's theory of human motivation as a basis for our theoretical framework.

## *3.3 A Social Psychology-based method*

Within the family of quantitative approaches to multidimensional poverty measurement, many approaches and techniques are often considered in the economic literature: the fuzzy set approach, the Rasch model, cluster analysis, multiple correspondence analysis, the MIMIC approach, latent variable models, the axiomatic approach, ordinal approaches, among others. Although all of them are used to measure a human phenomenon, curiously any of these approaches and techniques has ever incorporated what the science of mind and behavior has to tell us[34].

The importance that a Psychology-based method may have in an economic framework such as a poverty index might be picked up through the idea that, «because Psychology systematically explores human judgement, behavior and well-being, it can teach us important facts about how humans differ from the way they are traditionally described by economists» (Rabin, 1998:11). This means that a Psychology-based method may capture the importance of each attribute in a more adequate way then a data-driven statistically-based one, given that the former is based in a theory that systematically explores human judgement, behavior and well-being.

It is important at this stage to establish the difference from need to its satisfaction mechanisms. People have needs that are satisfied through the consumption of goods and services, the experience of feelings and sensations, the conditions of the local and global environment, and so on. Needs are goals that can be universalized. Our framework assumes that the attributes considered as relevant, in fact, function as mechanisms of satisfaction of the respective needs. These mechanisms are specific and vary with the

[34] An exception is the use of the Rasch model, which belongs to the field of psychometrics, but only as a quantitative tool, rather than incorporating social psychology theoretical results in the framework of the analysis.

society. For instance, to live in an area free of crime and vandalism functions as a mechanism of satisfaction of the need of safety.

The general framework of our index is similar to that presented by Cheli and Lemmi (1995), where a membership function is defined as

$$\mu_P(i) = \sum_{j=1}^{k} w_j \mu_{Aj}(i) \tag{33}$$

and weights are defined as

$$w_j = \frac{\ln(1/\mu b_{Aj})}{\sum_{j=1}^{k} \ln(1/\mu b_{Aj})} = \frac{\ln(\mu b_{Aj})}{\sum_{j=1}^{k} \ln(\mu b_{Aj})} \tag{34}$$

where $w_j$ is an inverse function of the average degree of deprivation in the population, according to the deprivation indicator $Y_j$. The problem here is that a weighting function based in a frequency attribute not only turns to be not internationally comparable as can also lead to very different weighting functions for the wrong reasons. As an example, in some societies where few people have a car, the possession of such an attribute will gain a high weight if compared with a society where almost everybody has a car. However, not having a car does not necessarily indicate a higher degree of poverty, once that it may be result of individual preferences or social norms of the local society. We can think an example of a society where individuals that use bicycles instead of cars have more status, for ecological reasons, for instance.

Therefore, in order to overcome these drawbacks of a scarcity-induced weighting scheme, we propose and develop a psychology-based method to weight the different attributes of deprivation.

## *3.4 Maslow's hierarchy of needs*

Abraham Maslow, an American professor of psychology, founded the so called humanistic psychology and proposed a hierarchy of needs (1943, 1970). The humanistic

psychology adopts a holistic approach to human existence through the study of values, freedom, tragedy, personal responsibility, human potential, and self-actualization, among other aspects. The Maslow's hierarchy of needs is a theory that parallels other theories of developmental psychology. An interpretation of Maslow's hierarchy of needs may be represented as a pyramid with the more basic needs at the bottom (figure 1).

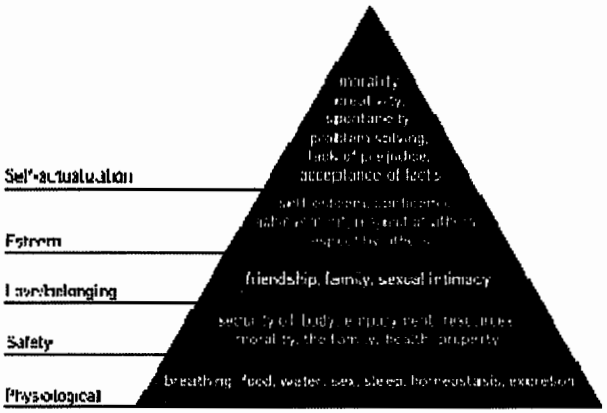


**Figure 1:** Maslow's hierarchy of needs

The most fundamental four layers of the pyramid contain what Maslow called "deficiency needs": Esteem, friendship and love, safety and security, and physiological needs. If the three intermediate groups of needs (the three up "deficiency needs") are not met, the organism gives no physical indication but the individual feels uneasy and tense. The theory puts forward that the most basic level of needs should be met previous to the individual will strongly desire (or focus motivation upon) the secondary or higher level needs.

Physiological neeeds are easily comprehensible, relating to the basic requirements for human survival, that is, the human body cannot keep on functioning if these necessities are not met. Some examples of these requirements are those for survival and protection, such as metabolic elements (adequate food, clean air, drinking water, excretion, homeostatic regulation, sufficient sleep) and satisfactory clothing and shelter.

After physiological needs are satisfied, the second coating of human needs concerns to safety, security and health. These requirements are basically related to a customary financial security and a safety net against accidents or illness, ample health, personal security, physical safety, security of the family, security of resources, and well-being.

By satisfying their physiological and safety needs, a social set of human needs of the individual concerning to feelings of belongingness take priority and lead his actions. Some examples of these requirements are the feeling of family belongingness, friendship and intimacy.

After physiological, safety and belonging needs are fulfilled, human priority turns to getting respect and having self-esteem and self-respect. People need to engage themselves to gain recognition and have an activity or activities that give the person a sense of contribution

## *3.5 Characterization and description of the poverty index*

The Poverty Index set out to define in this chapter hinges on two crucial theories:

a) The concept of Fuzzy Set Theory as incorporated into the study of poverty (e.g.: the seminal work of Cerioli and Zani 1990, Betti and Verma 1998, Lemmi and Betti 2006, Smithson and Verkuilen 2006);

b) The Maslow's Hierarchy of Needs (Maslow, 1970) to use in the relative weighting of attributes.

The objective here is to develop an index where poverty is considered and operationalized as a multidimensional phenomenon, not only as a monetary occurrence. Thus, the index will integrate the Fuzzy Set Theory in order to incorporate available data on multiple deprivation items. The main innovation is on the subsequent procedure of weighting these items, where the Maslow's Hierarchy of Needs will substitute other controversial criteria on the weighting of the deprivation items. One could argue that, *e.g.*, giving a weight to an attribute which is the inverse of the frequency of that attribute (Costa 2002) is a blind way of weighting, because one can choose not to have an attribute not because he cannot but simply because he does not want to. Imagine that having a car is very frequent. If the individual *A* have a small car (but cannot afford a big one) may not be considered poorer than *B*, who could have a big car but does not have a car because he does not want to. As "having a car" is very frequent, not having a car would have a high weight, even being not very important because richer people may prefer to use public transport, bicycles, walking, etc. given that they live in the centre of

Consequently, the chosen proxies for the physiological needs are the following (with the correspondent EU-SILC variables at the end of each line):

1. Equivalised disposable income (X1) – HX090;
2. Ability to keep home adequately warm (X2) – HH050;
3. Capacity to afford a meal with meat, chicken, fish (or vegetarian equivalent) every day (X3) - HS050;
4. Amalgamation of light problems / noise pollution / environmental problems (X4) – HS160, HS170, HS180;
5. Amalgamation of possession of TV / washing machine / car (X5) – HS080, HS100, HS110.

#### 3.5.3.2 Safety and health needs

Bearing in mind the variables available, we regard as the most important mechanisms for the fulfillment of the safety and health needs the conditions of not living in a violent area, having a net of financial safety, and having access to hygienic and salubrity conditions. As a result, the chosen proxies for the safety and health needs are the following:

1. Crime violence or vandalism in the area (X6) - HS190;
2. Ability to make ends meet (X7) – HS120;
3. Capacity to face unexpected financial expenses (X8) – HS060;
4. Amalgamation of availability of bath/shower / indoor flushing toilet / absence of leaking roof, damp walls, rot in windows (X9) – HH040, HH080, HH090;

#### 3.5.3.3 Need for love and belonging

Taking into consideration the variables available, we regard as the most important mechanisms for the fulfillment of the belonging need the conditions of living not alone, having the capacity to afford holidays (frequently a period of most intense interactions with friends and family), and to easily communicate. Therefore, for the needs for love and belonging (friendship, family), the following proxies are chosen:

1. Capacity to afford paying for one week annual holiday away from home (X10) - HS040;

2. Presence of a telephone (X11) - HS070;

3. Type of family: The one person household is considered worse then the other types (X12) – HX060.

### 3.5.4 Methodology

Some portions of this methodology rely here on several multidimensional poverty papers (especially Costa 2002, Dagum and Costa 2004). Let $H$ be the set of the $n$ households covered in the database. Let $P$ stand for a subset of households in $H$ such that, any household $h_i \in P$ presents some degree of poverty in at least one of the $m$ attributes included in $X = \{X_1, \ldots, X_j\}$. Then, the subset $P$ is a fuzzy subset of $H$. Let

$$x_{ij} = \mu_P [X_j(h_i)], \qquad 0 \leq x_{ij} \leq 1 \tag{35}$$

stand for the degree of membership to the fuzzy set $P$ of the i-th household ($i = 1, ..., n$) with respect to the $j$-th attribute ($j = 1, ..., m$), such that:

(i) $x_{ij} = 1$, iff the $i$-th household does not possess the $j$-th attribute;

(ii) $x_{ij} = 0$ iff the $i$-th household entirely possesses the $j$-th attribute; and

(iii) $0 < x_{ij} < 1$ iff the $i$-th household possesses the $j$-th attribute with an intensity belonging to the open interval (0, 1).

The expression $\mu_P (h_i)$ places the poverty ratio of the $i$-th household, that is, the degree of membership of the $i$-th household to the the fuzzy set $P$. It is defined as the weighted average of $x_{ij}$,

$$\mu_P (h_i) = \sum_{j=1}^{m} x_{ij} \cdot w_j \Big/ \sum_{j=1}^{m} w_j, \tag{36}$$

where $w_j$ is the weight attached to the $j$-th attribute. It follows from the definition of $x_{ij}$ in (i), (ii) and (iii) above, that,

$$0 \leq \mu_P (h_i) \leq 1, \quad (37)$$

where $\mu_P (h_i)$ measures the degree of poverty of the i-the household as a weighting function of the $m$ attributes. Therefore, it measures the multidimensional degree of poverty of the $i$-th household.

For calculating the relative weights of all attributes we turn to Maslow's Hierarchy of Needs.

### 3.5.5 Maslow's Hierarchy of Needs: The Model

Let $U$ be the Evaluation Factor, *i.e.*, the set of evaluation indices - Physiological Needs, Safety Needs and the Need for Love and Belongingness:

$$U = \{U_1 (X_1, X_2, X_3, X_4, X_5), U_2 (X_6, X_7, X_8, X_9), U_3 (X_{10}, X_{11}, X_{12})\}. \quad (38)$$

Setting up the set of Weight Distribution ($W$), we have:

The weight distribution set of $U$ is $W = \{W_1, W_2, W_3\}$;

The weight distribution set of $U_1$ is $W_1' = \{w_1, w_2, w_3, w_4, w_5\}$;

The weight distribution set of $U_2$ is $W_2' = \{w_6, w_7, w_8, w_9\}$;

The weight distribution set of $U_3$ is $W_3' = \{w_{10}, w_{11}, w_{12}\}$;

and

$$w_i = \begin{cases} W_1, & 1 \leq i < 6 \\ W_2, & 6 \leq i < 10 \\ W_3, & 10 \leq i < 12 \end{cases}$$

Following the Analytic Hierarchy Process (see Saaty 1990) for weighting, we can assign weightings for each $w_i$ according to the relative importance of the group of attributes that it belongs to in the Maslow's Hierarchy of Needs, as well as based on the the Fundamental Scale of Absolute Numbers (Saaty 2008). According to this principle, the values for each $w_i$ is as following:

$W_3' = \{w_{10}, w_{11}, w_{12}\} = 1$ (standard group of attributes);

$W_2' = \{w_6, w_7, w_8, w_9\} = 4$ (moderate plus, between slightly and strongly more important than the standard group);

$W_1' = \{w_1, w_2, w_3, w_4, w_5\} = 9$ (extreme importance, the highest possible more relative importance when compared with the standard group).

The number correspondent to the standard group of attributes stands for the variables that are in a higher postion in the hierarchy of needs, given that these needs are the standard ones. The number correspondent to the moderate plus group of attributes stands for the variables that are in a intermediate postion in the hierarchy of needs, given that these needs are more important, although not extremely important. The number correspondent to the extreme importance group of attributes stands for the variables that are extremely important for the human well-being.

Finally, the poverty ratio of the population $\mu_P$ is simply obtained as the average of the poverty ratio of the i-th household:

$$\mu_P = \sum_{i=1}^{n} \mu_P(h_i) n_i \Big/ \sum_{i=1}^{n} n_i \qquad (39)$$

where $n_i$ is the weight attached to the $i$-th sample observation when the data are extracted from a sample survey.

### 3.5.6 Advantages and limitations of the suggested poverty index

The index presented in this chapter is a multidimensional poverty index: It incorporates information from 12 attributes of deprivation, thus considering poverty as a multidimensional phenomenon. This characteristic is central since poverty is widely considered as the lack of basic human needs, which includes several kinds of deprivations. According to Sudan (2001:1), «Poverty is a complex and multidimensional

phenomenon. Its attributes can be captured in a myriad of images ranging from malnutrition, disease, lack of education, inadequate shelter, vulnerability and an absence of voice and powerlessness in society». All these attributes can be theoretically captured by our index and, in the case considered here, all those present in the EU-SILC shall be considered in the application of the index to the data.

Within the family of multidimensnsional indices, this index has the characteristic of incorporating a well established psychological theory – the Maslow's Hierarchy of Needs – as a support in the process of weighting the deprivation attributes. The index follows the Totally Fuzzy Relative approach, being similar to the Dagum and Costa proposed index (2004), but innovating in the weighting process, turning it closer to the measurement of what poverty really is - a multidimensional phenomenon – attributing the most adequate weight to each attribute according to the psychological theory.

While in other indices the weight of each attribute is frequency-based - taking here the example of Dagum and Costa (2004), the weight of each attribute is given by the inverse of the frequency of households who suffers from deprivation of that attribute - in our index the weight is exogenous, determined by its importance for the human being according to the socio-psychological theory. This difference may be seen as an important effort towards a poverty index that captures all the relevant and available measurable dimensions of poverty, where the importance of each dimension is the adequate when taking in account the human well-being, according with the human hierarchy of needs.

This characteristic of our index makes it comparable dinamically, once guaranteed that the variables considered are the same. It may also be flexible and more relative if we consider a different database with specific variables. Thus, the index can be used, if adequately adapted, for a study on other societies.

Nevertheless, it has some degree of subjectivity, as the choice of variables to meet the satisfaction of each need could be different, and the credit of numerical relative importance between the stages of hierarchical needs could also be different. Anyway, we think that the degree of subjectivity was minimized to a reasonable level and, perhaps, it is not possible to reduce it to none when the subject is poverty measurement.

One could also argue that the component of opportunities within society, many times associated with education levels, should be mandatory in multidimensional poverty

measurement. We consider that, with the generalization of compulsory education, ample health gives the freedom and opportunity to the choice of studying more or less. For instance, a higher formal level of education and a weak personality can many times to provide fewer opportunities than a minimum level of formal education associated to an entrepneur attitude[35].

## *3.6 Conclusion*

The formulation of a weighting scheme is central in the conception of a multidimensional poverty index. The use of a human need theory into the weighting scheme is an idea that tries to harmonize the subjectivity that is inherent to the measuring of poverty with the necessity of attributing weights for each item of deprivation. It also tries to avoid the disadvantages of a frequency-induced weighting scheme, replacing this choice for a normative framework, which is supported by a consolidated theory within the social sciences. The Maslow's theory is part of a holistic approach to human existence through the study of values, freedom, tragedy, personal responsibility, human potential, and self-actualization, among other aspects. This characteristic highlights the importance of bearing in mind that, when we measure poverty, we measure the deprivation of human beings, who have needs, and that these needs do not have all equal importance for the individual. The framework described in this chapter incorporates both the Maslow's theory and the Fuzzy Set Theory, and have the intention of developing an index in which poverty is considered and operationalized as a multidimensional phenomenon.

[35] There is a very huge number of examples, as the one given by the current richest person of the world - the self-made Carlos Slim Helú, who began working at the age of 8 and does not know how to work with a personal computer – that illustrates this idea.

# CHAPTER 4 – APPLICATION TO A SURVEY IN PORTUGAL

In this chapter we describe the data, what software was used in the computations and implement the new index presented, compared with similar indices, such as the Dagum and Costa (2004) index and the Principal Component Analysis method.

In section 4.1 the EU-SILC data is characterized and the need of its use is explained, the software used in the analysis is briefly described and the principal component analysis topic is introduced.

In section 4.2 we carry on the empirical analysis through the use of the three different poverty indices considered in this study.

In section 4.3 we compare the multidimensional results of the suggested index with the monetary poverty in order to conclude over the consistent poverty concept for Portugal in 2007. Our final remarks can be found in section 4.4.

## *4.1 Data and computation of the results*

### 4.1.1 Data and software

The EU-SILC is the Community Statistics on Income and Living Conditions, composed by microdata on hundreds of variables, including information on multidimensional and income poverty, social exclusion and housing condition. Collective households and institutions are excluded from the target population. The database used in this work is the cross-sectional microdata for households of the EU-SILC User Database for Portugal in 2007. This database involves a random sample of 4310 households and the reference population consists in all private households and their current members residing in the territory of Portugal.

The items available in EU-SILC are suitable and pertinent for the empirical study we want to carry on. As concluded by Guio et al. (2009), the Eurobarometer mainly corroborate that the items available in EU-SILC are «socially validated» and almost all

of them «are considered absolutely necessary or necessary». Accordingly, we considered not necessary to undergo a specific survey.

The software used for the computation and draw of the results were Excel 2010 and IBM SPSS Statistics Version 20 to manipulate data and to compute the fuzzy set indices, StataIC 11 to compute the Principal Component Analysis, and DASP 2.1 (Araar and Duclos, 2007) for poverty dominance tests.

### 4.1.2 Computation of the results

The microdata considered for the computation of the index is the set that involves the data for the 12 selected attributes ($m = 12$) of the 4310 households ($n = 4310$). The basic variables used from the database are in the Annex.

Departing from the database variables, the following variables were directly obtained or computed from that source:

- X1: Equivalised disposbale income = 1 - (HX090/maximum HX090 from the population);
- X2: Ability to keep home adequately warm = HH050 (considering 0 for yes, 1 for no);
- X3: Capacity to afford a meal with meat, chicken, fish (or vegetarian equivalent) every day = HS050 (0 for yes, 1 for no);
- X4: Problems with dwelling, neighbors or environment = (HS160+HS170+HS180) / 3 (considering 1 for each yes, 0 for each no);
- X5: Possession of domestic equipment and car = (HS080+HS100+HS110) / 3 (0 for each yes, 1 for each no – cannnot afford, ½ for each no – other reason);
- X6: Crime violence or vandalism in the area = HS190 (1 for yes, 0 for no);
- X7: Ability to make ends meet = 1 if HS120 = 1, 0 if HS120 = 6, 1/HS120 for other cases;
- X8: Capacity to face unexpected financial expenses = HS060 (0 for yes, 1 for no);
- X9: Dwelling conditions = (HH040+HH080+HH090) / 3 (HH040: 1 for yes, 0 for no; others: 0 for yes, 1 for no);

- X10: Capacity to afford paying for one week annual holiday away from home = HS040 (0 for yes, 1 for no);
- X11: Presence of a telephone = HS070 (0 for yes, 1 for no – cannnot afford, ½ for no – other reason);
- X12: Belonging = 1 for HX060 = 5, 0 for HX060 ≠ 5.

The value for our index is $\mu_P = 31.36\%$, with the values at the household level of the poverty measure ranging between 85.91% and 1.73%. Note that 100% would mean complete poverty and 0 would mean lack of poverty on the society. It can be interpreted as the proportion of poverty in the society, diffused by all the households, *i.e.*, as all the households have some poverty between 0 and 1. In this case, Portugal had, in 2007, a proportion of almost one third of poverty in the society.

The selection of the other methods used for comparison with our index follows two principles:

a) To take account of the multidimensionality and to have some similarities with our proposed index;

b) Suitable to be used with the EU-SILC database.

Following these criteria, we have chosen the measure proposed by Dagum and Costa (2004) and the Principal Component Analysis. As we will see along this chapter, the three indices permit to encompass aspects of capabilities and social exclusion approaches, Dagum and Costa (2004) also consider that poverty measurement is a natural field for application of fuzzy theory. Last, all of them are suitable to be used with the EU-SILC database.

First we will compare only with the Dagum and Costa (2004), the poverty measure that has more similarities to the index that we are proposing in this thesis. Let us call it the DC index. As our main argument for the presentation of our index is not related to the variables chosen, we are going to consider the same variables for both indices. Considering

$$w_j = \log(4310)/\sum_{i=1}^{4310} x_{ij} \qquad (40)$$

the result for the DC's $\mu_P$ is 13.75%, with the values at the household level of the poverty measure ranging between 0.15% and 82.18%.

It turns out that the assignment of different weights to attributes brings about a sharp reduction in the values of the membership function. The difference for the value of the overall DC index is of approximately 18 percentual points below the result for our index. This large difference is explained by the quite different values for the weights of the deprivation attributes. The weights considered for each index are in Table 1:

**Table 1: Weights for both computed indices**

| $w_j$ | **Our index** | **DC index** | **Difference in percentual points** |
|---|---|---|---|
| $w_1$ | 14,06% | 1,23% | 12,83% |
| $w_2$ | 14,06% | 2,40% | 11,66% |
| $w_3$ | 14,06% | 23,39% | -9,33% |
| $w_4$ | 14,06% | 5,60% | 8,46% |
| $w_5$ | 14,06% | 14,90% | -0,84% |
| $w_6$ | 6,25% | 10,94% | -4,69% |
| $w_7$ | 6,25% | 2,49% | 3,76% |
| $w_8$ | 6,25% | 5,31% | 0,94% |
| $w_9$ | 6,25% | 11,76% | -5,51% |
| $w_{10}$ | 1,56% | 1,76% | -0,20% |
| $w_{11}$ | 1,56% | 13,90% | -12,34% |
| $w_{12}$ | 1,56% | 6,30% | -4,74% |

Indeed, there are several weights with large differences between the indices. The largest difference is for income, for what we argue that the weight of 1.23% assigned to the DC

index is quite low. The second largest difference is for the presence of a telephone, for what we consider that the weight of 13.90% assigned to the DC index, 11 times larger than the weight assigned to income, is fairly high.

Empirically, the relevant conclusion is that our poverty index for Portugal in 2007 (using our poverty index), is 31.36%.

### 4.1.3 Principal component analysis

The principal component analysis was developed by Harold Hotelling (1933) in psychometrics and multivariate statistical analysis for the purpose of aggregating information scattered in many numeric measures.

The essential idea of the principal component analysis is to diminish the number of dimensions of a data set consisting of a huge number of interrelated variables, transforming this set of observations into a set of values of uncorrelated variables, while retaining as much as possible of the variation present in the data set, where the set of values of uncorrelated variables are called the principal components. This mathematical procedure uses an orthonormal transformation[36] to make the reduction of the dimensionality of the data set, becoming the number of principal components smaller than, or equal to, the number of original variables. The principal component analysis does not ignore covariances and correlations, but it concentrates on variances. The conversion is determined in such a way that the first principal component[37] has the maximum possible variance, and each following component in order has the maximum possible variance under the constraint that it be the orthonormal to the previous components.

One of the advantages of this multivariate statistical approach is that a large amount of the whole structure variability is able to be explained through a number of principal components that is smaller than the components necessary to replicate the full amount of variability of the system. Another advantage is that an analysis of principal components frequently discloses relationships that were not suspected before, allowing in this way a better understanding of the results.

[36] An orthonormal transformation is a linear transformation which preserves a symmetric inner product.
[37] The first principal component explains the largest proportion of the variation in the original data set, the second principal component explains the second largest proportion, and so on.

As most of the variables considered in this study are categorical data, we adopt a polychoric principal component analysis, particularly suitable for binary and ordinal data.

With the purpose of estimating the principal component analysis model, we submitted the 12 variables to a polychoric principal component analysis, a technique for estimating the correlation between two theorized normally distributed latent variables as of two observed ordinal variables, obtaining table 2.

**Table 2: Polychoric correlation matrix**

| PCM | X1 | X2 | X3 | X4 | X5 | X6 | X7 | X8 | X9 | X10 | X11 | X12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X1 | 1 | | | | | | | | | | | |
| X2 | 0,570 | 1 | | | | | | | | | | |
| X3 | 0,413 | 0,419 | 1 | | | | | | | | | |
| X4 | 0,024 | 0,128 | 0,098 | 1 | | | | | | | | |
| X5 | 0,589 | 0,442 | 0,383 | 0,100 | 1 | | | | | | | |
| X6 | -0,089 | -0,078 | 0,024 | 0,399 | -0,011 | 1 | | | | | | |
| X7 | 0,494 | 0,546 | 0,413 | 0,088 | 0,423 | -0,003 | 1 | | | | | |
| X8 | 0,668 | 0,480 | 0,372 | 0,133 | 0,491 | 0,090 | 0,674 | 1 | | | | |
| X9 | 0,270 | 0,391 | 0,225 | 0,236 | 0,407 | 0,167 | 0,294 | 0,358 | 1 | | | |
| X10 | 0,000 | 0,690 | 0,491 | 0,073 | 0,556 | -0,036 | 0,717 | 0,711 | 0,404 | 1 | | |
| X11 | 0,388 | 0,279 | 0,308 | 0,038 | 0,416 | 0,009 | 0,261 | 0,339 | 0,280 | 0,307 | 1 | |
| X12 | 0,191 | 0,222 | 0,214 | 0,010 | 0,538 | -0,005 | 0,114 | 0,304 | 0,210 | 0,148 | 0,302 | 1 |

With the purpose of making sure that the polychoric correlation matrix is appropriate, we made sure that it be positive semi-definite[38], guaranteeing so that we get a suitable co-variance matrix, given that otherwise it could have negative characteristic values[39]. By setting negative characteristic values to zero and reconstructing, we obtain the least-squares positive semi-definite approximation to the matrix. The polychoric co-variance matrix obtained is showed in Table 3.

The estimation of the polychoric correlation matrix demonstrates that the first principal component has a characteristic value of 4.57682. The leading characteristic vectors from the first principal component characteristic value decomposition of the correlation

[38] A matrix $M$ is positive semi-definite if and only if there is a matrix $M^{½}$ with $(M^{½})^2 = M$.
[39] A characteristic value is the factor by which its corresponding characteristic vector changes when multiplied by the matrix.

matrix correspond to the weights, *i.e.*, the relative contribution of the variable to the overall poverty component, is presented in Table 4.

The factor loadings, which correspond to the absolute component loadings, are plotted in Figure 2.

**Table 3: Principal components**

| Factor | Characteristic value |
|---|---|
| 1 | 4.57682 |
| 2 | 1.48094 |
| 3 | 1.21390 |
| 4 | 0.90989 |
| 5 | 0.74213 |
| 6 | 0.71515 |
| 7 | 0.67847 |
| 8 | 0.57336 |
| 9 | 0.43960 |
| 10 | 0.38245 |
| 11 | 0.28727 |
| 12 | 0.00000 |

As we can see, the variables that contribute with larger weights are Capacity to face unexpected financial expenses (X8 - 11.79%) and Possession of domestic equipment and car (X5 - 11.13%), and, on the other hand, the variable Crime violence (X6) contributes with only 0.42%.

**Table 4: Principal component weights**

| Variable | Weight |
|---|---|
| X1 | 9,63% |
| X2 | 11,03% |
| X3 | 9,09% |
| X4 | 2,61% |
| X5 | 11,13% |
| X6 | 0,42% |
| X7 | 11,08% |
| X8 | 11,79% |
| X9 | 8,16% |
| X10 | 10,83% |
| X11 | 7,93% |
| X12 | 6,28% |

When comparing with our index, the largest differences in weights are for X4 (Problems with dwelling, neighbors or environment) with 11.45 percentage points more to our index, and for X10 (Capacity to afford paying for one week annual holiday away from home) with less 9.27 percentage points to our index. We argue that a weight of 10.83% is undoubtedly too high as holidays are far from being one of the top priorities for the household and that it is adeaquate a higher weight for X4, as it happens in our index, due to its fundamental importance for well-being.

The result for the PCA index is 32.96%, with the values at the household level of the poverty measure ranging between 1.10% and 91.10%.

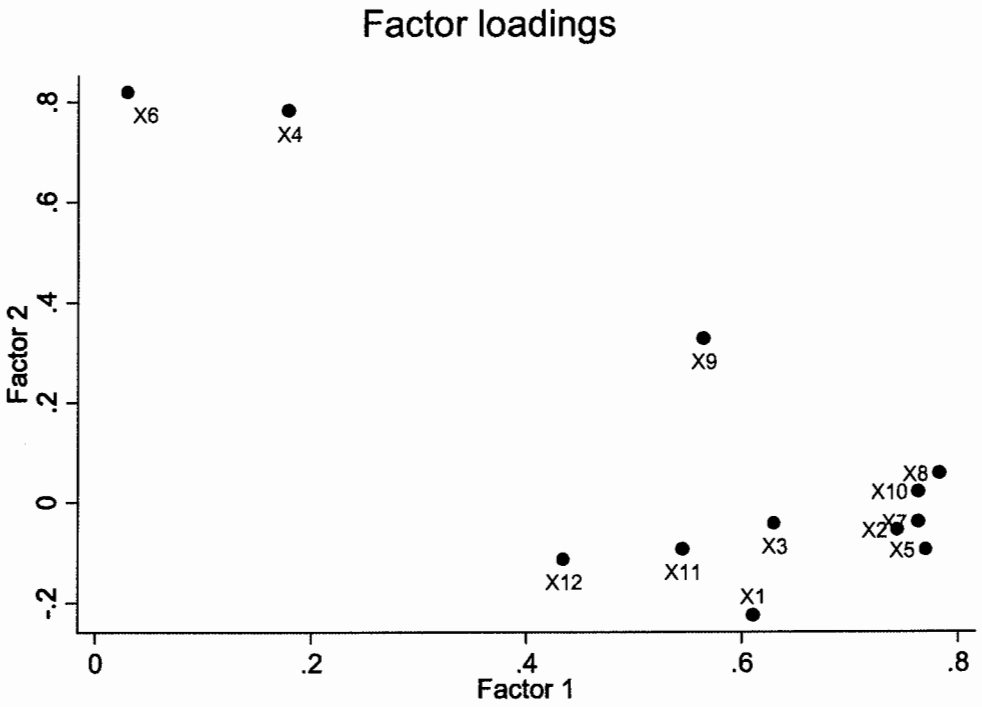


**Figure 2:** Factor loadings

## *4.2 Empirical analysis*

In this subchapter we empirically compare and analyze the results from the three multidimensional poverty indices computed in the previous subchapter, 4.1. In order to ensure the sensitivity of the orderings of the three indices computed, we have chosen the stochastic dominance tests. So as to settle on whether a relation of stochastic dominance holds between two distributions, the distributions are primary typified by their cumulative distribution functions. The results for dominance tests for pair-wise poverty index comparisons are given by Table 5:

**Table 5: First-order poverty dominance**

| Index Distribution | | Observation |
|---|---|---|
| **Distribution 1** | **Distribution 2** | |
| Our index | Dagum and Costa | Distribution 1 dominates distribution 2 |
| Our index | PCA | Intersections found, no poverty dominance |
| Dagum and Costa | PCA | Distribution 2 dominates distribution 1 |

We scrutinize from Table 5 that Dagum and Costa index is dominated by both our and PCA index distributions. This judgment is confirmed by Figures 3 and 5, which disclose that the poverty incidence curve (cumulative distribution function) of Dagum and Costa index is consistently above the other methods's index distribution functions over an extensive range of interval.

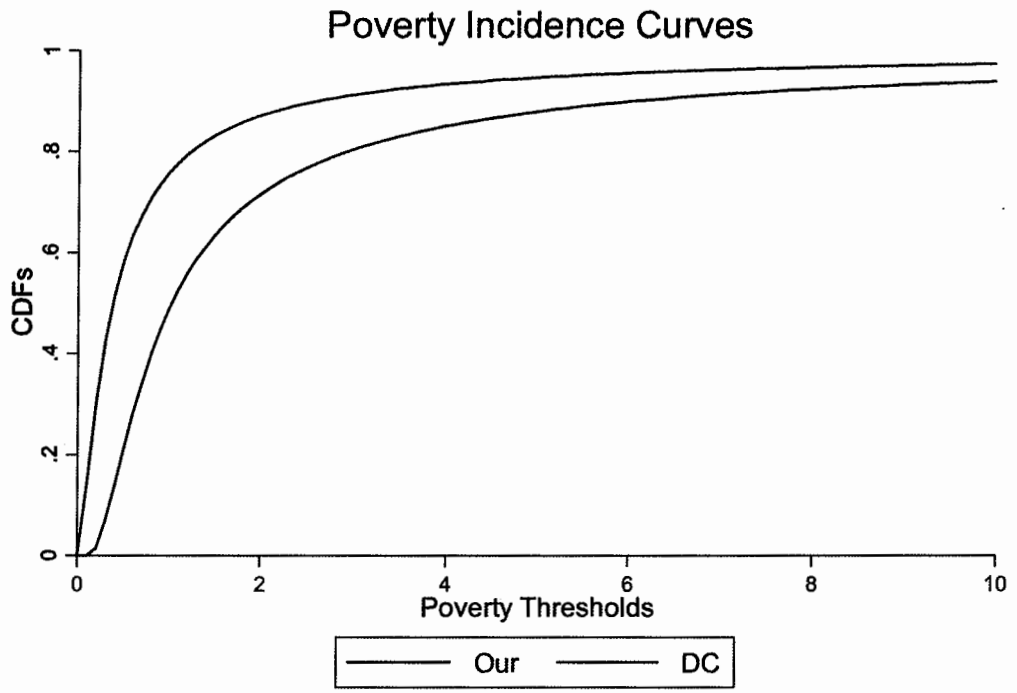


**Figure 3:** Our index and Dagum and Costa index poverty incidence curves

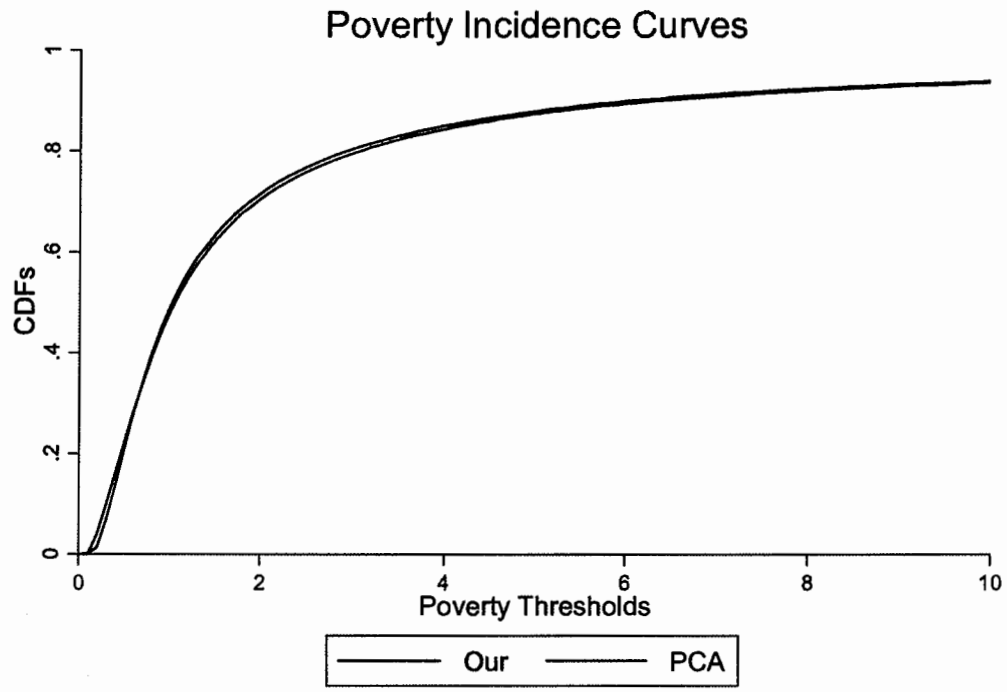


**Figure 4:** Our index and PCA index poverty incidence curves

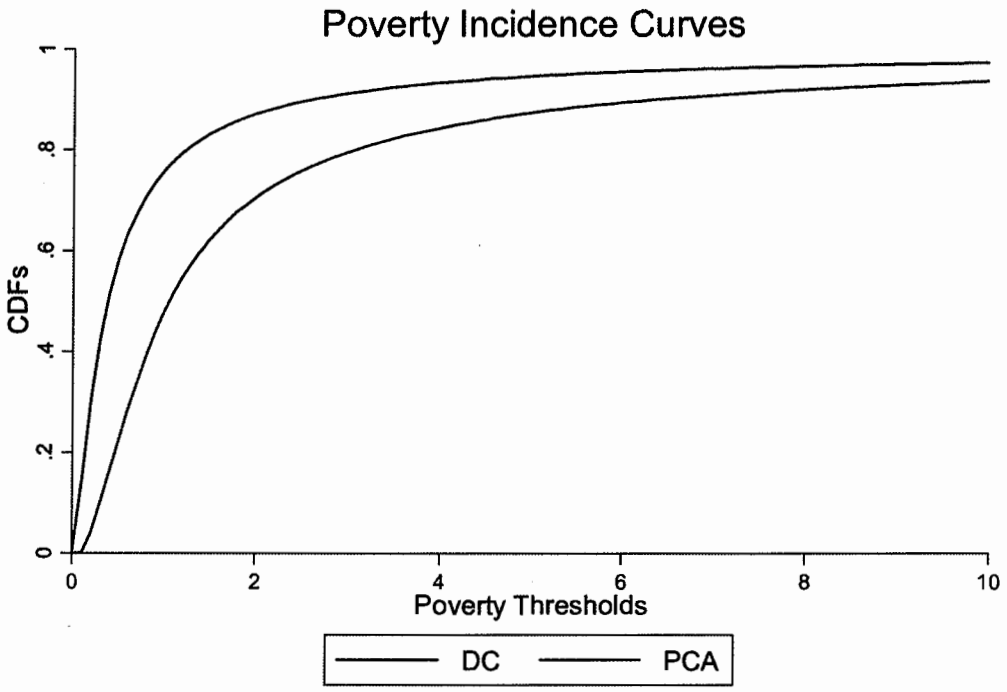


**Figure 5:** Dagum and Costa index and PCA index poverty incidence curves

This indicates significance first-order poverty dominance for both our index and PCA index CDFs over Dagum and Costa CDF. We may conclude with a fair degree of confidence that, over all possible poverty frontiers, Dagum and Costa index has more poverty than the others. On the other hand, it comes out of the dominance analysis in Table 5 that there is no clear dominance when we compare our index and PCA index distributions. This is further confirmed by Figure 4 which shows several intersections between our and PCA CDFs. As the CDFs in Figure 4 cross (and the crossings are significant) we conclude that the first-order poverty dominance is inconclusive. Given that first-order dominance is not observed, we tested for second- and third-order dominance and found no clear dominance of one index over the other.

As all these index values were built using the same twelve variables, we might attribute differences in the dominance results to differences in the weighting schemes. The intuition is that the weighting schemes of our index and PCA index depict less poverty than that of Dagum and Costa.

In the case of PCA, variables are weighted with the proportion of the variance in the original set of variables explained by the first principal component. This technique has the advantage of detrmining the set of weights which explains the major variation in the original variables.

The Dagum and Costa weighting scheme, which is a function of the frequency of deprivation in terms of a given variable, assign weights to the variables themselves.

Therefore, divergent weighting and conceptual issues may limit meaningful comparisons between these index values. Although objective, these two techniques are completely data-driven and the weights obtained are very rigid and may not necessariliy be appropriate for policy or poverty fighting strategy decisions.

The results for the three indices together with the empirical anlaysis through sensitivity tests might make us conclude that our index is more balanced. Its value is between the other two values and it does not have significant differences when compared with PCA index. This empirical evidence, altogether with its theoretical advantages - explained before - make us defend it as a more appropriate index to measure poverty.

## *4.3 Consistent poverty and income distribution*

In order to deepen our study of the situation of poverty in Portugal, and simultaneously having the purpose of comparing the multidimensional results obtained through the application of our proposed method with the traditional method of income distribution analysis and with the consistent poverty methodology, we develop an analysis of contrast between the methods using the same data[40].

The concept of consistent poverty combines relative monetary poverty with material deprivation. There are several specifications in the use of this concept, as the official poverty measure used in Ireland or those used in Rodrigues and Andrade (2012), but the general definition is that consistent poverty verifies for those who combine relative income poverty and the lack of basic items. Their analysis use the concept of material deprivation, as defined by the European Union, which consists on the enforced lack of at least any three of nine items of deprivation, and a measure of its intensity.

We will instead adopt a concept of consistent poverty based on the households who combine an income lower than 60% of the median income and a $\mu_{Pi}$ larger or equal to 40%, 50% and 60%. The results are given by Table 6, where $\mu_{Pi}$ refers to the poverty ratio of household *i* (see the Maslow's hierarchy of needs model at the sub-section 3.5.5):

**Table 6: Intersection between income poverty and certain percentages of $\mu_{Pi}$**

| **Income poverty (%)** | | **Multidimensional poverty (%)** | | **Intersection (%)** | |
|---|---|---|---|---|---|
| Income below 60% of median income | 19.05 | $\mu_{Pi} > 40\%$ | 26.22 | < 60% of median income $\cap$ $\mu_{Pi} > 40\%$ | 9.86 |
| | | $\mu_{Pi} > 50\%$ | 9.86 | < 60% of median income $\cap$ $\mu_{Pi} > 50\%$ | 4.59 |
| | | $\mu_{Pi} > 60\%$ | 3.02 | < 60% of median income $\cap$ $\mu_{Pi} > 60\%$ | 1.67 |

[40] For further inspection on the Portuguese situation, a deep study on monetary poverty and inequality and on material deprivation for Portugal, using the Survey on Living Conditions and Income, can be found at INE (2010).

As we can compute from these results, 52% of the households in a situation of income poverty have a $\mu_{Pi}$ above 0.4, 24% above 0.5 and 9% above 0.6. We consider these results as expected as our multidimensional index grasps different aspects of poverty, what does not happen with the income index.

Another interesting result is that the group of households within the lower decile of equivalised disposable income, Group $EI_{10\%}$, is constituted by the households with an income lower or equal to €3211.94. The group of households within the lower decile of multidimensional poverty, Group $MP_{10\%}$, is constituted by the households with a $\mu_{Pi}$ larger or equal to 49.90%. The intersection of groups $EI_{10\%}$ and $MP_{10\%}$ stands for 2.69% of all the households.

We conclude, first, that the level of income in the 10% line is very low, as it means an average monthly income under €300. Secondly, there are not many households, in proportional terms, with a high level of $\mu_{Pi}$, as less than 10% have a level above 50%. Finally, the intersection of groups of households considered as in the 10% poorer in the society, by both methods, is relatively small, with only 26.9% of households in the intersection group.

## *4.4 Concluding remarks*

Poverty measurement has been evoluting a lot in the last centuries and particularly in the last decades. The contribution of Sen and the institutionalization of new household and individual surveys permitted the development of multidimensional poverty measures. This development brings new challenges to social economists.

This work proposes a contribution to the answering to these challenges through the presentation and application of a fuzzy set based methodology for measuring multidimensional poverty. Our empirical analysis was based on 2007 EU-SILC data for Portugal.

First of all, we carried out an operationalization of the multidimensional poverty approach. This exercise delivered results, which are basically multidimensional poverty measurements, verifying that it is possible to measure poverty multidimensionally. We also show that our index satisfies a very important feature, which is to adequate the weighting scheme of a multidimensional poverty index to the hierarchy of human needs.

The application of our index to the Portuguese case illustrates our method and sensitivity tests compare it with other multidimensional poverty measurements. These tests permit us to conclude that it exhibits balanced (not extreme) results once the value of the index is between other multidimensional poverty indices.

Another important feature of our index is that it is not data-driven, what makes it adequate and very useful for comparisons.

These resulsts may lead to future research track investigation. One can amplify the number of indicators used in measuring multidimensional poverty, as well as to comprise supplementary approaches in our analysis and take a closer look at the marginal impact of each class of indicators on the value taken by the multidimensional indices of poverty. We hope that it may also be useful in the discussion between social sciences (especially Social Economics, Social Psychology and Sociology) and between experts on methodological issues about poverty measurement, especially on weighting schemes for multidimensional poverty measurements.

# CONCLUSION

This thesis makes a contribution - at theoretical, methodological and practical levels - to poverty investigation, by both lying out significant groundwork and applying it in a multidimensional framework. It proposes a contribution to the answering of the challenges that are put up to poverty measurement through the presentation and application of a fuzzy set based methodology for measuring multidimensional poverty. We show that our index satisfies a very important feature, which is to adequate the weighting scheme of a multidimensional poverty index to the hierarchy of human needs. Empirical tests permit to conclude that it exhibits balanced results. Within a multidimensional and static perspective, it addresses several baffling issues concerning poverty measurement, theoretically and empirically, such as the aggregation of deprivation items or identification and counting issues. The aggregation issue has been tipically addressed in the economic literature with some criteria that are, let us say, eminently of a statistical nature, not making an effective linkage to the human needs. Our proposal sets up an index where a suitable connection is accomplished between the weighting scheme and the human needs, namely through the incorporation of elements from the Maslow's hierarchy of needs into the weighting scheme. The value of the resultant index for Portugal in 2007 is around 31%. This result should not be interpreted as the proportion of poors, but as the poorness proportion in the society, where the value for every household lies in the interval between 0 and 1.

Chapter 1 summarizes the history of the economic thought on poverty measurement and presents the major approaches and the present challenges of poverty measurement. We can conclude that important changes in the concept of poverty took place from the mid-nineteenth century to the decade of 1960. It is generally assumed by most authors until that decade, explicitly or implicitly, that it is very difficult to define poverty and even more difficult to measure it. After some pioneering works until the beggining of the twentieth-century, the mainstream turned from a dominance of qualitative analysis to a quantitative one since the 1970s with Amartya Sen (1976); from a one-dimensional framework to a multi-dimensional one since the emergence of the capability approach (Sen, 1985b); from a predominantly relative concept to a predominantly absolute one,

and vice-versa, several times, with other sorts of poverty conception trying to enter in the competition, especially the subjective poverty. The end of this chapter surveys the most relevant and recent empirical literature on poverty, showing the current concerns in poverty analysis and the challenges placed to its measurement. The survey reflects the broad current consensus that poverty is a multidimensional concept.

In Chapter 2 we review the major monetary and multidimensional poverty indices in the economic literature. It shows several limitations on the state-of-the art. In some cases, there is an absence of a multidimensional approach at all. In other cases, the multidimensionality of poverty is addressed only at the attribute level, not as an aggregation issue. Finally, we found limitations in the weighting scheme solutions, namely, there is not a suitable correspondence between the index framework and the hierarchy of human needs, where a high frequency of an attribute in the society may wrongly lead to a high weight of that attribute, given that many households may choose not having some attribute because they do not want to, and not because they cannot afford it. Given this scenario, we found room to develop an alternative weighting scheme. With this motivation for some innovation in this area of study, our aim was to create a weighting scheme delineated to ensure that deprivations are weighted according to the hierarchy of human needs.

Chapter 3 presents, in the scope of the multidimensional approach, an original proposal of a poverty measurement index, namely on the weighting scheme, with the details of the Psychology-based method, the Maslow's Hierarchy of Needs, as well as the important choices that are necessary to define the index and the computations, such as the analysis unit or the choice of attributes. The index presented incorporates information from 12 attributes of deprivation and follows the Totally Fuzzy Relative approach, being similar to the Dagum and Costa proposed index (2004), but innovating in the weighting process. In our index the weight is exogenous, determined by its importance for the human being according to the Psychological Theory. This feature is very important as it means that the index captures all the relevant and available measurable dimensions of poverty, according with the human hierarchy of needs, as well as that the index is comparable worldwide, since the variables considered are exogenous to the data.

In Chapter 4 we implement the new index presented, compared with similar indices, such as the Dagum and Costa (2004) index and the Principal Component Analysis

method, through EU-SILC microdata for Portugal in 2007. The application of our index to the Portuguese case illustrates our method. Stochastic dominance tests are carried out for all the 3 indices computed. These tests allow us to conclude that our index is balanced: Its value is between the other two values and it does not have significant differences when compared with the index computed through Principal Component Analysis.

Additional academic debate as well as further discussions on the application in poverty research and policy planning will be needed. First, a wider application of the multidimensional approach would be desirable in order to conduct it towards methodological improvements. Second, a more comprehensive dataset may comes out as necessary as it could allow additional accuracy. Still, the framework used for empirical analysis might need additional improvements, such as, for instance, a larger set of indicators.

# ANNEX

The microdata considered for the computation of the indices is the set that involves the data for the 12 selected attributes ($m = 12$) of the 4310 households ($n = 4310$). The basic variables used from the database were the following:

- HH040: Leaking roof, damp walls/floors/foundation, or rot in window frames or floor (yes/no);
- HH050: Ability to keep home adequately warm (yes/no);
- HH080: Bath or shower in dwelling (yes/no);
- HH090: Indoor flushing toilet for sole use of household (yes/no);
- HS040: Capacity to afford paying for one week annual holiday away from home (yes/no);
- HS050: Capacity to afford a meal with meat, chicken, fish (or vegetarian equivalent) every second day (yes/no);
- HS060: Capacity to face unexpected financial expenses (yes/no);
- HS070: Do you have a telephone (including mobile phone)? (yes/no – cannnot afford/no – other reason);
- HS080: Do you have a colour TV? (yes/no – cannnot afford/no – other reason);
- HS100: Do you have a washing machine? (yes/no – cannnot afford/no – other reason);
- HS110: Do you have a car? (yes/no – cannnot afford/no – other reason);
- HS120: Ability to make ends meet (from 1 – with Great difficulty to 6 - very easily);
- HS160: Problems with the dwelling: too dark, not enough light (yes/no);
- HS170: Noise from neighbors or from the street (yes/no);
- HS180: Pollution, grime or other environment problems (yes/no);

- HS190: Crime, violence or vandalism in the area (yes/no);
- HX060: Household type (composition).
- HX090: Equivalised disposable income (income in euros);

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