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The Rasch Model and Multidimensional Poverty Measurement

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3.1 Introduction

The topic of the multidimensionality of poverty is currently at the heart of many theoretical, empirical and institutional debates in the European Union (Atkinson, Cantillon, Marlier, Nolan, 2002). Despite this increasing interest, there seems to be no consensus on how to define and measure multidimensional poverty. Key aspects of this debate are the questions of the dimensionality of the poverty concept and the nature of the relationship between the items measuring each dimension. In this chapter we apply the Rasch model in order to illustrate its contribution to analysing these questions.

The Rasch model is essentially a unidimensional measurement theory developed by Georg Rasch (1960), in order to assess the school achievement of Danish soldiers. Ability is considered to be an unknown latent trait of persons responding to items. The response of a person to an item represents the manifest or observed variable, and is coded in a dichotomous format: correct and wrong answers are given, respectively, the values of 1 and 0. This model states explicitly the relation between observed and latent variables. The application of this psychometric model to poverty is possible if one considers poverty as a latent construct and the positive answer to an item as a deprivation. If the set of items selected on theoretical grounds as indicators of poverty conform to the Rasch model, then a poverty or deprivation index can be estimated from the simple sum of the dichotomous items.

The Rasch model, in its basic form, is unidimensional. Several reasons, however, exist to consider this model as particularly interesting for the study of the multidimensional aspects of poverty.

1. Many researchers, such as Townsend (1979) or Mack and Lansley (1985), constructed a deprivation index based on non-monetary indicators without any measurement model. An index is computed by summing the dichotomous items of deprivation and assumes the unidimensional nature of the construct without testing it. The Rasch model offers precisely a way of confirming or rejecting the unidimensional hypothesis of the score.
2. The unidimensional hypothesis of the model is particularly interesting for the measurement of poverty. If the very nature of poverty consists in accumulating disadvantages, the relationship between the items is hierarchical. In other terms, the model assumes that if a person suffers from a very severe deprivation, he (she) will also suffer from other, less severe deprivations.

3. Multidimensional aspects can be operationalized through the model. Some recent extensions of the original Rasch model take into account the possibility of multidimensionality (Hardouin, 2005). Multidimensional aspects can also be operationalized when applying the basic Rasch model iteratively to a set of items.

This last procedure will be used throughout this chapter which includes three sections: section 3.2 presents the main features of the Rasch model while section 3.3 applies it to multidimensional poverty measurement. In section 3.4 an empirical illustration is given, based on the Luxemburgish socioeconomic panel ‘Liewen zu Lëtzebuerg’ (PSELL-3).

3.2 The Rasch model

The Rasch model belongs to the field of psychometrics. This discipline attempts to measure latent traits such as intelligence, sociability or self-esteem, which cannot be observed directly and must be inferred from their external manifestations. The measurement of a latent trait is often based on a test, that is, on a set of questions to which the surveyed population is asked to give an answer. The main hypothesis is that it is possible to indirectly infer the position of a person on a latent trait through his/her answers to this test.

We can model the information coming from a survey as a matrix $X$ containing the answer $x_{ij}$ of $i = 1 \ldots n$ individuals to $j = 1 \ldots m$ items. In the case where all the items are dichotomous, the answer can be positive, that is indicative of a high position on the latent trait, in which case $x_{ij} = 1$ or negative, that is indicative of a low position on the latent trait so that in such a case $x_{ij} = 0$. On the basis of this information, we can compute a raw score $S_i = \sum_{j=1}^{m} x_{ij}$ for each individual $i = 1 \ldots n$. This score can vary from 0 to $m$ and represents the observed score of individual $i$ on the latent trait.

Psychometrics can be divided into two branches according to the way in which the relationship between this observed score and the true score on the latent trait is conceived. On one hand, the classical test theory presupposes a linear relationship between the observed score and the true score of the individuals. The reliability of the observed score depends on an error component. The shortcomings of this approach have been widely documented (Molenaar, 1995). One of them is that there is no empirical verification of the legitimacy of summing the different items in the same scale.

In the second branch, the Item Response Theory (IRT) models the relationship between the observed items and the latent variable via a measurement model that allows verifying that the external manifestations really measure the same