

# **Fuzzy Chronic Poverty: A Proposed Response to Measurement Error for Intertemporal Poverty Measurement**

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A number of chronic poverty measures are now being used by policymakers to quantify the prevalence and intensity of chronic poverty, vis-a-vis transient experiences. For this exercise, data on multiple time periods are used to assess the welfare trajectories of individuals, or households, over time. Our research examines the implications of measurement error for chronic poverty measurement, and proposes an alternative approach to measure chronic poverty. We augment existing measures, seeking to minimize the consequences of measurement error. This method is based on a novel criterion for the identification of poverty that draws from fuzzy set theory.

We are interested in measures that incorporate a normative property of duration sensitivity (Porter and Quinn, 2008), whereby, for a given average welfare level, a longer duration in poverty increases the value of the poverty measure. Including such sensitivity to duration has obvious normative advantages. However, measures that do implicitly or explicitly weight poverty more heavily (and sometimes with discontinuity) incorporating this property, are likely to be more sensitive to measurement error than measures with less attractive normative properties (e.g. the ‘averaging’ approach of Jalan and Ravallion (2000)).

We first tackle one of the most popular measures, that proposed by Foster (2009), which has increasingly been adopted in policy applications (e.g. Perez-Mayo (2009), Nunez Velasquez (2009)). The measure includes a ‘double cut-off’: 1) A poverty line indicating material deprivation in one time period, and 2) a duration cut-off denoting the number of periods in poverty experienced by one individual, or household, that categorises them as chronic poor. If a person is deprived for a period longer than the duration poverty line, then the person is considered chronically poor. This measure’s focus axiom is insensitive to any deprivations from people who are not deemed chronically poor in the identification stage. Given this duration cut-off, measurement error has been shown to have quite serious consequences around the discontinuity (see Porter (2010)). The second measure under consideration is the one by Bossert et al. (2011). This measure has an arguably stronger duration property, in that consecutive spells of poverty are weighted more heavily, and does not incorporate a discontinuity, rather a weighting function. Bossert et al. (2011) observe that: “[t]he negative effects of being in poverty are cumulative, hence a two-period poverty spell is much harder to handle than two one-period spells that are interrupted by one (or more) period(s) out of poverty..(p1). Other measures may also be considered such as the ones by Mendola et al. (2009), Gradin et al. (2010), Dutta et al. (2011).

### **Introduction of poverty identification with fuzzy sets:**

In order to compensate for the potential effects of measurement error on duration-sensitive chronic poverty measures, we propose a generalization of these measures building on the fuzzy set literature. Fuzzy set theory has been used extensively in the social sciences for a while (e.g. see Ragin (2000), Smithson and Verkuilen (2006)). In the poverty literature, fuzzy set theory was introduced as an alternative identification criterion by researchers who were dissatisfied with the blunt dichotomy posed by traditional poverty lines for the identification of the poor. Instead they opted for the membership functions used in fuzzy set theory (see e.g. Lemmi and Betti (2006)).

While we do not intend to contest the practice of setting a poverty line for identification purposes, we do worry about the consequences of using a traditional poverty line in chronic poverty assessments based on duration-sensitive measures, when transitions across the line may be taking place spuriously due to measurement error. Since traditional measurement error corrections are usually not readily available (for a comprehensive treatment, see Bound et al. (2001)), we propose a fuzzy-style adjustment to the period-specific poverty lines, and then to the identification criteria of both the time-specific poor and the chronically poor. This adjustment smoothes out the impact of (potentially spurious) transitions that take place across, and too close to, the poverty lines. Thereby we generalize several of the proposed duration-sensitive measures of chronic poverty.

In our approach a traditional poverty line,  $z$ , is compared against a 'thick' poverty line bounded by  $z_1$  and  $z_2$  such that  $z_1$  [is less than]  $z_2$ . In a traditional identification approach, a person is deemed poor if his/her income is below  $z$ , and non-poor otherwise. Under our approach poverty status ceases to be dichotomous if a person's income is in the interval  $[z_1, z_2]$ . Two important features of our identification approach stand out: 1) transitions across  $z$ , in its vicinity, do not generate abrupt changes in poverty status when the 'thick' poverty line is used. For big changes in poverty status to happen, the magnitude of the transition has to be large enough to cross from  $z_1$  to  $z_2$  (or the other way around). In those cases we assume that the transition is less likely to be spurious (e.g. driven by measurement error). 2) Our fuzzy identification approach can be fine-tuned by either changing the values of  $[z_1, z_2]$  or by changing the parameters that control the shape of the membership function (e.g. its convexity). We explore the theoretical and empirical implications of this generalization using the Ethiopian Panel Household Survey.

**NB** A figure providing illustration of our proposed identification adjustment is available from the authors, as are the cited references