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A Fuzzy Logic Based Approach to Measure the Principle of "Leaving No One Behind" on Multidimensional Poverty

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In 2015 world leaders signed up to 17 Global Goals - the Sustainable Development Goals (SDG) - that have the potential to end poverty, to reduce inequality and to tackle climate change in 15 years. One of the pillars of the 2030 Agenda for Sustainable Development and the SDG, and one which represents a critical improvement over the Millennium Development Goals, is the pledge to ‘leave no one behind’. In committing to the realization of the 2030 Agenda for Sustainable Development, Member States recognized that the dignity of the individual is fundamental and that the Agenda´s goals and targets should be met for all nations and people and for all segments of society. Furthermore, they endeavoured to reach first those who are furthest behind.

Consequently, the Sustainable Development Agenda has moved inequalities to center stage. Numerous goals and targets include a focus on inequalities and the advancement of communities that have historically experienced discrimination. Explicitly, goal 10 focuses on reducing inequalities within and among countries, even though this goal is undermined and distorted by the targets and indicators, which set an agenda for inclusion rather than for reducing inequalities. Behind it lies the idea that a focus on absolute goals obviates the need for relative indicators of inequality.

It should be also reminded that the revealing test for whether the SDGs will truly `leave no one behind' is not whether the SDG goals and targets include such (aspirational) language, but whether this language will translate into implementation of the goals on the basis of equality and non-discrimination. In that regard, monitoring will play an important role. As metrics pegged to specific targets, indicators have the power to concentrate effort and attention. Moving beyond aggregate outcomes will require that the data related to these indicators be disaggregated along lines sufficient to meaningfully demonstrate the existence, magnitude and interplay of multiple forms of inequalities. That is, to leave no one behind, it is not enough to address the problems of those at the bottom; we need to analyze inequality from an individual point of view. The starting

point requires a precise understanding and identification of who are left behind and by how much.

This is precisely where this paper enters. We propose to use the fuzzy approach to measure the degree to which an individual is ‘left behind’ in a specific dimension of poverty and then we propose alternatives to measure the degree an individual is ‘left behind’ in a multidimensional setting.

This is not the first paper to implement fuzzy sets. However, its novelty consists in proving how the use of fuzzy sets theory can be useful to respond to the concern that progress does not leave anyone behind and complement information on the proportion of individuals who are in the bottom part of the distribution indicating who are the ones that have been left behind and assessing by how much. In this sense, we follow Temkin (1993) that propose inequality can be viewed in terms of complaints of individuals located at disadvantaged positions in the dimension analyzed. The society's highest values of the dimension analyzed are the reference point for all, and everybody except the best positioned individual has a legitimate complaint. Consequently, a measure of the degree an individual is left behind is the sum of his/her shortfalls from all persons better positioned than him/her in the dimension. This is a novel proposal in two aspects: i) to the best of our knowledge, this is an original membership function in the fuzzy approach literature regarding poverty, and ii) it is a novel proposal to measure the concept of ‘leaving behind’, that allows us to identify those left behind and quantify by how much are they left behind.

This procedure can be applied to any dimension. We present our proposal illustrating the concept of ‘leave behind’ in terms of multidimensional poverty, specifically in terms of the concept of `At risk of poverty or social exclusion' (AROPE), for 26 European countries in years 2006 and 2016 by using the microdata of EU-SILC (European Statistics on Income and Living Conditions). In this regard, AROPE, as indicator of multidimensional poverty, contains three dimensions, two continuous and one discrete, which allows us to illustrate the particularities of our proposal in both types of dimensions, and to propose alternatives to the joint measurement of dimensions of poverty.

The empirical results have shown that even though the ranking of countries considering the `Left Behind' measure (LB) correlates with that of AROPE rate, showing the consistency of our proposal, the fuzzy measure gives richer information because while AROPE informs about the extension of multidimensional poverty, LB incorporates information on the depth of multidimensional poverty and allows us to evaluate the `leave no one behind' concept in terms of multidimensional poverty. In this sense, there are countries in which AROPE rate ranks them better (lower rates) than the LB. This is the case for Norway, The Netherlands, and Portugal in 2006, or Finland, the Netherlands and the United Kingdom for 2016, where LB measure is high even though the proportion of individuals above the thresholds of multidimensional poverty is high, evincing that there is a problem of inequality in terms of multidimensional poverty. Regarding the change in the LB measure between 2006 and 2016, we find signs of convergence

between the countries analyzed in the concept of ‘left behind’ since those with higher values of LB are the ones that have reduced their value the most. These results are a good starting point to prioritize certain socio-economic policies to counteract inequality in certain countries. Obviously more research is needed in terms of specific characteristic of the population left behind in each country to properly implement effective policies to reduce inequality.