

A Multiple Correspondence Analysis  
Approach to the Measurement  
of Multidimensional Poverty in Morocco,  
2001–2007

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## Abstract

The measurement of multidimensional poverty has been advocated by most welfare scholars and is experiencing a growth in interest, partly explained by controversial debates that have emerged across academics and practitioners. This paper follows one of the least explored approaches—Multiple Correspondence Analysis—to assess multidimensional poverty in Morocco between 2001 and 2007. Multiple Correspondence Analysis provides two major advantages for the measurement of multidimensional poverty: it generates a matrix of “weights” based on the variance-covariance matrix of

all welfare dimensions selected and provides a natural approach for constructing a composite welfare indicator that satisfies essential poverty ordering axioms. The application shows that poverty in Morocco has declined according to both monetary and multidimensional indicators and that these findings are robust to stochastic dominance tests. The paper concludes that the sustained positive growth that Morocco experienced during the last decade has translated in improvements in living conditions well beyond monetary returns.

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# **A Multiple Correspondence Analysis Approach to the Measurement of Multidimensional Poverty in Morocco, 2001-2007<sup>1</sup>**

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## 1. Introduction

With various degrees of emphasis and depth, most welfare economists of our time have recognized the importance of considering poverty as a state of deprivation which is multidimensional in nature (Sen, 1976, Kolm, 1977, Atkinson and Bourguignon 1982, Maasoumi, 1986, Duclos et al. 2001). Some important critiques to this approach have also emerged suggesting that several indexes of poverty measured on different dimensions may be more effective than a single multidimensional index (Ravallion, 2011). However, the debate around the measurement of multidimensional poverty is not so much about the 'if' but about the 'how'. The Alkire and Foster (2011) index of multidimensional poverty, for example, has recently generated great attention and controversy witnessing both the importance and the complexity of the topic.

The complexity of measurement of multidimensional poverty arises principally from two main issues. The first issue relates to the direction of aggregation in the construction of the index, whether "horizontally" where dimensions are aggregated across individuals first or "vertically" where individuals are aggregated across dimensions first. These two approaches imply different methodologies and can often lead to different results. The second problem is the weighting of the different dimensions. Some scholars prefer to attribute equal and unitary weights to all dimensions while other scholars use various methods to identify dimension specific weights. The weight choice evidently implies a combination of normative and positive criteria, which makes it difficult to argue that one choice is better than another (partly explaining the controversy around multidimensional indexes).

In this paper we follow the "horizontal" approach by constructing first a composite indicator of welfare and then use this indicator to rank households and measure poverty. In doing so, we follow one of the least beaten tracks by making use of Multiple Correspondence Analysis for the construction of the composite indicator. This technique has been recently rediscovered for the study of multidimensional poverty (Asselin, 2009, Njong, and Dschang, 2008) as it provides a method for assigning weights to different dimensions while it responds to some essential welfare axioms.

Our application is on Morocco using 2001 and 2007 consumption data. During the last decade, Morocco has experienced consistent growth generated by economic reforms and investments in infrastructures. These developments have resulted in improved living conditions as shown by official statistics and reports (Doudich and Ezzrari, 2009). However, it is typically heard from local and foreign commentators that these gains have been unequally shared and/or that living conditions have been improved in certain areas but not in others. Thus, a multidimensional approach to the study of poverty can provide a better sense of whether the gains in Morocco have been robust and comprehensive.

The paper is organized as follows: Section 2 briefly reviews the different approaches to the study of multidimensional poverty. Section 3 illustrates the Multiple Correspondence Analysis approach and its properties; section 4 describes Morocco's economic framework and data; section 5 describes the results of the MCA conducted in two steps; section 6 provides a multidimensional poverty analysis of Morocco in 2001 and 2007 and section 7 concludes.

## **2. Alternative approaches to the study of multi-dimensional poverty**

A poverty index requires, by definition, a welfare measure that we can use to rank households or individuals and a poverty line that we can use to separate the poor from the non-poor. In the case of a uni-dimensional index of poverty, this exercise is quite straightforward and scholars have reached a certain consensus on the desirable properties that these indexes should have while practitioners have endorsed these properties by using popular measure of poverty that satisfy these properties such the Foster-Greer-Thorbecke (FGT) poverty indexes.

In the case of a multi-dimensional poverty analysis, the situation is much complicated by the fact that rather than working with one dimension of welfare we work with several dimensions. We pass from a uni-dimensional space to a multi-dimensional space. If we think of individuals as represented in rows ( $r$ ) and welfare dimensions as represented in columns ( $c$ ), then the new multidimensional distribution can be represented by a  $r \times c$  matrix. A multi-dimensional analysis complicates the study of poverty in at least two important respects. First, it is what we could describe as the 'direction' of aggregation. The question of how one should proceed in the aggregation of individuals and dimensions, whether by rows first (individuals) or by columns first (dimensions). And second what is the weight that should be attributed to each individual and dimension during the aggregation process.

The direction of aggregation reflects different methodological approaches. We can first define deprivation for a society in each of the deprivation dimensions we wish to use and then aggregate deprivation across dimensions to construct a multidimensional deprivation index. This is the approach followed, for example, by the UNDP Human Development Index where deprivation levels are first measured within the different dimensions at the societal level and then aggregated into one indicator. Alternatively, we can first define a multi-dimensional indicator of deprivation at the individual level and then aggregate this indicator across individuals at the societal level. Under certain conditions the end results at the societal level will be the same but this is not necessarily always the case. For example, different approaches to weighting the different dimensions or individuals can result in very different societal indicators.

In this paper, we follow this second approach. We define first what we call a Composite Welfare Indicator (CWI)<sup>4</sup> at the individual level and then aggregate this individual welfare indicator across individuals as we would do with standard uni-dimensional poverty measures. Therefore, the multidimensional question is treated at the individual level with the construction of the CWI while aggregation at the societal level can follow standard procedures used for uni-dimensional indexes.

The second question of weight is complex and largely unresolved. When we aggregate different welfare dimensions the question is whether each dimension should have the same weight or different weights. Should, say, illiteracy be given the same weight as malnutrition? Some authors have preferred to attribute equal weights to different welfare dimensions. In this case, the problem of weights does not arise as all dimensions are attributed an equal weight (usually one). Other authors have made an effort to attribute different weights to the different dimensions according to various criteria. For example, some authors have imposed arbitrary weights on different dimensions based on economic criteria or simply normative considerations. Some use hybrid approaches where weights are attributed to differentiate income and non-income components but then equal weights are used for non-income dimensions. Other authors have tried instead to use surveys that ask questions to respondents about the importance of different dimensions and used answers to these questions to attribute weights to dimensions. Another stream of literature tried to seek weighting schemes based on expenditure patterns or other behavioral patterns measured in observed variables. Decancq and Lugo (2010) have reviewed these different approaches to weighting schemes in multidimensional indices of poverty and classified these approaches in no less than eight different categories.

Another approach that has been recently explored with the measurement of multidimensional poverty is a weighting scheme based on factorial or Principle Component Analysis (PCA). The idea is simple. We can consider welfare as a complex and unobserved multidimensional phenomenon that we want to estimate based on a set of observed proxies of welfare. We are searching therefore for a latent variable and our objective is to use and aggregate what we consider as possible dimensions of welfare in a way that they can represent satisfactorily the unobserved complex welfare indicator.

The natural choice for exploring latent variables is a PCA type of analysis. In addition to considering multidimensional poverty as a latent variable, this technique is particularly appealing because it provides weights for each dimension based on the covariance matrix of the  $rXc$  matrix. Therefore, the weights are implicitly determined by the procedure and based on the correlation system of all variables vis-à-vis the latent multidimensional variable. PCA type of analyses are particularly indicated for continuous and

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<sup>4</sup> Unlike previous studies, we refer to the composite indicator as ‘welfare’ rather than ‘poverty’ indicator. That is because the composite indicator applies to poor and non-poor and is therefore a ‘welfare’ indicator.

quantitative variables and this is a drawback if one wants to apply the methodology to the study of multidimensional poverty where non-income variables are typically categorical. A better approach for categorical variables is Multiple Correspondence Analysis (MCA). This is a technique that is still relatively little explored. Decancq and Lugo's (2010) review of weighting methods, for example, does not make any mention of MCA methods, which address part of the concerns raised by the authors in relation to PCAs.

### **3. A multiple correspondence analysis approach**

In this paper we opt to use Multiple Correspondence Analysis (MCA) developed first by Benzécri, (1973) (see also Greenacre, 1984). The construction of our Composite Welfare Indicator (CWI) will rely exclusively on categorical variables and it is well known in factorial analysis that when dealing with categorical variables a suitable choice is MCA as it makes fewer assumptions than PCA on the underlying distributions of variables. In MCA analyses, each modality of each categorical variable is typically broken down into a 0/1 binary indicator.

As PCA, MCA is a data exploration technique that is used to uncover correlation patterns across sets of variables described by single components named principal components. Principal components can be considered as latent unobserved variables that account for the maximum variance of a set of other variables. The first principal component represents the unobserved latent variable that captures the highest variance of all observed variables used in the analysis and that is therefore the best candidate to represent all the variables considered. The first principal component can be visualized as the interpolation line that passes through a cloud of points set in an imaginary  $n$ -dimensional space of variables (axes) and that minimizes the square of the distances from all these variables (axes) and points. The main difference of this approach from standard econometric approaches is that the dependent variable is unobserved and cannot be used directly to estimate correlation coefficients. We assume therefore that welfare is a multidimensional latent (unobserved) variable.

There are at least two computational advantages in using MCA for poverty analysis in addition to its suitability for categorical data (Asselin, 2009). The first is that MCA gives more weight to indicators with a smaller number of hits. If we have few deprived individuals within any dimension, these individuals are given a higher weight. In the case of deprivation indicators where the state of deprivation is indicated by one, this could be interpreted as giving more importance to minority population groups such as the relatively more deprived. Njong and Dschang (2008) compare PCA, MCA and the fuzzy approach in a study of multidimensional poverty in Cameroon and find that PCA estimates show unambiguously lower

poverty than those obtained from the other two methods. They conclude that MCA and fuzzy methods are more sensitive to deprivation and may be preferred to PCAs approaches for this reason.

The second property is reciprocal bi-additivity. This states that a) the composite deprivation score of an individual is the simple average of the factorial weights of the deprivation categories and b) The weight of a given dimension of deprivation is the simple average of the composite deprivation scores of the population units that belong to the given dimension. This second property is particularly important because it implies that the population ordering in each of the dimensions used is preserved in the composite indicator as discussed below in the context of the basic axioms.

With these properties in mind we can turn to the formulation of the CWI. Let  $k$  be the number of dimensions (variables) with  $k = (1, 2, \dots, K)$ ,  $j$  the number of modalities of each dimension with  $j=(1,2,\dots,J_k)$  and  $I$  the binary (0/1) indicator of each modality.  $W$  is the weight determined with MCA (the factor score on the first axe normalized by the eigenvalue  $\lambda$  with  $s$ =factor score), and  $i$  is the index number indicating households. Then the functional form of the Composite Welfare Indicator (CWI) can be described as

$$CWI_i = \frac{1}{K} \sum_{k=1}^K \sum_{j_k=1}^{J_k} W_{j_k}^k I_{j_k^i}^k$$

with

$$W_{j_k}^k = \frac{s^k}{\sqrt{\lambda_1}}$$

In essence, the composite indicator is the simple average across dimensions (variables) of the weighted sum of each binary modality of each dimension.

As described in Asselin (2009) a two-steps procedure simplifies somehow the axiomatic requirements for the first component to be a consistent composite index and boils down to two major axioms: 1) *Monotonicity Axiom* stating that the composite indicator must be monotonically increasing in each of the primary indicators. If any individual improves his/her situation in relation to one of the primary indicators, then the composite index should improve (everything else being equal). This axiom implies two requirements: a) First Axis Ordering Consistency (FAOC-I) for an indicator  $I$ , which states that there must be an ordinal consistency between the ordering of categories and the ordering of weights across categories, either increasing or decreasing order; b) Global First Axis Ordering Consistency (FAOC-G),



which states that, for all indicators, FAOC-I is met with the same orientation, either decreasing or increasing; 2) *Composite Poverty Ordering Consistency (CPOC)* stating that the population ordering of an indicator  $I$  is preserved with the composite indicator.

FAOC-I is always met with binary indicators. Consistency is always met if one of the two categories of the binary indicator is empty (such as “have” and “not have” some asset). With multinomial indicators and if FAOC-I is not met, the categories can be reorganized so as to meet the property, for example by reducing the multinomial indicator into a binomial one. FAOC-G requires instead that all indicators have the same orientation with respect to the first-axis. This is more difficult to achieve given that some indicators may represent a sub-set of deprivation showing different signs versus the first axis. In this case, we might want to re-elaborate the variable or to eliminate the variable altogether. It is also possible to explore further axes as discussed in Asselin (2009) but this is an option that we won't need to follow with our data.

By construction, the weights that result from the MCA procedure average to zero and can have positive and negative values. This is inconvenient for measuring poverty in the second step and it is useful to positively rescale the weight by subtracting the lowest weight from each weight as follows

$$W_{j_k}^k = \frac{s^k - s_{\min}^k}{\sqrt{\lambda_1}}$$

so that the most deprived category of an indicator is always equal to zero and the composite index is always greater or equal to zero. In the paper, rather than rescaling the weights, we will rescale the CWI so that it will become easier to compare this measure with standard monetary measures of welfare such as expenditure per capita.

We will also consider multidimensional poverty over time. This adds the complication of the choice of weights given that we need to have consistent weights over time. One possibility is to merge the two datasets and calculate the weight using both surveys. A second possibility is to calculate the weights in one year and apply the same weights to the other year. We initially tested both approaches and found that the final results were almost identical with a correlation coefficient calculated between the two CWIs of 0.995 and a very consistent ranking of households. We therefore opted for the second approach and used the weights calculated from the second of the two surveys used in this paper. This is the same approach followed by other authors (see for example Asselin, 2009)

#### **4. Economic context and data**

The study of poverty in Morocco has seen major developments during the last two decades thanks to the increased availability of micro-data and thanks to the increased capacity on the part of the government to analyze poverty. The High Commission for the Plan (HCP), for example, has published several studies during the last decade covering a range of topics such as pro-poor growth, geographical targeting, poverty maps and poverty dynamics. All these studies relied on expenditure as a measure of welfare, took a uni-dimensional approach to the study of poverty and found consistent results in that poverty has declined in both urban and rural areas between 2001 and 2007.

This positive result is consistent with the general macroeconomic framework and key reforms implemented by the government in recent years. Starting from the 1990s, Morocco has embarked in a process of liberalization of the economy that led to increased foreign investments and trade. The country has also implemented a large program of public investments throughout the decade and has been able to improve significantly on other fronts such as health and education. Average GDP growth has increased to 4-5% a year with peaks of 7%. During the second half of the last decade, the government has also launched a large human development program (Initiative for National Human Development – INDH) that covers all poor areas of the country and finances local development activities from private entrepreneurship to public recreational centers. The INDH program has now completed its first phase and is currently launching a second phase. The evaluation of the first phase is extremely complex given the nature of the program but stakeholders agree that the program had a visible impact on local communities.

A multi-dimensional approach to the study of poverty can complement uni-dimensional studies and also offer a better sense of whether recent reforms and improvements in welfare have concerned most dimensions of welfare or only a few dimensions. We therefore rely on the same data used by other studies including the National Survey on Consumption and Expenditure carried out between 2000 and 2001 and including 14,243 households (henceforth NSCE 2000/01) and the National Survey on Living Standards carried out between 2006 and 2007 and including 7,062 households (henceforth NSLS 2006/07). Both surveys are representative at the national, urban-rural and regional levels and they are fully comparable across all variables used in this paper.

Table 1 lists all variables used in the first step of the MCA exercise where we use a large set of variables to test how these variables polarize around the different axes. These variables are grouped in eight broad areas including employment, education, health, housing, utilities, durables, nutrition and expenditure. The choice of these initial variables is largely normative but based on decades of research on poverty in

Morocco where all these variables have been shown to be closely associated with welfare indicators of various types.<sup>5</sup> Most of these variables are also typically used in the literature on the construction of multi-dimensional poverty indexes (see Decancq and Lugo, 2010 for a review).

The MCA procedure is carried out separately for urban and rural areas. Morocco is a country of great divides between urban and rural areas and the sets of variables relevant for constructing the CWI are expected to be different so as to reflect the respective peculiarities of rural and urban areas. Following the first-step procedure, the number of variables is reduced to meet the consistency properties of the principal component. We will see that this variables reduction process leads to different results in urban and rural areas confirming the initial hypothesis that urban and rural areas are better represented by two different models rather than by one model.

[Table 1]

## 5. Multiple Correspondence Analysis

The MCA analysis is carried out in two steps. In the first step we use all variables listed in Table 1 to provide a first indication of the association patterns with the principle component. In the second step we remove or adjust variables so as to meet the basic conditions of the MCA discussed in previous sections.

**Step 1** - Table 2 and 3 illustrate the results of the preliminary MCA for urban and rural areas. The table of eigenvalues highlights the distinction between the first factorial axis and the following axes (labeled as dimensions “Dim” in the tables). In urban areas (Table 2), this axis alone explains more than 52% of the total inertia of the cloud of variables while the explanatory power drops to 9% for the second axis and to 6% for the third axis. Most of the variance of the set of variables used for urban areas is captured by one axis. In rural areas (Table 3), the first axis is less powerful capturing 46.6% of the total variance. This is also followed by one axis that captures over 11.5% of the total variance and a few other non negligible axes.

In order to improve the model in a way that satisfies that basic properties discussed in previous sections, we now need to look at the inertia of each variable and modality on the first axis, which is our latent multidimensional measure of welfare. Table 4 provides details of the various poverty proxies for the first axis in urban and rural areas. The state of poverty is described by the indicators negatively correlated to the first axis, while well-being is captured by the indicators that are positively correlated. A review of the most negatively correlated variables to the first axis allows identifying poor households as those

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<sup>5</sup> See <http://www.omdh.hcp.ma/> for a number of poverty studies on Morocco conducted by the High Commission for the Plan.

households with very low access to education, health, fresh water, sanitation, housing, nutrition and assets regardless of the place of residence.

More specifically, a low level of welfare is characterized by a low literacy rate of the household head, a small proportion of members who cannot read and write in the household and a high proportion of members with no diploma in the household. In the field of health, sanitation and drinking water, the MCA shows that the poor usually do not have access to health care for illness or injury and have no medical coverage. They do not have toilets at home and are not connected to the potable water supply or even to a public fountain nearby (the case of rural households). Poor households also fail to meet their basic nutrition needs to the extent that their expenditure on food is below the food poverty line. These households have also children under age of five suffering from malnutrition and stunted growth.

In the field of housing, poor households live in homes characterized by the absence of basic hygienic conditions and comforts. They have no electricity in their homes, use candles and gas lamps or kerosene for lighting. In terms of communication, poor households do not have televisions, satellite dishes and cell phones. The percentage of households that do not have these means of communication is greater in rural than in urban areas. The group of poor households also lacks basic durables such as gas stove, gas oven, refrigerator or freezer. In terms of employment, poor households are those headed by jobless people. There is also a category of non-poor households who may be well off in terms of employment but they are still very poor compared to other dimensions such as education, health, water and communications. Therefore the phenomenon of the employed poor is also clearly visible in these data.

In contrast to poor households, wealthy households are generally those who have access to education, health, drinking water, sanitation, decent housing, food and basic assets. Households that are well connected to the welfare axis are households whose head is literate, who have a high proportion of literate people and where low levels of education are absent. These same households have also access to basic health services in case of illness or injury and are covered by the health insurance system. They have children under five years of age who do not suffer from stunted growth or malnutrition. These households also have homes connected to potable water and sewage systems and have hygienic toilets. They live in decent housing and have electricity and various means of comfort (kitchen and appliances). Affluent households are households that have access to communication (televisions, mobile phones and satellite dishes), whose head is an employed person and where young children aged 15 to 24 do not exercise a professional activity.

We can also trace some differences between urban and rural areas. For example, the employment of the head of the household takes different signs in urban and rural areas and so do most modalities for the type of accommodation and for used water. There are also differences in signs for at least one modality of other variables such as education and health variables.

Overall, we can safely argue that the first axis describes a situation of welfare and that this welfare is multidimensional in that many different aspects of welfare such as health and education exhibit very similar behaviors towards this axis. However, much more can be done in further refining the model by removing or adjusting variables so as to better meet the fundamental properties of the MCA approach.

**Step 2.** Next, we review the behavior of each variable to test whether the model is robust to the underlying properties discussed. The MCA provided us with the basic elements to select the variables that will be used in the construction of the CWI. The main criterion used to reduce the number of variables without losing substantial consistency is the First Axis Ordering Consistency (FAOC-I). The variables that have the FAOC-I property are those obeying the rule that welfare deteriorates from a position of wealth to a position of poverty throughout the first axis.<sup>6</sup> We therefore proceeded to eliminate some variables based on FAOC-I. These variables include the employment of the head of the household in both urban and rural areas. This variable had a counter-intuitive sign and was clearly a substitute for other employment variables. Other categorical variables did not meet the FAOC-I property but were kept and restructured so as to meet the property. These variables are access to health care, state of health and medical coverage, type of housing, children's nutritional status and source of drinking water. Categorical variables representing the proportions of employed in the household and those of the unemployed were eliminated altogether failing to meet FAOC-I. Possession of a freezer in rural areas responds to FAOC-I but the variable was eliminated because of the low frequency of one of the modalities (less than 1%).

Tables 2 and 3 also report results for the final MCA exercise. For urban areas (Table 2), the MCA performed on the remaining variables led to an increase in the explanatory power of the first factor, which rose from 52% to 69%. In the final analysis the poor are situated on the left and the rich on the right so that well-being increases from left to right. In this new plan and as shown in Table 5, all variables have the FAOC-I property of ordinal consistency on the first axis. We can also see that all variables show the same direction vis-à-vis the first axis satisfying FAOC-G. There is therefore a clear separation of rich and poor households who are opposed to the first factorial axis. We can conclude that the household score generated by the MCA on the first axis is a consistent indicator that can be used for ordering purposes to

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<sup>6</sup> Note that other criteria also used to select relevant variables such as the spread on the first axis, the high frequency of non-responses or low frequencies of responses on certain modalities.

measure poverty. The same conclusion can be reached for rural areas (Table 3) and the gain of the second step procedure is much greater. The explanatory capacity of the first axis passes from 46.7% to 70.3% with the second axis falling to 4.3%. The direction of the relation of the variables with the first axis is also consistent across the variables (Table 5) which is what we need to use our new latent variable as a welfare indicator.

It is also instructive to look at the size of the weights in Table 5 to see the importance that the analysis attributes to each domain. As a rule of thumb, we take values larger than two as an indication of key welfare factors. In this category we find households with the share of education above 2/3 for urban areas and the share of alphabetized above 2/3 for rural areas, owing a villa in both urban and rural areas, owing a shower, a television or satellite dish in rural areas and owing a television and a freezer in urban areas. Also, being connected to the water and sewage systems are major indicators for rural areas while not being connected to these same network is very relevant in urban areas.

[Tables 2-5]

## **6. Multidimensional poverty**

### **6.1 The Composite Welfare Index (CWI)**

Following the MCA procedure, we can finally calculate the CWI for each household. As defined in previous sections, the value of the CWI for a household is the average of its weight categories corresponding to the average of standardized scores on the first factorial axis. In other words, it is the factorial coordinates of the household on the first axis that classifies households according to their state of well-being. The extreme values of the CWI thus calculated are -1.77 (the poorest households) and 0.75 (the richer households) in urban areas and -1.0 and 1.35 respectively in rural areas. It is worth providing a poverty profile of these extreme cases to have a sense of the actual living conditions of these households.

A household that has the smallest CWI value (-1.77) in urban areas has the following characteristics: the household head is illiterate; more than three-fourth of the members of this household have no grade and less than a third can read and write; members of the household do not have access to health care services and have no medical coverage; children within the household suffer from stunting; housing is precarious and it is not connected to the networks of drinking water, electricity and sewage; the household does not own basic assets such as shower, kitchen, toilet, television, satellite dish, portable gas stove, refrigerator and others; in terms of expenditure, household food expenditure is well below the food poverty line and total expenditure is not even half the poverty line. Instead, the household with the highest CWI in urban

areas (0.75) has the following characteristics: the household head is literate; all household members received education and can read and write; all members of this household have medical coverage; the dwelling of the household is a villa and is connected to all utilities; the household also has all the elements of comfort with all listed durable goods; in terms of expenditure, food expenditure of households is four times the poverty line.

For rural areas, the household with the lowest CWI value (-1.0) lives in very difficult conditions. All members of this household are either illiterate or have no education, they do not have access to health care services and they are not covered by medical insurance. With regard to housing conditions and comforts, this household has no basic equipment or durables. Food expenditure and total expenditure of the household are respectively below the food poverty line and the full poverty line. The rural household with the highest CWI score (1.35) lives in better conditions in terms of access to basic amenities (education, health, housing and others) and, in terms of expenditure, this household belongs to the wealthiest 20% of rural households.

## **6.2. Multidimensional Poverty in 2007**

The CWI is a numeric variable that measures the level of welfare of households. Like all other variables measuring welfare (expenditure, income or consumption), this indicator can be used to measure poverty. However and unlike other monetary measures of welfare, the CWI can take positive and negative values. This question can be simply solved by adding to the score of each household the absolute value of the lowest score in the distribution. Then all we need to do is to determine a threshold that divide the poor from the non poor and then measure poverty. Therefore, multidimensional poverty in our paper is better described as a uni-dimensional poverty exercise based on a multi-dimensional (composite) measure of welfare. As already discussed, this is different from multi-dimensional measures of poverty that first aggregate individuals across each dimension at the societal level and then aggregate dimensions with various weighting mechanisms.

As a poverty line, we will use a relative poverty line defined as 60% of the median CWI ( $Z_i=0,6 * CWI_{i,median}$ , with  $i= 1$  for urban areas and 2 for rural areas). Any study on poverty requires defining a poverty line dividing the poor and non-poor households. For monetary approaches, there are countries that use absolute poverty lines which represent the minimum amount necessary for the individual to meet basic needs. This is also the case, for example, of poverty analysis carried out in Morocco in the past. Other countries use relative poverty lines, often defined as a percentage of median income, which represent the minimum welfare level generally accepted in society. This is the case, for example, of European Union's countries. In the case of the CWI, we opted for a relative poverty line since the CWI

indicator is not a monetary indicator where we can find the monetary poverty line. In principle, we could have estimated the CWI for the household closest to the monetary poverty line and used this value as poverty line for the CWI distribution. However, the monetary poverty line is meaningful in that it separates the poor and non-poor on the monetary scale but cannot equally apply to a scale where the household ranking may be different such as the CWI scale. For example, a household that is on the monetary poverty line but owns all possible assets would result in a very high poverty line on the CWI scale. Vice-versa, a household that is on the monetary poverty line but owns no assets may result in a very low poverty line on the CWI scale. Hence the choice of a relative poverty line.

To give a flavor of the CWI poverty line selected we looked at the characteristics of the household that is closer to the line in urban and rural areas. In urban areas, we found this household to have the head unemployed, a good share of educated people, no coverage of health insurance, to be well connected to water and electricity, to own many but not all essential items and to be in the first expenditure quintile. In rural areas, the household the closest to the poverty line suffers from youth unemployment, has low levels of education (but alphabetized), has access to health services but no insurance, lives in basic accommodation and is not connected to electricity, water or sewage networks and lacks basic items such as a gas stove and a refrigerator. However, this household does not suffer from malnutrition and belongs to the fourth expenditure quintiles among rural households. Although these two households may not be representative of households located around the poverty line on all dimensions, this illustration shows that the profile of an urban and rural poor household may be very different.

Based on the relative poverty line selected, Table 6 reports the CWI values of the main moments of the distribution as well as the values of the poverty line for urban and rural areas. It is evident that the mean and the median of the distributions are quite close indicating that the distributions are not very skewed. This is particularly the case in rural areas where the mean and median values are almost identical.

[Table 6]

We can now measure poverty using the CWI. In the construction of our CWI, we have considered two variables that were constructed using expenditure per capita, the food poverty variable and expenditure quintiles. Here we also want to compare poverty measured with the multidimensional indicator with poverty measured with the more traditional expenditure indicator. We can then assess the relation between poverty measured with the CWI and with expenditure per capita.

A simple correlation coefficient between the CWI and expenditure per capita shows that this relation is positive and significant with a coefficient of 0.46. This would suggest that there is a direct linear



relationship between the two variables but that this relationship is by no means unitary. High household expenditure per capita is likely to be associated with a high CWI but this is not always the case.

Table 7 shows poverty levels according to both CWI and expenditure measures for urban and rural areas. All measures show invariably that poverty is higher in rural areas. This is true for all FGT poverty measures and for both CWI and expenditure measures. The difference in poverty between CWI and expenditure measures is more marked in rural as opposed to urban areas although this may simply be a scale effect given that poverty is higher in rural areas.

[Table 7]

The relation between CWI poverty and expenditure poverty has also a mechanical element built into it given that expenditure is one of the dimensions considered in the construction of the CWI. Given that for 2007 we also have income, in Table 8 we plotted CWI poverty rates by income per capita quintiles instead of expenditure. We find that higher income per capita quintiles correspond to lower levels of poverty as one would expect. CWI poverty is monotonically decreasing in income quintiles with no exceptions for the three FGT indicators. CWI poverty also declines very significantly between the first and second quintile. However, it is also evident that the two types of poverty do not overlap completely. In monetary terms, 60% of the median value would be situated between the first and second income quintile whereas CWI poverty still exists in the third, fourth and fifth expenditure quintile. Therefore, many non-poor households clearly fall under the CWI poverty line.

[Table 8]

It is useful at this stage to assess the extent of double poverty, or the poverty groups that are found to be poor by both the multidimensional and the uni-dimensional approach. This is shown in Table 9. In urban areas, about 2% of the population is found to be double poor. About 10% of the population is at least poor in one of the two dimensions while the remaining 90% is neither CWI nor expenditure poor. In rural areas, the rates are higher as we know by now but the distribution in the various cells of the table is also different. About 6% of the population is double poor while over 26.7% is poor according to at least one criteria with only 73.3% of the population being outside both types of poverty.

[Table 9]

Some insights about the main drivers of double poverty can be derived from Table 10 where we look at double poverty according to various household characteristics in 2007. Poverty is higher in households

headed by men as compared to households headed by women but this difference is not very large and the number of households headed by women is relatively small. Depending on the size of households, double poverty increases with household size. It displays its maximum when the household is composed of 10 or more people with a percentage of 7.3% against 0.9% for those living in households with less than 4 people. Interestingly, households that are poor according to non-monetary criteria but non-poor according to monetary criteria seem to experience higher poverty the smaller is the household size. This might be explained by the fact that smaller families have fewer assets than larger families, income being equal. By grade level of the household head, 23.8% of people living in households headed by someone with no education are at risk of at least one form of poverty. Double poverty affects 5.5% of those households headed by people who never attended school. Also, the higher the educational level of the household head the lower is the risk of poverty as one would expect. Overall and considering urban and rural areas together, in 2007 3.8% of people were below the poverty line according to both CWI and expenditure criteria. This can be considered as the core of poverty in Morocco while 82.8% of the population is above all forms of poverty.

[Table 10]

### **6.3 Multidimensional poverty over time**

As already discussed and in order to conduct the MCA analysis over time, we used the weights from the NSLS 2006/07 for both time periods considered. We also followed exactly the same methodology we used for the 2006/07 MCA for the 2000/01 data. The multidimensional poverty line for 2000/01 is equal to 60% of the CWI median value and amounts to 1.1 in rural areas and 0.6 in urban areas.

The analysis of CWI and expenditure poverty over time shows that the two forms of poverty declined significantly between 2001 and 2007 (Table 11). This decrease is more pronounced with the multidimensional approach as compared to the monetary approach at the national level. The rate of multidimensional poverty decreased from 23.9% in 2001 to 12.1% in 2007, an average annual decline of about 12%. Income poverty has decreased annually by an average of about 9.5%, from 15.3% in 2001 to 8.9% in 2007. Urban and rural areas show different patterns. Poverty in rural areas is much higher and the decline over the 2001-2007 period has been steeper. Multidimensional poverty in particular shows that rural poverty declined by more than half, from 42.35 to 18.3%.

[Table 11]

### **6.4 Robustness analysis**

The choice we made of poverty lines is an arbitrary choice and changing the poverty line affects results to an extent that poverty trends over time could also be reversed. It is sensible therefore to test the sensitivity of our results to changes in the poverty line. We use stochastic dominance analysis, which ensures that all possible poverty lines are taken into account. This technique can attest that temporal comparisons are valid for a given range of poverty lines and for a given class of poverty measures.

To simplify the presentation of results, we normalized the CWI and expenditure distributions so that the poverty line under the two approaches is equal to 100. To check the conditions of the first order stochastic dominance, we calculated the differences of the effects of poverty distributions calculated for 2001 and 2007, for different values of poverty lines (table 12). It is clear from reading the table that the distribution of 2007 dominates the 2001 distribution nationally according to the two approaches to poverty. Indeed, whatever the poverty line considered, the incidence of poverty is more important in 2001 than in 2007. Expenditure poverty has decreased substantially between 2001 and 2007 regardless of the place of residence, regardless of the poverty line and regardless of the measure used.

#### **[Table 12]**

We can now assess stochastic dominance of first order visually by comparing the Cumulative Distributions Functions (CDFs). Figure 1 presents the results. Plots are presented for urban and rural areas and for expenditure and the CWI separately. For the expenditure measure, there is a visible gap between the 2001 and 2007 curves in both urban and rural areas. The 2007 curves dominate the 2001 curves in that poverty is lower in 2007 for any poverty line considered. For the CWI measure, this same phenomenon is even more visible in rural areas where we can clearly see that welfare has improved and poverty has declined for any poverty line considered. However, this is not true for urban areas where the curves intersect around the third quartile suggesting that dominance is reversed along the curve. With very high poverty lines, the poverty headcount was higher in 2007 than in 2001, although we cannot be sure that this would apply to all poverty indexes. This clearly shows the utility of a stochastic dominance approach. In all statistics presented thus far, we found no indications that poverty might have grown between 2001 and 2007. With first-order dominance we uncover a small but visible increase in multidimensional poverty for the upper part of the distribution if a very high poverty line is used.

As a final exercise, we focus again on 2007 and compare the expenditure and CWI Lorenz curves, also for urban and rural areas (Figure 2). This is suitable for measures that are intrinsically different such as

expenditure and CWI given that both axes are normalized to one. In reality we cannot exclude some data generation pattern in the MCA approach that would make the CWI scores exhibit consistently lower or higher inequality than a typical expenditure measure. Intuitively, one would expect a measure built on several indicators to show higher inequality than a measure built on one indicator but this is not the case. The CWI measure shows invariably less inequality than the expenditure measure and this is true for both urban and rural areas. This finding is also robust and visible all along the two distributions. We can also see that rural areas exhibit higher inequality than urban areas for both the CWI and expenditure measures. This is particularly true for the CWI measure suggesting that diversity in non-monetary measures is much more pronounced in rural areas than in urban areas.

[Figures 1 and 2]

## **7. Conclusions**

The paper has used Multiple Correspondence Analysis (MCA) to construct a consistent Composite Welfare Indicator (CWI) and used this indicator to assess poverty in Morocco between 2001 and 2007. This is one of the least explored paths in the measurement of multidimensional poverty and complements existing studies on poverty in Morocco. It is also an approach that has two important computational advantages. It gives more weight to indicators with a small number of hits, hence giving more importance to deprived minorities, and complies with the welfare axiom of reciprocal bi-additivity (see Asselin, 2009).

The MCA procedure was carried out separately for urban and rural areas on the assumption that the MCA models would be different in the two areas. Results of the two-steps procedure showed indeed that the resulting models are different and confirm the known fact about Morocco of a deeply divided society along urban and rural lines. The multidimensional indicators that characterize these two areas for both the poorest households and the least poor are often different, which is an important finding for policy purposes.

Overall, we found that the multidimensional approach largely confirms previous results on monetary poverty. Monetary and non-monetary indicators are positively and significantly correlated but this correlation is by no means unitary suggesting that multidimensional and monetary poverty do not describe the same phenomenon. However, the multidimensional approach corroborates monetary results in various respects. In 2007, poverty is found to be higher in rural areas as compared to urban areas and according to all FGT poverty indicators. And the decline in poverty observed between 2001 and 2007 has

not been limited to improvements in monetary indicators but has concerned multiple aspects of living conditions including health, education and labor market conditions. In fact, the decline in multidimensional poverty appeared to have been more pronounced than the decline for monetary poverty. The multidimensional approach also confirms that the decline in poverty has been stronger in rural as opposed to urban areas, although the starting level was much higher in rural areas.

Robustness tests including stochastic dominance tests validate both the monetary and the multidimensional findings. Interestingly, multidimensional inequality shows invariably less inequality than the monetary counterpart, in both urban and rural areas, which may be explained by the fact that larger families tend to be more monetary poor in per capita terms but also tend to own a larger number of assets on a household basis. The paper has also confirmed that the urban-rural divide remains very deep in Morocco and should continue to rank high in terms of policy priorities.

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**Table 1 – List of Variables and Modalities**

<b>Variable</b>	<b>Modality</b>	<b>Variable</b>	<b>Modality</b>
<b>EMPLOYMENT</b>		<b>UTILITIES</b>	
Head of household unemployed	yes	Fresh water	network
	No		fountain
Head of household employed	yes		source
	No		other
Youth unemployment	active	Electricity	individual meter
	unemployed		collective meter
	inactive		no meter
	no youth		no electricity
Household share of employed	none	Used water	network
	less than 1/3		septic tank
	between 1/3 and 2/3		latrine
	more than 2/3		other
Household share of unemployed	none	<b>DURABLES</b>	
	less than half	Satellite dish	yes
	more than half		no
<b>EDUCATION</b>		Portable phone	yes
Head of household alphabetized	yes		no
	No	Gas stove	yes
Household share with no education	less than 1/3		no
	between 1/3 and 1/2	Gas hoven	yes
	between 1/2 and 3/4		no
	more than 3/4	Refrigerator	yes
Household share of alphabetized	less than 1/3		no
	between 1/3 and 1/2	Freezer	yes
	between 1/2 and 2/3		no
	more than 2/3	<b>NUTRITION</b>	
<b>HEALTH</b>		Child stunting	yes
Household access to health	no health problems		no
	total access		no children
	partial access	Child malnutrition	yes
	no access		no
Household medical coverage	yes		no children
	No	<b>INCOME</b>	
Household share of medical coverage	total coverage	Food poverty	yes
	at least half household		no
	less than half household	Income quintiles	Q1

	no coverage		Q2
<b>HOUSING</b>			Q3
Type of accommodation	villa		Q4
	apartment		Q5
	moroccan house		
	basic dwelling		
	rural house		
	Other		
Cohabitation	one household		
	two households		
	three households		
	four households and more		
Bathroom/shower	yes		
	No		
Kitchen	yes		
	No		
Toilet	yes		
	No		
Number of persons per room	one person or less		
	between one and two		
	between two and three		
	more than three		



**Table 2 – Multiple Correspondence Analysis (Urban Areas)**

<b>Dimension</b>	<b>MCA (preliminary)</b>			<b>MCA (final)</b>		
	<b>Principal inertia</b>	<b>Percentage</b>	<b>Cumulated percentage</b>	<b>Principal inertia</b>	<b>Percentage</b>	<b>Cumulated percentage</b>
Dim 1	0.0238	52.03	52.03	0.02569	69.22	69.22
Dim 2	0.00425	9.28	61.31	0.00204	5.51	74.72
Dim 3	0.00275	6.01	67.32	0.00127	3.41	78.14
Dim 4	0.00208	4.55	71.87	0.00118	3.17	81.31
Dim 5	0.00139	3.04	74.91	0.00048	1.3	82.62
Dim 6	0.00073	1.6	76.51	0.00037	0.99	83.61
Dim 7	0.00045	0.98	77.49	0.00029	0.78	84.39
Dim 8	0.00034	0.74	78.22	0.00013	0.37	84.76
Dim 9	0.00028	0.61	78.84	0.00006	0.17	84.93
Dim 10	0.00016	0.35	79.18	0.00003	0.09	85.02
Dim 11	0.00013	0.29	79.48	0.00001	0.03	85.05
Dim 12	0.00011	0.25	79.73	0	0.02	85.06
Dim 13	0.00009	0.19	79.92	0	0.01	85.07
Dim 14	0.00006	0.14	80.05	0	0	85.07
Dim 15	0.00005	0.12	80.17	0	0	85.07
Total	0.04575	100	--	0.03711	100	--

**Table 3 – Multiple Correspondence Analysis (Rural Areas)**

<b>Dimension</b>	<b>MCA (preliminary)</b>			<b>MCA (final)</b>		
	<b>Principal inertia</b>	<b>Percentage</b>	<b>Cumulated percentage</b>	<b>Principal inertia</b>	<b>Percentage</b>	<b>Cumulated percentage</b>
Dim 1	0.01745	46.66	46.66	0.0263	70.34	70.34
Dim 2	0.0043	11.51	58.17	0.0016	4.33	73.67
Dim 3	0.00229	6.12	64.32	0.0011	2.82	77.49
Dim 4	0.00164	4.39	68.68	0.0009	2.33	79.82
Dim 5	0.00109	2.91	71.59	0.0005	1.36	81.18
Dim 6	0.00067	1.79	73.38	0.0003	0.76	81.94
Dim 7	0.0004	1.08	74.46	0.0002	0.57	82.51
Dim 8	0.00029	0.78	75.25	0.0001	0.28	82.79
Dim 9	0.0002	0.52	75.77	0.00006	0.17	82.96
Dim 10	0.00016	0.42	76.19	0.00004	0.1	83.06
Dim 11	0.00011	0.29	76.47	0.00001	0.04	83.1
Dim 12	0.00009	0.23	76.71	0	0.03	83.13
Dim 13	0.00007	0.2	76.91	0	0.01	83.14
Dim 14	0.00004	0.1	77.01	0	0	83.14
Total	0.0289	100	--	0.03738	100	--

**Table 4 – Multiple Correspondence Analysis (Preliminary weights, Urban and Rural areas)**

			<b>Urban</b>	<b>Rural</b>
<b>Area</b>	<b>Variable</b>	<b>Modality</b>	<b>Dim1</b>	<b>Dim1</b>
Employment	Head of household unemployed	yes	-0.4	1.21
		no	0.01	-0.02
	Head of household employed	yes	-0.19	-0.15
		no	0.35	0.73
	Youth unemployment	active	-0.69	-0.29
		unemployed	0.15	1.37
		inactive	0.63	1.08
		no youth	-0.19	-0.35
	Household share of employed	none	0.35	0.9
		less than 1/3	-0.01	0.66
		between 1/3 and 2/3	-0.02	-0.15
		more than 2/3	-0.53	-0.59
	Household share of unemployed	none	-0.12	-0.16
		less than half	0.41	1.54
		more than half	0.19	1.73
Education	Head of household alphabetized	yes	0.79	1.25
		no	-1.12	-0.62
	Household share with no education	less than 1/3	0.97	2.18
		between 1/3 and 1/2	-0.53	0.71
		between 1/2 and 3/4	-1.67	-0.54
		more than 3/4	-2.22	-1.44
	Household share of alphabetized	less than 1/3	-2.06	-1.11
		between 1/3 and 1/2	-0.47	0.51
		between 1/2 and 2/3	0.27	1.67
		more than 2/3	1.32	2.89
Health	Household access to health	no health problems	-0.08	-0.28
		total access	0.16	0.5
		partial access	-0.17	0.31
		no access	-0.34	-0.29
	Household medical coverage	yes	2	4.31
		no	-0.97	-0.32
	Household share of medical coverage	total coverage	2.1	4.48
		at least half household	2.06	4.88
		less than half household	1.65	3.54
no coverage		-0.97	-0.32	
Housing	Type of accommodation	villa	2.73	4.59
		apartment	1.82	-0.97
		moroccan house	-0.12	2.77

		basic dwelling	-3.93	-0.92
		rural house	--	0.93
		Other	-1.67	-0.9
	Cohabitation	one household	0.17	0.03
		two households	-1.47	-1.08
		three households	-2.03	-0.35
		four households and more	-2.65	-0.05
	Buthtub/shower	yes	1.68	4.14
		no	-1.36	-0.32
	Kitchen	yes	0.35	0.39
		no	-3.07	-2
	Toilet	yes	0.16	0.97
		no	-5.44	-2.25
	Number of persons per room	one person or less	0.83	0.28
		between one and two	0.4	0.36
		between two and three	-0.9	-0.39
		more than three	-2.2	-1.51
Utilities	Fresh water	network	0.59	2.57
		fountain	-3.34	0.09
		source	-6.09	-1.33
		other	-3.25	-0.2
	Electricity	individual meter	0.7	1.04
		collective meter	-1	0.24
		no meter	-2.79	-0.91
		no electricity	-4.53	-1.91
	Used water	network	0.49	2.75
		septic tank	-1.76	1.4
		latrine	-2.07	1.04
		other	-5.04	-1.84
Durables	Satellite dish	yes	1.2	2.35
		no	-1.79	-0.86
	Portable phone	yes	0.33	0.86
		no	-1.67	-1.53
	Gas stove	yes	0.62	1.02
		no	-0.97	-0.76
	Gas oven	yes	0.31	1.01
		no	-0.36	-1.09
	Refrigerator	yes	0.67	2.27
		no	-3.06	-1.2
	Freezer	yes	2.92	4.88
		no	-0.17	-0.03

Nutrition	Child stunting	yes	-0.95	-0.86
		no	-0.76	-0.2
		no children	0.31	0.34
	Child malnutrition	yes	-1.21	-1.73
		no	-0.81	-0.38
		no children	0.31	0.34
Expenditure	Food poverty	yes	-2.63	-1.47
		no	0.23	0.26
	Expenditure quintiles	Q1	-3.17	-1.59
		Q2	-1.6	-0.4
		Q3	-0.48	0.3
		Q4	0.24	0.91
		Q5	1.56	2.34

**Table 5 – Multiple Correspondence Analysis (Final weights, Urban and Rural areas)**

			<b>Urban</b>	<b>Rural</b>	
			<b>Dim1</b>	<b>Dim1</b>	
Employment	Head of household unemployed	yes	-0.48	--	
		no	0.01	--	
	Youth unemployment	active	-0.63	-0.08	
		unemployed	0.11	0.04	
Education	Head of household alphabetized	yes	0.8	1.13	
		no	-0.13	-0.56	
	Household share with no education	less than 1/3	0.91	1.85	
		between 1/3 and 1/2	-0.44	0.71	
		between 1/2 and 3/4	-1.49	-0.36	
		more than 3/4	-2.32	-1.4	
	Household share of alphabetized	less than 1/3	-2	-0.99	
		between 1/3 and 1/2	-0.35	0.5	
between 1/2 and 2/3		0.32	1.53		
more than 2/3		1.18	2.38		
Health	Household medical coverage	yes	0.15	0.44	
		no	-0.13	-0.26	
	Household share of medical coverage	at least half household	1.75	3.16	
less than half household		1.2	2.22		
no coverage		-0.79	-0.21		
Housing	Type of accommodation	villa	2.47	--	
		apartment	1.81	--	
		moroccan house	-0.1	--	
		basic dwelling	-3.73	--	
	Type of accommodation	villa, apartment, Moroccan house	--	2.36	
		rural house	--	0.81	
		basic dwelling	--	-0.8	
	Cohabitation	Cohabitation	one household	0.18	--
			two households	-1.49	--
			three households	-2.11	--
			four households and more	-2.56	--
	Cohabitation	one household	--	0.03	
		two households and more	--	-0.76	
	Buthtub/shower	yes	1.62	3.5	
		no	-1.31	-0.27	
	Kitchen	yes	0.35	0.38	

		no	-3.15	-1.98
	Toilet	yes	0.15	0.93
		no	-5.4	-2.16
	Number of persons per room	two persons or less	0.53	0.29
		between two and three	-0.82	-0.31
		more than three	-2.12	-1.36
Utilities	Sewage	yes	0.5	--
		no	-2.62	--
	Used water	network	--	2.32
		septic tank	--	1.24
		latrine	--	1
		other	--	-1.71
	Water access	yes	0.6	--
		no	-3.37	--
	Fresh water	network	--	2.22
		fountain	--	0.17
		other	--	-0.47
	Electricity	individual meter	0.7	1.04
		collective meter	-0.92	0.34
		no meter	-2.83	-0.69
		no electricity	-4.77	-1.98
Durables	Television	yes	0.2	0.73
		no	-4.11	-2.38
	Satellite dish	yes	1.2	2.2
		no	-1.78	-0.8
	Portable phone	yes	0.34	0.85
		no	-1.76	-1.51
	Gas stove	yes	0.68	1.18
		no	-1.06	-0.88
	Gas hoven	yes	0.49	1.1
		no	-0.43	-0.74
	Refrigerator	yes	0.69	2.09
		no	-3.15	-1.1
	Freezer	yes	2.73	--
		no	-0.15	--
Nutrition	Child stunting	yes	-0.75	-0.62
		no	0.09	0.15
	Child malnutrition	yes	-1.1	-1.5
		no	0.02	0.07
Expenditure	Food poverty	yes	-2.63	--
		no	0.23	--

	Expenditure quintiles	Q1	-3.17	-1.34
		Q2	-1.49	-0.34
		Q3	-0.39	0.24
		Q4	0.27	0.78
		Q5	1.45	1.96



**Table 6 – CWI statistics and poverty line**

	<b>CWI mean</b>	<b>CWI median</b>	<b>Poverty line</b>
<b>Urban</b>	1,775	1,8546	1,1128
<b>Rural</b>	0,996	0,9902	0,5941

Source : NSLS 2006-2007.

**Table 7 – CWI and Expenditure Poverty**

<b>Area</b>	<b>CWI Poverty</b>			<b>Expenditure Poverty</b>			<b>Difference</b>		
	<b>FGT0</b>	<b>FGT1</b>	<b>FGT2</b>	<b>FGT0</b>	<b>FGT1</b>	<b>FGT2</b>	<b>FGT0</b>	<b>FGT1</b>	<b>FGT2</b>
<b>Urban</b>	7.4	1.9	0.8	4.8	0.8	0.2	2.6	1.1	0.6
<b>Rural</b>	18.3	6.2	3.2	14.4	3.3	1.2	3.9	2.9	2
<b>Total</b>	12.1	3.8	1.9	8.9	1.9	0.6	3.2	1.9	1.3

Source: NSLS 2006/07. Totals are simple weighted averages of the urban and rural statistics.

**Table 8 – Multidimensional poverty versus income poverty**

<b>Quintiles of Income per capita</b>	<b>CWI Poverty</b>		
	<b>FGT0</b>	<b>FGT1</b>	<b>FGT2</b>
<b>1</b>	<b>28.3</b>	<b>10.0</b>	<b>5.4</b>
<b>2</b>	<b>17.1</b>	<b>4.8</b>	<b>2.1</b>
<b>3</b>	<b>9.0</b>	<b>2.8</b>	<b>1.3</b>
<b>4</b>	<b>4.3</b>	<b>1.0</b>	<b>0.4</b>
<b>5</b>	<b>2.0</b>	<b>0.3</b>	<b>0.1</b>
<b>Total</b>	<b>12.1</b>	<b>3.8</b>	<b>1.9</b>

Source: Calculations based on data from the NSLS 2006-2007.

**Table 9 - CWI versus Expenditure Poverty**

		<b>CWI Poverty</b>		
		<b>Poor</b>	<b>Non poor</b>	<b>Total</b>
<b>Expenditure Poverty</b>	<b>Urban</b>			
	<b>Poor</b>	2.2	2.6	4.8
	<b>Non poor</b>	5.2	90	95.2
	<b>Total</b>	7.4	92.6	100
	<b>Rural</b>			
	<b>Poor</b>	6	8.4	14.4
	<b>Non poor</b>	12.3	73.3	85.6
	<b>Total</b>	18.3	81.7	100

Source: NSLS 2006/07. Totals are simple weighted averages of the urban and rural statistics.

**Table 10 – Double poverty according to various household characteristics**

<b>Characteristics of household head</b>	<b>Multidimensional and monetary poverty</b>	<b>Poor multidimensional and non-poor monetary</b>	<b>Multidimensional non-poor and poor monetary</b>	<b>Multidimensional and monetary non-poor</b>	<b>Total</b>
<b>Sex of hh head</b>					
Male	3.9	8.4	5.3	82.4	100
Female	3.5	7.5	4	85	100
<b>Household Size</b>					
One person	0.9	25.3	0	73.8	100
2-3 pers.	1.1	11.7	0.4	86.8	100
4 to 6 people.	3	8.4	2.6	86	100
7-9 pers.	5	6.6	7.7	80.7	100
10 people and more	7.3	7.8	14.4	70.5	100
<b>Education of hh head</b>					
No level	5.5	11.7	6.6	76.2	100
Fundamental	1.5	3.9	3.4	91.2	100
Secondary	0.7	1	1.6	96.7	100
Higher	0.4	0	0	99.6	100
<b>Employment status of household head</b>					
Employer	0	2.5	0.6	96.9	100
Salaried	4	8.3	5.7	82	100
Independent	4.9	11.4	5.2	78.5	100
Other	5.1	8.2	3.1	83.6	100
Total	3.8	8.3	5.1	82.8	100

**Table 11 – Poverty over time**

	<b>Multidimensional Poverty</b>		<b>Monetary Poverty</b>	
	2001	2007	2001	2007
Urban	9.4	7.4	7.6	4.8
Rural	42.3	18.3	25.1	14.4
Total	23.9	12.1	15.3	8.9

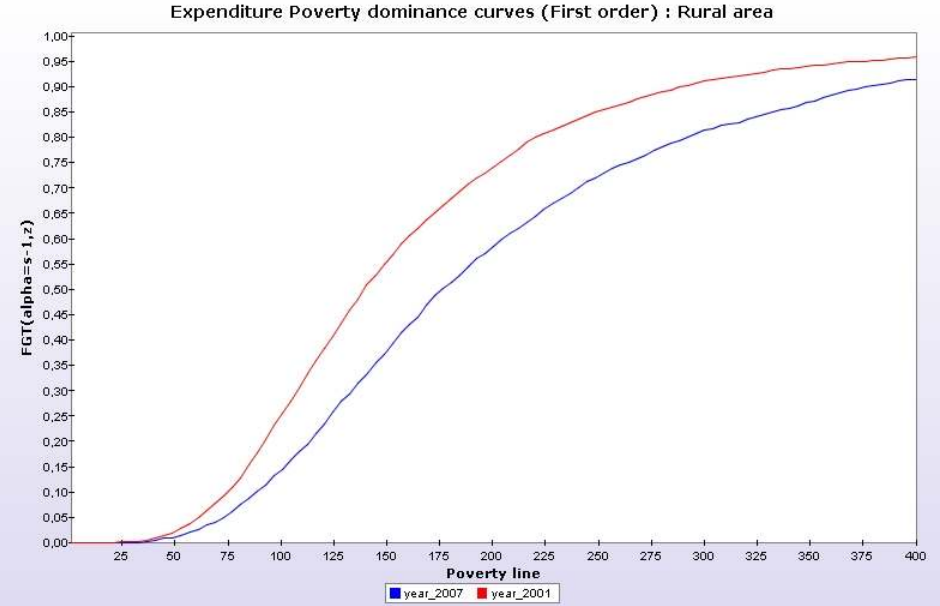
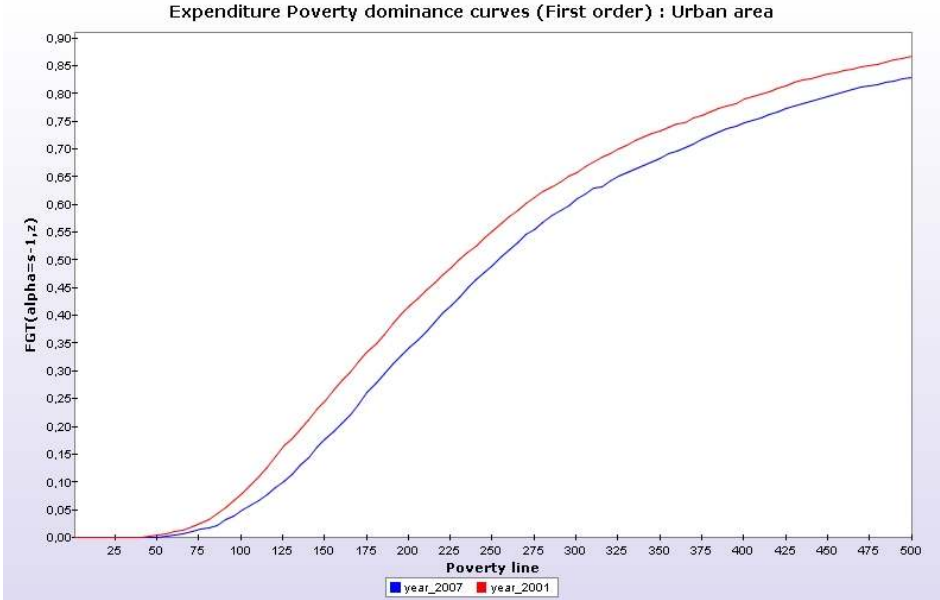
Source: NSLS 2006/07. Totals are simple weighted averages of the urban and rural statistics.

**Table 12 - Robustness analysis**

<b>Threshold z</b>		<b>25</b>	<b>50</b>	<b>75</b>	<b>100</b>	<b>125</b>	<b>150</b>
<b>CWI Poverty</b>							
2001	Urban	0.3	1.2	3.9	9.4	19.3	34.4
	Rural	3.8	13.4	27.9	42.3	55.3	68.1
	Total	1.4	6.6	14.5	23.9	35.1	49.2
2007	Urban	0.2	1.1	3.4	7.4	16	31.0
	Rural	1.4	5.1	10	18.3	27.1	39.3
	Total	0.7	2.8	6.3	12.1	20.8	34.6
<b>Difference</b>	Urban	0.1	0.1	0.5	2	3.3	3.4
	Rural	2.4	8.3	17.9	30.2	28.2	28.8
	Total	0.7	3.8	8.2	11.8	14.3	14.6
<b>Expenditure Poverty</b>							
2001	Urban	-- -	0.3	2.5	7.6	16.2	24.3
	Rural	0.2	2.3	10.1	25.1	40.9	55.6
	Total	0.09	1.2	5.8	15.3	27.1	38.1
2007	Urban	-- -	0.07	1.2	4.8	9.9	17.5
	Rural	0.04	1.2	5.7	14.4	25.9	38
	Total	0.02	0.6	3.2	8.9	16.8	26.4
<b>Difference</b>	Urban	-- -	0.2	1.3	2.8	6.3	6.8
	Rural	0.18	1.1	6.9	10.7	15	29.2
	Total	0.07	0.6	2.6	6.4	10.3	11.7

Source: NSLS 2006/07. Totals are simple weighted averages of the urban and rural statistics.

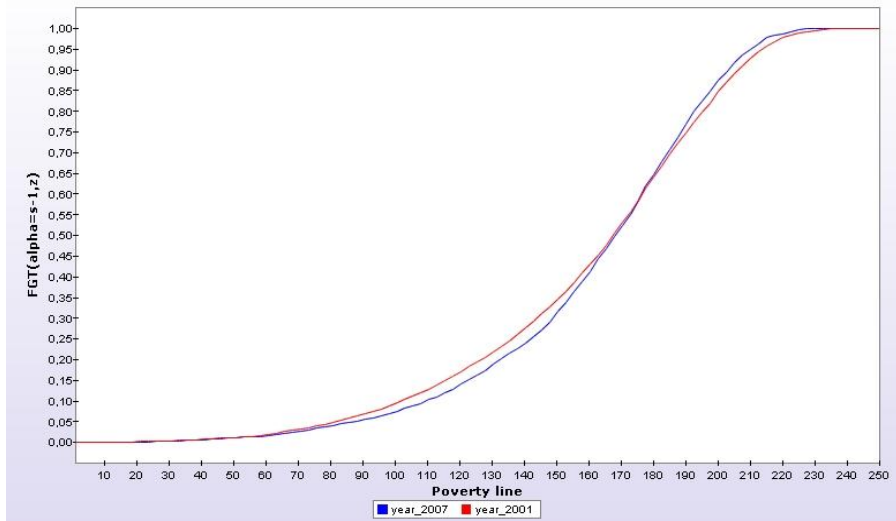
Figure 1 – Stochastic Dominance (first-order)



(Cont.)



Composite Welfare Indicator Poverty dominance curves (First order) : Urban area



Composite Welfare Indicator dominance curves (First order) : Rural area

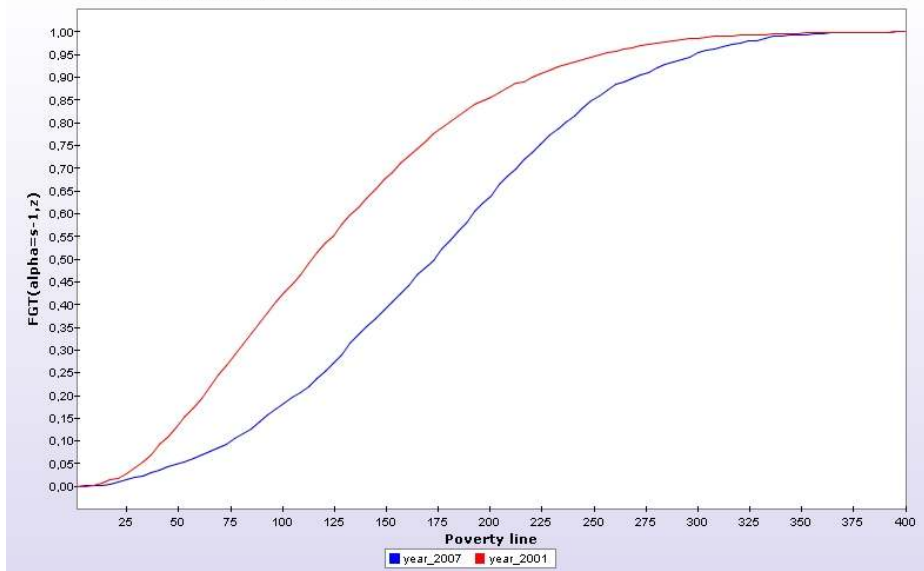


Figure 2 – CWI and Expenditure Lorenz

