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# ABSTRACT

## Individual Poverty Measurement Using a Fuzzy Intrahousehold Approach

This work studies the impact of accounting for intrahousehold inequality in the distribution of resources for the measurement of poverty. For the estimation of intrahousehold distribution of resources the study relies on collective Engel curves. For the poverty analysis, we propose a fuzzy intrahousehold index which is less sensitive to small changes around the poverty line compared to standard FGT indices and produce more reliable results. This provides an interesting approach to address individual poverty in contexts where intrahousehold inequality is at work and there is a concentration of individuals near the poverty line. The proposed approach is applied to the analysis of individual poverty in Albania, finding an expected general increase in poverty rates. Besides, a previously unperceived issue – female poverty – emerges as a worryingly aspect to be accounted for in anti-poverty policies.

**JEL Classification:** I32, J16, D13

**Keywords:** female poverty, gender inequality, fuzzy set poverty, intrahousehold distribution, collective model, Albania

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# 1 Introduction

It has been long recognized that studies ignoring intrahousehold inequality do not account for an important part of the distribution of welfare, and several applications have rejected the unitary model of the family, mainly in developed countries (for an exhaustive review, see Chiappori and Meghir, 2015). Fewer studies are available for less developed countries, despite the fact that intrahousehold inequality issues may have a stronger impact on poverty analysis in these countries.

Among developing countries, the most relevant studies analyse Malawi (Dunbar et al., 2013) and Côte d'Ivoire (Bargain et al., 2014). Both of them find a notable impact of intrahousehold inequality on poverty, especially of children. However, while Bargain et al. (2014) do not find strong evidence of female poverty, Dunbar et al. (2013) find that on average women have about 15% more probability of being poor (which raises to more than 60% for large families). Both of them estimated traditional poverty indexes. Mangiavacchi et al. (2017) estimated a collective consumption model for Albania in 2002 finding a consistent gender discrimination in the allocation of resources, however they do not study how intrahousehold inequality affects individual poverty.

Given the evidence that intrahousehold inequality can be a serious issue in developing and transition countries, we propose a method for measuring poverty that provides two main advantages. First, thanks to the estimation of a collective consumption model, the intrahousehold distribution of resources can be used to provide a truly individual poverty measure accounting for the presence of intrahousehold inequality. Second, the use of a fuzzy set poverty indicator allows us to overcome one of the most notable limitations of the standard monetary poverty measurement: the poor/non-poor dichotomy.

It is worth nothing that the introduction of even small values of intrahousehold inequality imply a larger variance in the distribution of consumption with respect to the per-capita measure. In such a scenario, standard poverty measures relying on a poverty line, as the headcount ratio, depth and severity of poverty, are expected to over-react to the introduction of intrahousehold inequality. Two reasons drive this expectation: i) even with a perfectly equal (on average) intrahousehold distribution of resources, some households will face unequal distributions, thus increasing the dispersion of the consumption variable; ii) when the poverty line lies just below (above) the mode of the per-capita consumption distribution, even small amounts of intrahousehold inequality in proximity of the poverty line will cause more (less) individuals to fall below the poverty line than those rising out of poverty.

For this reason, the present work goes beyond the conventional study of poverty based on the poor/non-poor dichotomy defined in relation to some chosen poverty line, which for instance represents a certain percentage of the median (mean) of the income or consumption distribution, or is based on the cost of a certain basket of goods necessary for meeting basic needs. The conventional approach presents a serious limitations: poverty is not an attribute that characterises an individual in terms of its presence or absence, but is rather a predicate that manifests itself in different shades and degrees.

In fact, we propose to treat poverty as a matter of degree, determined in terms of the individ-

ual's position in the distribution of income or consumption expenditure. The state of poverty or deprivation is thus seen in the form of "fuzzy sets" to which all members of the population belong but to varying degrees (Cerioli and Zani, 1990; Cheli and Lemmi, 1995; Betti and Verma, 2008). Because the fuzzy poverty measure takes into account the statistical units above the poverty line (at variance with standard FGT measures), we are able to perform a reliable comparison with official per-capita poverty measures.

To test the usefulness of the proposed approach, we apply it to the measurement of poverty in Albania. Specifically, we analyse whether intrahousehold inequality has an impact on poverty measurement and to the extent this is particularly relevant for women. To this aim we build an individual consumption measure that accounts for intrahousehold inequality and that is fully comparable with the per-capita consumption and poverty line used for official INSTAT (the National Statistical Institute) poverty measures and apply our fuzzy intrahousehold poverty indicator.

To the best of our knowledge this is one of the first studies (besides Dunbar et al., 2013; Bargain et al., 2014) that propose poverty measures accounting for intrahousehold inequality, and the first one which combines intrahousehold inequality with the fuzzy poverty measurement. The most relevant empirical contributions are i) the proposal of a truly individual poverty measure, ii) the identification of a previously overlooked issue, female poverty, iii) an in-depth analysis of the magnitude and spatial distribution of female poverty.

The article continues with Section 2, which provides background information on previous results on intrahousehold inequality, introduces the fuzzy approach to poverty measurement and describes in more detail the country under investigation. Section 3 presents the empirical strategy, Section 4 discusses the results, and Section 5 concludes.

## 2 Country Relevance

Albania is the smallest of the Eastern European transition countries and has started the transition process from central planning in 1991 as the most isolated, undeveloped and poor country in Europe. Albanian communism was signed by complete reliance on central planning, the elimination of any form of private property or activity and the strong emphasis on national self-reliance. Consequently, when the transition began in 1991, it shocked the population, which was completely unfamiliar with market institutions. Indeed, Albania was one the countries following the "shock therapy" as path of reforms.

Despite an overall good trend in poverty reduction, Albania remains among the poorest countries in Europe. In 2002, 25.2% of Albanians were living in absolute poverty, a figure that reduced to 17.9% in 2005, and 12.5% in 2008 (INSTAT, 2015). The recent global financial crisis has interrupted the positive trend in the rate of growth and poverty reduction, with a decrease in the GDP growth rate from 7.5% in 2008 to 1.4% in 2012 (according to the IMF), while the poverty rate increased to 14.3% in 2012 (Albanian Living Standard Measurement Survey, ALSMS).

Since 2002 poverty has been identified as being particularly serious in rural areas. According to

INSTAT (2015) rural poverty rate was 29.6% in 2002, with respect to 19.5% of the urban population. More recently, however, the gap seems almost closed. In 2012 rural poverty rate was 15.5%, while urban poverty 13.3%.

A disaggregation by prefecture performed by Betti et al. (2017) shows that in 2012 the highest poverty rate was in Kukes (22.0%), and the lowest rate was in Gjirokaster (8.0%). Poverty rates varied remarkably across communes, from 2.6% of Zagori (Gjirokaster prefecture) to 38.5% of Kalis (Kukes prefecture). The highest poverty rates were in the communes and districts in the North-East of the country, while in the South and South-East of the country, poverty rates were substantially lower. Poverty rates were higher in the communes and districts of the mountain region (20.6%), and the lowest rates were in Tirana region (11.7%).

Respect to household composition, it has been clear since 2002 that children are a particularly vulnerable group with respect to poverty: 34% of children under five lived in a poor household, the proportion among primary school-aged children was 32%, and that among adolescents was 30% (World Bank, 2003). These figures improved in the following years, but children remain the most vulnerable age category in 2012, with 21.1% being poor, compared to an average of 14.3% in the total population (Dávalos et al., 2015).

All this literature has substantially disregarded one possibly vulnerable group: women. Indeed, official figures provide little information on specifically female poverty. Nevertheless, Albania is a particularly interesting setting to study gender issues, in particular in relation with the governance of household resources.

At the end of the Second World War, Albania was a traditional rural society with patriarchal family values and patrilineal kinship system. In mountain and rural areas the social and economic structure was governed by the *Kanun* of Lek Dukagjini, a set of traditional and unwritten laws based on patriarchy (Gjonca et al., 2008; Vullnetari, 2012). This set of laws gave males unquestioned authority within the household. During the isolationist communist regime, the educational policies targeted on females tried to dilute the patriarchal values of Albanian households, not entirely successfully. The family maintained a central position in the society archetype of Albania and patriarchal values resurfaced after the fall of the regime in the 1990s and the consequent increase in economic uncertainty. The country partially returned to a traditional family structure with the risk of relegating women to a subsidiary role. Mangiavacchi et al. (2017) has also shown that in Albanian families women tend to be severely discriminated in the distribution of household resources and this suggests that there may be an outstanding female poverty issue.

# 3 Methodological Approach to Individual Poverty Analysis

## 3.1 Collective Engel curves

The estimation of intrahousehold distribution of resources relies on the collective framework (Chiappori, 1988, 1992), in which individual members' preferences are explicitly accounted for in the household decision process. The interaction between household members is summarized by a rule

governing the distribution of resources within the household, the so called "Sharing rule." The collective framework permits identifying the sharing rule together with the structure of preferences and welfare functions of each household member, which are then used to analyse intrahousehold inequality issues.

In particular, the reference framework is that of collective consumption models, as proposed by Arias et al. (2004), Caiumi and Perali (2015) and Menon et al. (2017), but extended also to children as in Dunbar et al. (2013) and Mangiavacchi et al. (2017).

The estimation of collective models requires assumptions for the identification of the sharing rule. The intrahousehold allocation of resources is not (fully) observable, but it can be recovered using observable household consumption of exclusive or assignable commodities, such as men's, women's and children's clothing (Browning et al., 1994; Chiappori and Meghir, 2015; Menon et al., 2017). The identification strategy is based on this individual-specific consumption information and the observation of suitable distribution factors, exogenous variables that modify the intrahousehold distribution of resources but do not affect consumption choices.

In this work, the analysis is based on the collective Engel curves theory developed in Bourguignon et al. (2009). The estimation technique is grounded on the work of Mangiavacchi et al. (2017) and Menon et al. (2017), with the difference that no price information is needed. Thanks to this feature, the estimation process if simplified, widening the possible application outlets to household budget surveys where it is not feasible to derive household level prices or (pseudo) unit values.

In this setting, the household is composed of $K$ members indexed as $k = 1, 2, ..., K$, who decide via a bargaining process their optimal consumption levels of non-assignable and assignable goods, $\mathbf{c}_k$ and $\mathbf{q}_k$, respectively, given household consumption expenditure $Y$.[1] This decision problem can be represented by a two stage process. In the first stage family members agree on the division of household resources, such that each member is assigned the amount $\phi_k$, and $Y = \sum_{k=1}^{K} \phi_k$. In the second stage each member maximizes her own utility subject to her private budget constraint

$$V_k = \max_{\mathbf{c}_k, \mathbf{q}_k} \quad u_k(\mathbf{c}_k, \mathbf{q}_k) \;\; s.t. \;\; \mathbf{p}'_{\mathbf{c}} \mathbf{c}_k + \mathbf{p}'_{\mathbf{q}_k} \mathbf{q}_k = \phi_k. \tag{1}$$

The solution of the individual problem produces individual specific demand functions that sum up to the household demand for each commodity. In Mangiavacchi et al. (2017) and Menon et al. (2017) the demand system is specified as a collective version of the Quadratic Almost Ideal Demand System (Banks et al., 1997), identifying household price effects, individual income effects (a novelty of this approach) and the sharing rules. Because unit-values are not available for all commodities in the 2012 ALSMS, the estimation of a complete demand system would require a tedious procedure to estimate pseudo unit-values (Lewbel, 1989). Instead, we propose an alternative procedure based on the estimation of a collective Engel curves system with individual income effects, similar to

[1] In general, for poverty analysis $Y$ can be either household income or consumption expenditure. Because official poverty measure in Albania are computed using expenditure data, from now on $Y$ denotes total household expenditure in consumption.

Mangiavacchi et al. (2017) but without prices and part of the structure of the QUAIDS.

For each household $i$ and commodity $j$ a household level Engel curve is defined as[2]

$$w_{ij} = \alpha_j + \sum_{k=1}^{K} \left[ \beta_{kj} \left( \ln \phi_{ki} \right) + \lambda_{kj} \left( \ln \phi_{ki} \right)^2 \right] . \tag{2}$$

Clearly, in this specification the sharing rules $\phi_k$ are not fully observed. Instead, it is possible to use assignable commodities expenditure to define the observed share of household expenditure $\sigma_{ki} = (q_{ki} + \frac{1}{K} c_i)/Y_i$, and scale the observed individual expenditure by a correction term $m_{ki}(\mathbf{z}_i)$ that is a function of a set of variables $\mathbf{z}_i$ called "distribution factors", which are assumed to alter the bargaining power of household member but not consumption preferences

$$\begin{aligned} \phi_{ki} &= \sigma_{ki} \cdot Y_i \cdot m_{ki}(\mathbf{z}_i) \text{ , or in logs} \\ \ln \phi_{ki} &= \ln \sigma_{ki} + \ln Y_i + \ln m_{ki}(\mathbf{z}_i) . \end{aligned} \tag{3}$$

In order to ensure that the sharing rules sum up to household expenditure, i.e. $\sum_{k=1}^{K} \phi_{ki} = Y_i$, the correction terms must respect $\sum_{k=1}^{K} \sigma_{ki} m_{ki}(\mathbf{z}_i) = 1$, that is

$$m_{Ki}(\mathbf{z}_i) = \frac{1 - \sum_{k=1}^{K-1} \sigma_{ki} m_{ki}(\mathbf{z}_i)}{\sigma_{Ki}} . \tag{4}$$

By specifying the $m_{ki}(\mathbf{z}_i)$ function as a Cobb-Douglas, its logarithm becomes linear in $\mathbf{z}_i$, and the Collective Engel Curve System is defined by the following equation

$$w_{ij} = \alpha_j + \sum_{k=1}^{K} \left[ \beta_{kj} \left( \ln \sigma_{ki} + \ln Y_i + \ln m_{ki}(\mathbf{z}_i) \right) + \lambda_{kj} \left( \ln \sigma_{ki} + \ln Y_i + \ln m_{ki}(\mathbf{z}_i) \right)^2 \right] . \tag{5}$$

The system of equations defined by (5) is estimated by a non-linear seemingly unrelated regression allowing for correlation of the error terms, and is used to predict the relative share of resources for each of the $k$ household member as

$$\widehat{r}_{ki} = \sigma_{ki} \cdot \widehat{m}_{ki}(\mathbf{z}_i) \equiv \frac{\widehat{\phi}_{ki}}{Y_i} . \tag{6}$$

Knowing $\widehat{r}_{ki}$, the computation of individual consumption expenditure is straightforward using the last part of equation (6), i.e. $\widehat{\phi}_{ki} = \widehat{r}_{ki} Y_i$.

### 3.2 The Fuzzy Intrahousehold Methodology for Individual Poverty Analysis

As introduced in Section 1, in the so-called traditional approach, poverty is characterized by a simple dichotomization of the population into poor and non poor defined in relation to some chosen

[2]The choice of a quadratic specification in income is based on non-parametric evidence on the shape of the Engel curves. While a linear specification would have been inadequate, a cubic one would have added little advantage but with a relevant estimation cost in terms of efficiency.

poverty line. We believe that poverty is not merely an attribute that characterises an individual in terms of presence or absence, but is rather a vague predicate that manifests itself in different shades and degrees. The fuzzy approach considers poverty as a matter of degree rather than an attribute that is simply present or absent for individuals in the population. This degree may be defined by a membership function (Zadeh, 1965, m.f.,).

The traditional approach can be seen as a special case of the fuzzy approach, where the membership function may be seen as $\mu(y_i) = 1$ if $y_i < z$, $\mu(y_i) = 0$ if $y_i \geq z$ where $y_i$ is consumption expenditure of individual $i$ and $z$ is the poverty line.

An early attempt to incorporate the concept of poverty as a matter of degree at methodological level was made by Cerioli and Zani (1990) who drew inspiration from the theory of Fuzzy Sets initiated by Zadeh (1965). They proposed the introduction of a transition zone $(z_1 - z_2)$ between the two states, a zone over which the m.f. declines from 1 to 0 linearly:

$$\mu_i = 1 \, if \, y_i \leq z_1; \quad \mu_i = \frac{z_2 - y_i}{z_2 - z_1} \, if \, z_1 < y_i < z_2; \quad \mu_i = 0 \, if \, y_i \geq z_2$$

Subsequently, Cheli and Lemmi (1995) proposed the so called Totally Fuzzy and Relative (TFR) approach in which the m.f. is defined as the distribution function $F(y_i)$, normalised (linearly transformed) so as to equal 1 for the poorest and 0 for the richest person in the population. In order to make this mean equal to some specified value (such as 0.1) and to facilitate comparison with the conventional poverty rate, Cheli (1995) takes the m.f. as normalized distribution function, raised to some power $\alpha \geq 1$. Formally:

$$\mu_i = FM_i = (1 - F_{(M),i})^{\alpha} = \left( \frac{\sum_{\gamma=i+1}^{n} \omega_\gamma | y_\gamma > y_i}{\sum_{\gamma=2}^{n} \omega_\gamma | y_\gamma > y_1} \right)^{\alpha}, \; i = 1, 2, ..., n; \; \mu_n = 0 \tag{7}$$

where $y_i$ is consumption expenditure of the $i-th$ individual, $F_{(M),i}$ is the value of consumption expenditure distribution function $F(y_i)$ for the $i-th$ individual, $(1 - F_{(M),i})$ is the proportion of individuals who are less poor than the person concerned with mean $1/2$ by definition, $\omega_\gamma$ is the sample weight of individual of rank $\gamma$ in the ascending expenditure distribution and $\alpha$ is a parameter. The value of $\alpha$ is arbitrary, but Cheli and Betti (1999) have chosen the parameter $\alpha$ so that the mean of the m.f. is equal to the head count ratio (HCR) computed for the conventional poverty line. Increasing the value of this exponent implies giving more weight to the poorer end of the consumption expenditure distribution.

Betti and Verma (2008) have used a somewhat refined version of the expression (7) in order to

define what they called Fuzzy Monetary indicator (FM):

$$\mu_i = FM_i = (1 - L_{(M)i})^{\alpha} = \left( \frac{\sum_{\gamma=i+1}^{n} \omega_\gamma y_\gamma | y_\gamma > y_i}{\sum_{\gamma=2}^{n} \omega_\gamma y_\gamma | y_\gamma > y_1} \right)^{\alpha}, \; i = 1, 2, ..., n; \; \mu_n = 0$$

where $L_{(M),i}$ represents the value of the Lorenz curve of consumption expenditure for individual $i$; then $(1 - L_{(M),i})$ represents the share of total consumption received by all individuals who are less poor than the person concerned. This share varies from 1 for the poorest to 0 for the richest individual. The mean of $1 - L_{(M),i}$ values equals (1+G)/2, where G is the Gini coefficient of the distribution.

The FM Indicator we intend to adopt in the present work is defined as a combination of the $(1 - F_{(M),i})$ indicator, the proportion of individuals less poor than the person concerned, proposed by Cheli and Lemmi (1995), and of the $(1 - L_{(M),i})$ indicator, the share of total consumption received by all individuals less poor than the person concerned, proposed by Betti and Verma (2008). Formally:

$$\begin{aligned} \mu_i &= FM_i = (1 - F_{(M),i})^{\alpha-1}(1 - L_{(M),i}) \\ &= \left( \frac{\sum_{\gamma=i+1}^{n} \omega_\gamma | y_\gamma > y_i}{\sum_{\gamma=2}^{n} \omega_\gamma | y_\gamma > y_1} \right)^{\alpha-1} \left( \frac{\sum_{\gamma=i+1}^{n} \omega_\gamma y_\gamma | y_\gamma > y_i}{\sum_{\gamma=2}^{n} \omega_\gamma y_\gamma | y_\gamma > y_1} \right). \end{aligned} \tag{8}$$

The parameter $\alpha$ is estimated so that the mean of the FM indicator is equal to the head count ratio computed for the conventional poverty line.[3]

In the present study we extend the FM indicator in equation (8) with intrahousehold consumption in order to obtain a truly individual poverty measure

$$\mu_i = FM_i = \left( \frac{\sum_{\gamma=i+1}^{n} \omega_\gamma | \phi_\gamma > \phi_i}{\sum_{\gamma=2}^{n} \omega_\gamma | \phi_\gamma > \phi_1} \right)^{\alpha-1} \left( \frac{\sum_{\gamma=i+1}^{n} \omega_\gamma \phi_\gamma | \phi_\gamma > \phi_i}{\sum_{\gamma=2}^{n} \omega_\gamma \phi_\gamma | \phi_\gamma > \phi_1} \right),$$

where per-capita consumption $y_i$ is replaced by intrahousehold consumption $\phi_i = \widehat{\phi}_{ki}$, for each household member type $k$.

[3]Both the aggregated FM indicator, and the parameter $\alpha$ have an economic interpretation: the FM measure is expressible in terms of the generalized Gini measures $G_\alpha$, which is a generalization of the standard Gini coefficient, $FM = \frac{\alpha + G_\alpha}{\alpha(\alpha+1)} = HCR$.

### 3.3 Data

The data used for the analysis is the Albania 2012 Living Standard Measurement Survey by INSTAT. The survey includes a sample of 6,671 households (substantially larger than previous surveys, which interviewed 3,600 households), randomly chosen on the basis of the 2011 Population and Housing Census via a two stage procedure: first 834 Primary Selection Units were randomly chosen to be representative of the whole territory, and second in each PSU 8 households were randomly chosen (with an additional 4 in case of non response or non contact). The increase in the sample size had the main objective of having data representative at the prefecture level (12 prefectures divided into urban and rural areas), rather than region level (4 regions divided into urban and rural areas). It is a rich dataset containing information on household consumption, socio-economic conditions and income sources. The survey records detailed individual information on education, labour market participation, health and migration history.

The collective Engel curve system presented in Section 3.1 is estimated both for adults and children, with two different family models: i) one composed by a man, a woman and a child (thus with $K = 3$), and ii) one composed by a man and a woman (with $K = 2$). To estimate the sharing rule for both models different samples are needed. In particular, model i) needs households characterized by the presence of at least a man, a woman and a child, while model ii) requires the presence of at least a man and a woman. In both cases children are defined as being younger than 15.[4]

For model i) 3,774 households are dropped because of household composition, plus another 1,037 because of zero expenditure recorded for at least one household member. A few missing values in the explanatory variables further reduce the sample to 1,860 households. For model ii) 3,539 households are dropped because of household composition and 1,298 households have zero expenditure for at least one household member. A few missing values in the explanatory variables further reduce the sample to 1834 households.

The collective Engel curves system is defined over 5 categories of consumption: food, clothing, housing, alcohol and tobacco, and other goods. On average, for the whole sample, Albanian households spend 67.5% of their budget on food, 5.5% on clothing, 22.1% on housing (including utilities, domestic services, small appliances, but not rent), 0.5% on alcohol and tobacco and 4.3% on other goods (including personal care, services, leisure and education expenditure). The average household expenditure is 381,330 LEK (almost 273 Euro).

The observed individual expenditure share ($\sigma_k$) is computed starting from assignable expenditures. For model i) man and woman expenditures are composed by clothing and footwear expenditure for men and women, while child expenditure is composed by clothing, footwear and education expenditure. Non-assignable expenditure is computed as a residual from total household expenditure. In order to account for possibly different household compositions, per-capita expenditures are computed for each household member category. For instance man expenditure is divided by

[4]This choice is needed because expenditure on children clothing and footwear is used for computing $\sigma_k$ in equation (3) and the variable is recorded only for children under 15.

Table 1: Distribution of individual expenditures by model type.

| Model i) | | | | | Model ii) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | std. Dev. | Min. | Max. | | Mean | std. Dev. | Min. | Max. |
| $\sigma_{man}$ | 0.316 | 0.033 | 0.065 | 0.431 | $\sigma_{man}$ | 0.501 | 0.011 | 0.355 | 0.623 |
| $\sigma_{woman}$ | 0.316 | 0.033 | 0.079 | 0.430 | $\sigma_{woman}$ | 0.499 | 0.011 | 0.378 | 0.645 |
| $\sigma_{child}$ | 0.368 | 0.063 | 0.233 | 0.856 | | | | | |
| n.obs. | | 1,860 | | | n.obs. | | 1,834 | | |

the number of men in the household. Non assignable expenditure is divided by the household size. Finally total household expenditure is recalculated summing per capita assignable expenditures and three per-capita non-assignable expenditures. The shares of individual expenditures ($\sigma_k$) are computed as the sum of per-capita assignable and non-assignable expenditure divided by the recalculated total household expenditure. For model ii) man and woman assignable expenditures and the recalculated total household expenditure are defined as for model i). This is a way of scaling households with complex compositions to a two or three-members households in such a way that they are comparable.[5]

After estimating intrahousehold resources distribution, to predict individual consumption it is necessary to account for possibly complex household composition. Each component belonging to category $k$ will have access to a share of total household consumption equal to $\hat{r}_k/n_k$. Subsequently, individual level consumption expenditure is obtained multiplying this share by total household consumption. Instead of using the total household expenditure variable used for estimating models i) and ii), for comparative purposes total household expenditure is derived from the per-capita consumption variable used for producing official poverty figures by INSTAT and The World Bank. We will refer to this variable as 'intrahousehold consumption'.

It is worth noting that the estimation of intrahousehold distribution of resources covers a relatively small fraction of the sample (about 55%), however this figure rises substantially by an out-of-sample prediction of the $m(\mathbf{z})$ function for those households excluded because of a zero expenditure on assignable items (up to 90%). The rest of the sample is composed of singles living alone (about 7%), for whom there is no need to obtain the intrahousehold distribution of resources, and households without a main couple, mainly lone parents (about 3%). We decided not to estimate a Collective Engel system for the latter as the sample size is too small, and use instead per-capita consumption.

The summary statistics of the individual shares are presented in Table 1. A first inspection reveals that for model i) the distribution seems rather egalitarian, with a slightly larger share for the child. Model ii) instead reveal a perfectly egalitarian distribution (on average) among men and women.

The distribution factors ($\mathbf{z}$) used in the estimation of the $m(\mathbf{z})$ were the age difference and the

[5]This neglects the possibility of economies of scales, but in absence of information on household production it would not be possible to identify the model.

Table 2: Descriptive statistics for the variables used in models i) and ii)

| | Model i) | | Model ii) | |
|---|---|---|---|---|
| Variable | Mean | Std. Dev. | Mean | Std. Dev. |
| Share of food | 0.645 | 0.129 | 0.649 | 0.141 |
| Share of clothing | 0.086 | 0.057 | 0.073 | 0.059 |
| Share of housing | 0.208 | 0.080 | 0.222 | 0.089 |
| Share of alcohol and tobacco | 0.006 | 0.010 | 0.006 | 0.011 |
| Share of other goods | 0.055 | 0.073 | 0.050 | 0.098 |
| Log of total expenditure | 12.943 | 0.333 | 12.855 | 0.372 |
| Age difference in the main couple | -0.051 | 0.042 | -0.046 | 0.041 |
| Education years difference in the main couple | -0.001 | 0.029 | -0.005 | 0.028 |
| Proportion of female children | 0.481 | 0.386 | - | - |
| Average children age | 8.960 | 4.679 | - | - |
| Divorce ratio (prefecture) | 7.338 | 3.509 | 7.742 | 3.416 |
| Number of observations | 1,860 | | 1,834 | |

years of education difference of the main couple[6] (woman minus man), the proportion of female children in the household, the average age of children, and the prefecture level divorce ratio (number of divorced per 1000 inhabitants).

The descriptive statistics of the budget shares, log of total expenditure, and distribution factors are presented in Table 2 both for model i) and model ii).

# 4 Results

## 4.1 Collective Engel curves estimation

The estimation of the system of collective Engel curves described by equation 5 is performed using a feasible generalized non-linear least squares (FGNLS) regression.

Table 3 presents the estimation results for both model i) and ii), with the family composed of three members (males, females and children) and two members (males and females without children) respectively. Concerning the individual income effects, both linear and quadratic, model i) appears to be estimated more precisely than model ii). In any case, most distribution factors of the $m_k(\mathbf{z})$ functions are significant for both specifications, indicating that intrahousehold inequality is well captured by the model.

Figures 1 and 2 show the density of the share of resources of each household member (left panel) and their evolution with household expenditure (right panel). Overall, the picture appears particularly unfavourable to women. In a three-members family women have on average 28.1% of

[6]The main couple is defined as the oldest working age couple in the household.

Table 3: Estimation results for models i) and ii)

| | Food | | Clothing | | Housing | | Other goods | |
|---|---|---|---|---|---|---|---|---|
| | coef | se | coef | se | coef | se | coef | se |
| **Males, females and children** | | | | | | | | |
| *Engel curve parameters* | | | | | | | | |
| constant | -0.2259 | (1.6981) | 1.7376** | (0.8315) | -1.3970 | (1.1368) | 0.8451 | (0.5243) |
| $\beta_m$ | -1.7165** | (0.8611) | 0.4125 | (0.4174) | -0.7238 | (0.5668) | 2.1256*** | (0.3568) |
| $\lambda_m$ | 0.0796** | (0.0377) | -0.0184 | (0.0182) | 0.0306 | (0.0247) | -0.0958*** | (0.0159) |
| $\beta_f$ | 1.4601* | (0.7733) | -1.0014*** | (0.3736) | 0.6606 | (0.5054) | -1.2161*** | (0.3456) |
| $\lambda_f$ | -0.0603* | (0.0345) | 0.0449*** | (0.0166) | -0.0295 | (0.0225) | 0.0488*** | (0.0154) |
| $\beta_c$ | 0.4052 | (0.2943) | 0.2749* | (0.1440) | 0.3986** | (0.1969) | -1.0764*** | (0.0929) |
| $\lambda_c$ | -0.0254** | (0.0124) | -0.0116* | (0.0061) | -0.0182** | (0.0083) | 0.0552*** | (0.0039) |
| *Distribution factors* | *m(.) function for males* | | | *m(.) function for females* | | | | |
| Age difference (spouse - husband) | 0.0883 | (0.1486) | | -0.0223 | (0.1376) | | | |
| Education difference (spouse - husband) | 0.5270** | (0.2260) | | -0.4922** | (0.2200) | | | |
| Ratio of female children | 0.0179 | (0.0168) | | -0.0365** | (0.0170) | | | |
| Average children age | 0.0076*** | (0.0021) | | -0.0092*** | (0.0020) | | | |
| Divorce ratio | -0.0005 | (0.0018) | | -0.0026 | (0.0017) | | | |
| *Number of observations* | 1,860 | | | | | | | |
| **Males and females** | | | | | | | | |
| *Engel curve parameters* | | | | | | | | |
| Constant | 0.8935 | (2.1091) | -0.4167 | (0.8848) | -1.8085 | (1.2966) | 2.1415 | (1.4463) |
| $\beta_m$ | 0.5783 | (0.5032) | -0.2154 | (0.2094) | 0.6935** | (0.3103) | -1.0544** | (0.4611) |
| $\lambda_m$ | -0.0247 | (0.0215) | 0.0090 | (0.0088) | -0.0306** | (0.0131) | 0.0463** | (0.0199) |
| $\beta_f$ | -0.6615 | (0.5090) | 0.3056 | (0.2149) | -0.3041 | (0.3194) | 0.6877 | (0.4686) |
| $\lambda_f$ | 0.0301 | (0.0221) | -0.0131 | (0.0092) | 0.0122 | (0.0137) | -0.0303 | (0.0204) |
| *Distribution factors* | *m(.) function for males* | | | | | | | |
| Age difference (spouse - husband) | 1.6467* | (0.8601) | | | | | | |
| Education difference (spouse - husband) | -1.0614 | (0.7863) | | | | | | |
| Divorce ratio | 0.0257** | (0.0101) | | | | | | |
| *Number of observations* | 1,834 | | | | | | | |

Figure 1: Densities of the predicted distribution of resources for Men, Women and children, and their trends along household expenditure.

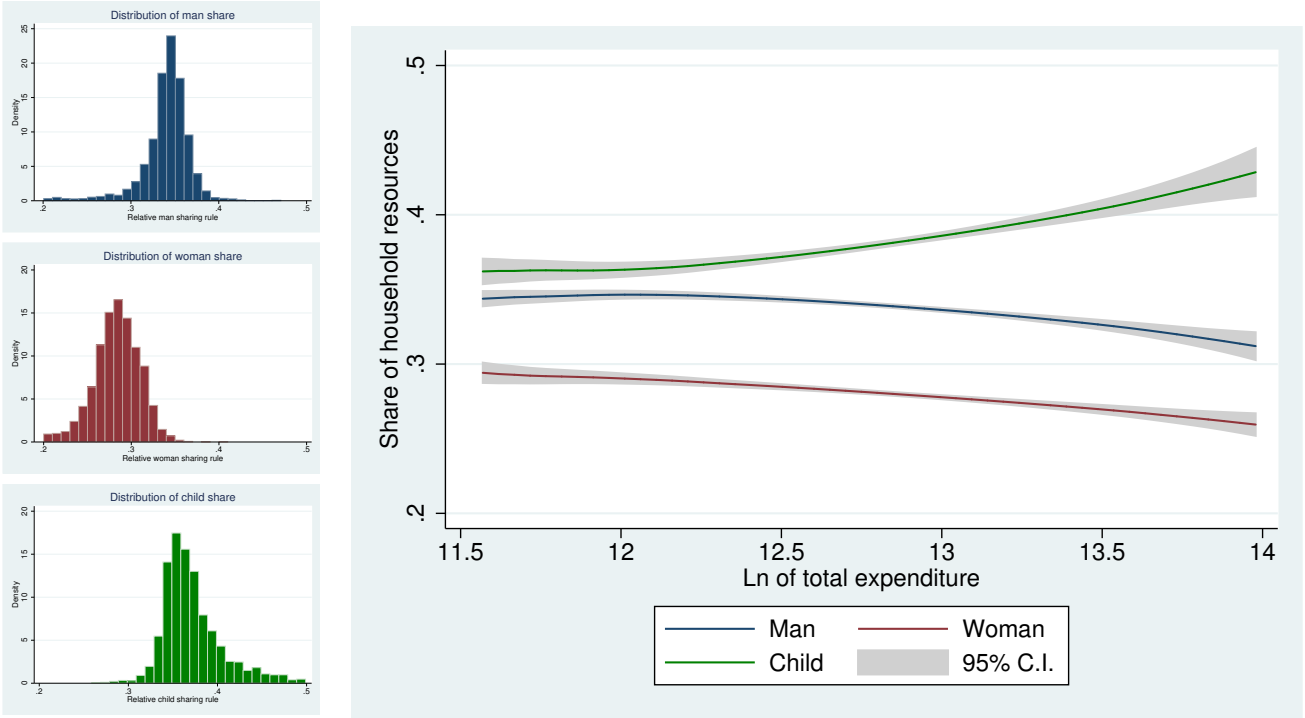



Figure 2: Densities of the predicted distribution of resources for Men and Women without children, and their trends along household expenditure.

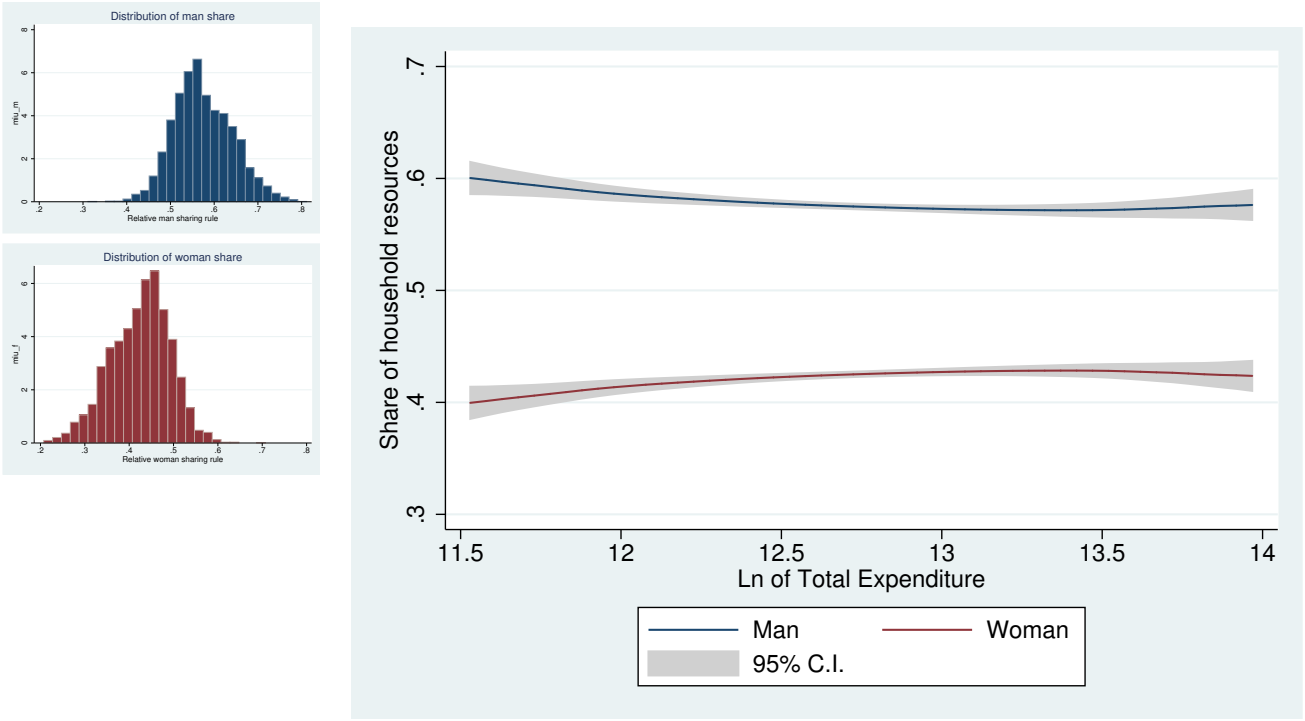
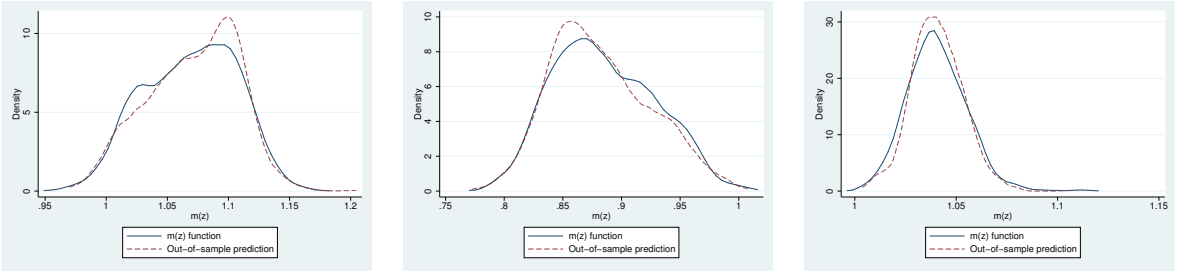
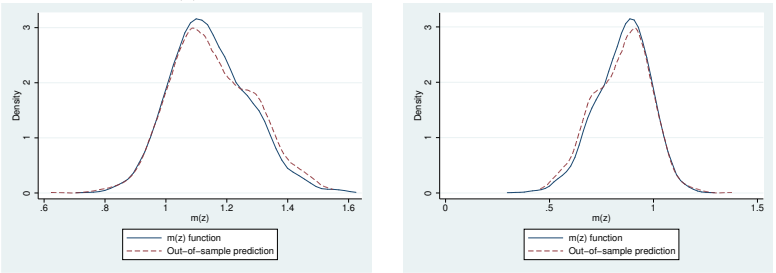


Figure 3: Densities of the estimated and predicted $m_k(\cdot)$ functions.

Predicted $m_k(\cdot)$ functions for the Man, Woman and Child sub-sample




Predicted $m_k(\cdot)$ functions for the Man and Woman sub-sample




household resources, well below the fair share of 33%. Men obtain on average slightly more than the fair share (33.8%), but children are those that obtain more resources (on average 38%), but children in rich families are much better off than those living in poorer families. In two-member families the situation is similar, with women having access to 42.5% of household resources, with a slightly wider gap in poor families.

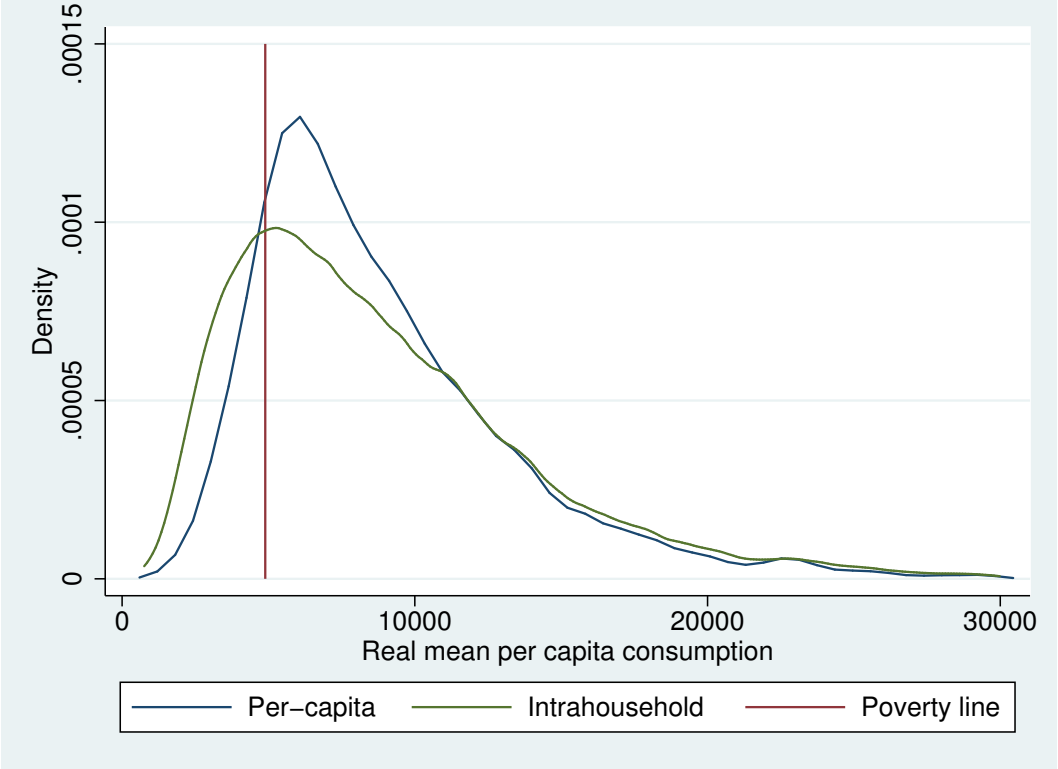
These results hold for the families that belong to the estimation samples; as mentioned above, to avoid estimation difficulties families with zero or missing assignable expenditure were removed. Because the poverty analysis reported below needs to include all of the households in the original sample, we perform an out-of-sample prediction of the $m_k(\mathbf{z})$ functions and use them to compute intrahousehold distribution of resources for these families. Figure 3 shows that the distribution of the predicted $m_k(\mathbf{z})$ functions closely resemble that of the estimated ones, suggesting that excluding those families from the estimation of the collective Engel curve system did not generate significant sample selection bias in the estimation of intrahousehold distribution of resources.

## 4.2 Fuzzy intrahousehold poverty measurement

Before commenting on the results of the poverty analysis using the intrahousehold consumption expenditure and the fuzzy set methodology, it is worth mentioning a few peculiar characteristics of the Albanian situation *vis-a-vis* poverty measurement.

For the official poverty figures INSTAT follows the World Bank's indications. Poverty is thus based on per-capita consumption expenditure and the poverty line was fixed in 2002 to 4,891 LEK

Figure 4: Per-capita and intrahousehold consumption densities




and has been used in all subsequent analyses. As a consequence the ALSMS 2012 contains a variable that measures per-capita consumption in 2002 prices with a comparable set of commodities. In order to be consistent with the official measure we use this variable for the per-capita and fuzzy monetary poverty measures, but also as a base for the intrahousehold and fuzzy-intrahousehold ones, reconstructing total household expenditure from per-capita consumption. Then, knowing the share of household resources of each household member type $k$ ($\widehat{r}_k i$), it is easy to assign to each member of family $i$ and type $k$ a share of household resources $\widehat{r}_k i/n_{ki}$, where $n_{ki}$ is the number of individuals of type $k$ in family $i$. Multiplying this share by household expenditure based on the official per-capita consumption, we obtain an intrahousehold consumption measure which is comparable with the official one, and indeed has exactly the same average value. Of course, and this is the value added by intrahousehold inequality, the dispersion is not the same.

Figure 4 illustrates this by plotting the densities of the official per-capita consumption and the intrahousehold consumption measures. A first relevant result is that the huge poverty reduction since 2002 resulted in a strong concentration of individuals who live just above the poverty line in 2012. By definition, these individuals are marked as "non-poor", and thus forgotten by any standard poverty analysis (e.g. the HCR, depth and severity of poverty). This issue is overcome with the fuzzy poverty analysis, which accounts for the whole distribution of consumption and is thus less sensitive to small changes in per-capita consumption around the poverty line.

When intrahousehold inequality is accounted for, the distribution of consumption is much more

Table 4: Poverty indicators disaggregated at prefecture level.

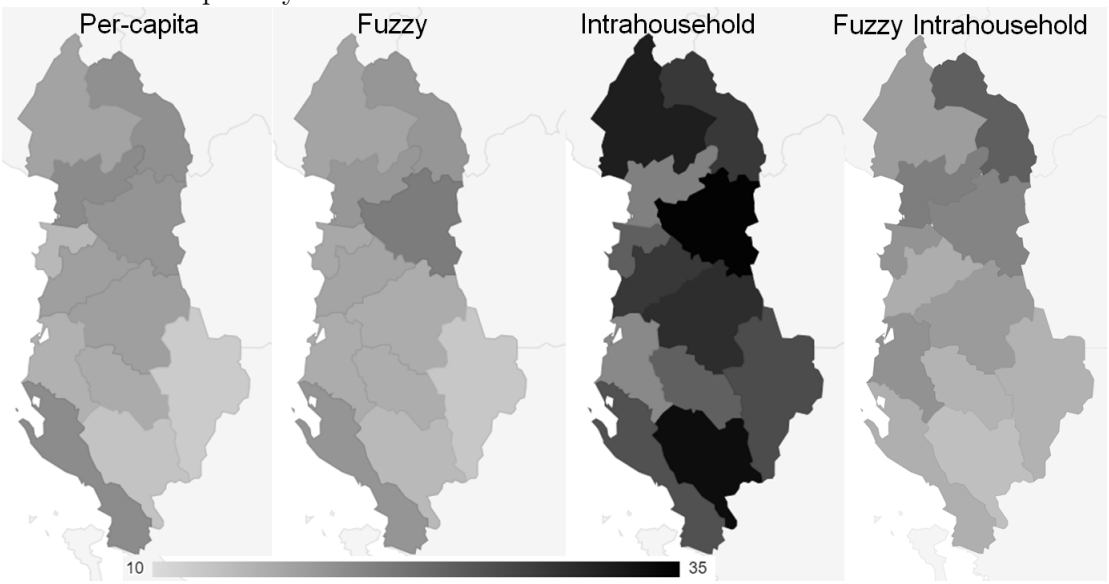
| Prefecture | Headcount | Fuzzy | Intrahousehold | Fuzzy/intrahousehold |
|---|---|---|---|---|
| Country | 14.31% | 14.31% | 23.64% | 16.92% |
| Berat | 12.34% | 12.22% | 20.80% | 14.63% |
| Diber | 12.67% | 14.16% | 26.98% | 19.98% |
| Durres | 16.50% | 15.37% | 25.38% | 18.32% |
| Elbasan | 11.27% | 13.70% | 22.59% | 17.42% |
| Fier | 17.07% | 17.22% | 25.96% | 18.42% |
| Gjirokaster | 10.63% | 10.62% | 17.94% | 13.35% |
| Korce | 12.44% | 12.58% | 20.96% | 14.77% |
| Kukes | 22.50% | 20.76% | 35.24% | 24.23% |
| Lezhe | 18.41% | 17.86% | 27.37% | 20.69% |
| Shkoder | 15.45% | 14.39% | 23.56% | 17.21% |
| Tirane | 13.92% | 13.38% | 22.30% | 15.33% |
| Vlore | 11.12% | 12.15% | 21.64% | 15.17% |

disperse, especially for consumption levels below 10,000 LEK. This increased dispersion around the poverty line has the effect that several individuals that were just above the poverty line shift below that line when accounting for intrahousehold inequality. For instance imagine a childless couple characterized by a per-capita consumption of 5,000 LEK. When accounting for intrahousehold inequality the woman would have 42.5% of household resources, i.e. 4,250 LEK, and thus will be counted as poor with a traditional poverty measure using intrahousehold consumption. Given that the Albanian population so concentrated just above the poverty line, the logical consequence of introducing intrahousehold inequality is of a sharp increase of the statistical units below the poverty line.

Indeed, Table 4 shows that the national poverty rate jumps from 14.31% of the per-capita HCR to 23.64% of the intrahousehold HCR. This phenomenon is generalized to all 12 Prefecture, in particular in those characterized by lower poverty rates. This makes it clear that traditional poverty indicators are particularly sensitive to an increase in dispersion, a natural consequence of the introduction of intrahousehold inequality. When a fuzzy poverty measure is applied to individual consumption, with the $\alpha$ parameter calibrated in order to produce a poverty rate exactly equal to the per-capita value (14.31%), the increase in the poverty rate due to the more dispersed distribution is much smaller, reaching a poverty rate of 16.92%.

With respect to the traditional approach to poverty, the fuzzy technique is thus less sensitive to variation in the distribution: as can be seen comparing columns 2 and 3 of Table 4 for the spatial disaggregation, extreme prefecture level poverty rates tend to be closer to the average. The same is even more apparent when comparing columns 4 and 5, where the introduction of intrahousehold

Figure 5: Poverty mapping of Albanian prefectures using per-capita, fuzzy, intrahousehold and fuzzy-intrahousehold poverty measures.




inequality causes the HCR to jump to more that 20% for almost all prefectures, while the fuzzy poverty shows a more reasonable increase (see also Figure 5 for a visual insight).

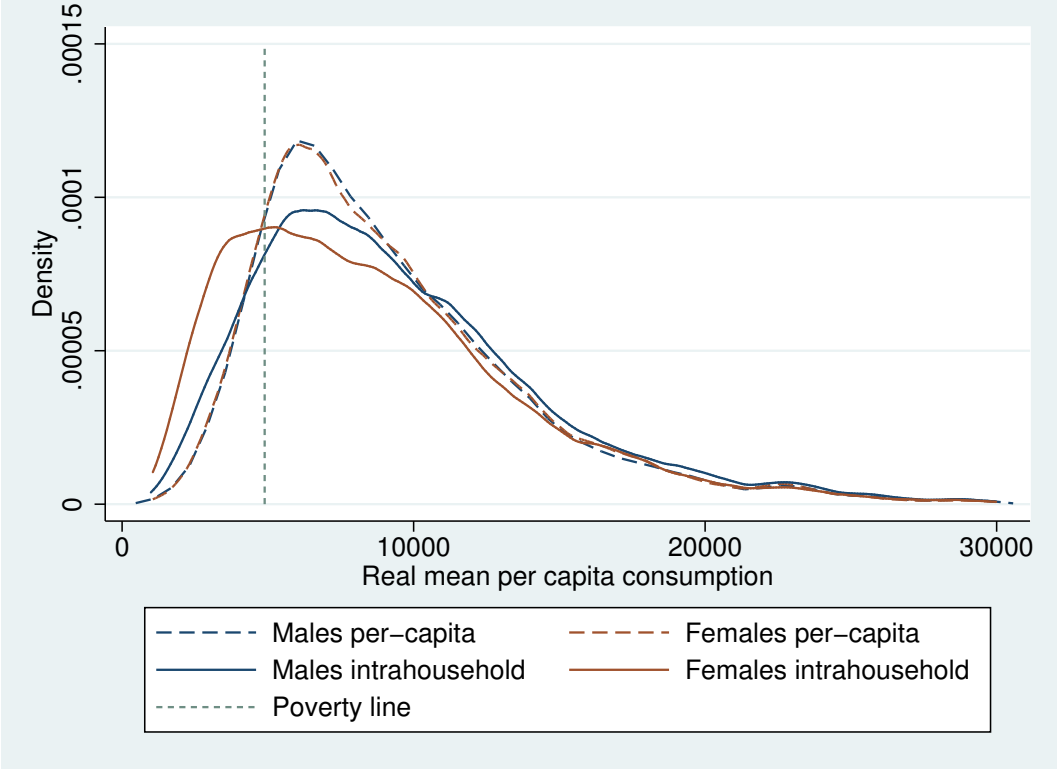
This characteristic of the fuzzy set method is true for any partition of the population (Betti and Verma, 2008; Betti et al., 2012). There are two main reasons: i) the traditional approach to poverty takes into account only the statistical units that lie below the poverty line, and, most importantly ii) it is more sensitive to changes in the distribution of consumption for the statistical units that are close to the poverty line. Because the fuzzy method accounts also for those units just above the poverty line, the fuzzy poverty will be higher for the partitions with lower HCR, because they are more likely to have a higher concentration of population just above the poverty line, and *vice-versa*. In practice, as shown at the end of Section 3.2, the fuzzy index is able to embody relative poverty and inequality in consumption.

### 4.3 Female poverty in Albania

As seen in the previous Section, the availability of information on intrahousehold distribution of resources permits estimating poverty more precisely and truly at the individual than at family level. In addition, it allows one to explore with more precision whether poverty has a gender or generational dimension. When poverty is concentrated among the more vulnerable members of the society, children and women, there is an additional issue that calls for urgent policy interventions. In this Section we explore whether the use of intrahousehold consumption is able to provide significant further insights on female and child poverty.

A first look at Figure 6 reveals that while the male and female distributions of per-capita

Figure 6: Per-capita and intrahousehold consumption densities of males and females




consumption almost perfectly overlap *quasi-by-definition*, with intrahousehold consumption there is a clear distinction between the two, with a large share of women that "cross" below the poverty line.

The implications of such a difference in the distribution of males and females are summarized by rows 2 and 3 of Table 5. While with per-capita consumption all poverty measures are about the same for males and females (less than 0.3 percentage points of difference with the HCR), when accounting for intrahousehold inequality the difference explodes: women are almost 30% more likely to be poor than men, and larger figures are observed for the depth and severity of poverty. When using the more appropriate fuzzy poverty indicator, although the figures have a smaller absolute magnitude, the difference is even lager: women are 35% more likely to be poor than men. This finding is particularly relevant because with the standard measures of poverty it was not possible to detect any significant measure of female poverty and as a consequence no action has been undertaken by the policy makers in order to improve this situation. Although the magnitude of intrahousehold inequality is subject to estimation error, and thus it would be inappropriate to claim that women are exactly 35% more likely than men to be poor, these findings are consistent with estimations performed in 2002 (Mangiavacchi et al., 2017), reinforcing the evidence that supports a relevant and persistent female poverty issue for Albania.

As highlighted by Figure 7, which compares the probability of being poor between women and

Table 5: Poverty indicators disaggregated by gender, age and area of residence

| | Per-capita | | | Intrahousehold | | | Fuzzy | |
|---|---|---|---|---|---|---|---|---|
| | Headcount | Depth | Severity | Headcount | Depth | Severity | Per-capita | Intrahousehold |
| Country | 14.31% | 2.96% | 0.97% | 23.64% | 6.60% | 2.64% | 14.31% | 16.92% |
| Males | 14.17% | 2.87% | 0.94% | 19.73% | 5.16% | 1.98% | 14.18% | 14.38% |
| Females | 14.44% | 3.04% | 0.99% | 27.52% | 8.02% | 3.29% | 14.43% | 19.44% |
| Adults | 12.43% | 2.52% | 0.81% | 20.08% | 5.63% | 2.25% | 12.59% | 14.79% |
| Children | 20.96% | 4.52% | 1.52% | 36.25% | 10.04% | 4.00% | 20.37% | 24.47% |
| Urban | 13.31% | 2.84% | 0.91% | 21.81% | 6.10% | 2.41% | 13.30% | 15.63% |
| Rural | 15.53% | 3.10% | 1.03% | 25.88% | 7.22% | 2.91% | 15.54% | 18.50% |

Figure 7: Gender poverty gap mapping (female/male poverty rates) of Albanian prefectures using per-capita, fuzzy, intrahousehold and fuzzy-intrahousehold poverty measures.

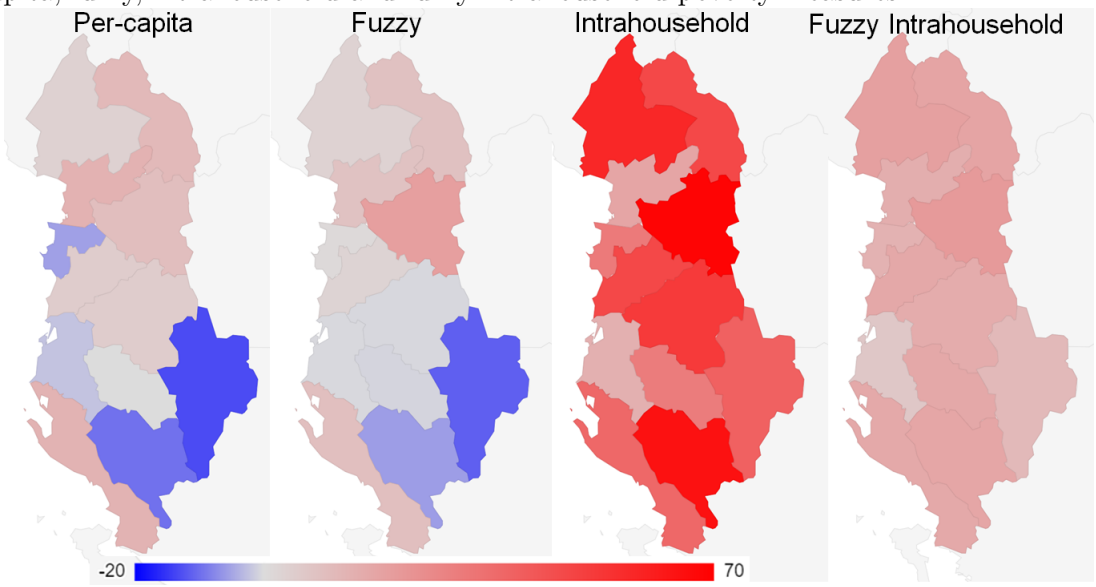


Table 6: Gender poverty gaps by prefecture (female poverty/male poverty -100%)

| Prefecture | Headcount | Fuzzy | Intrahousehold | Fuzzy/intrahousehold |
|---|---|---|---|---|
| Country | 1.89% | 1.81% | 39.44% | 35.18% |
| Berat | -0.02% | -0.72% | 30.57% | 39.52% |
| Diber | 9.49% | 19.41% | 68.57% | 56.07% |
| Durres | -5.47% | 1.09% | 31.30% | 31.12% |
| Elbasan | 5.01% | -0.42% | 51.56% | 36.47% |
| Fier | -2.29% | -0.33% | 14.06% | 13.66% |
| Gjirokaster | -9.70% | -5.75% | 64.64% | 43.03% |
| Korce | -13.14% | -11.37% | 39.02% | 25.04% |
| Kukes | 11.11% | 8.47% | 47.03% | 43.29% |
| Lezhe | 13.24% | 8.32% | 17.64% | 32.57% |
| Shkoder | 3.49% | 3.06% | 57.61% | 46.78% |
| Tirane | 5.14% | 2.78% | 47.02% | 41.50% |
| Vlore | 12.90% | 9.11% | 36.81% | 38.87% |

men for each prefecture, with per-capita based poverty measures female poverty seems not to be an issue, and in some prefectures male poverty is even larger than female poverty. When accounting for intrahousehold inequality, female poverty is an issue for all prefectures, even with the fuzzy indicator (although to a slightly smaller extent). Table 6, shows that this difference can be as high as 56.1% in Diber with the fuzzy intrahousehold poverty (68.6% with the intrahousehold HCR). The least gender unequal prefecture is Fier, with women being 13.7% more likely to be poor than men.

Given the relevance of female poverty, one concern could be that this phenomenon might be driven by the most traditional portion of the population, which could possibly be rooted in rural areas. Table 7 reports the relative female poverty indicators by area of residence, revealing instead that female poverty is typically an urban phenomenon. Focussing on the fuzzy intrahousehold indicator, women are 41% more likely to be poor in a urban context, versus almost 30% of rural areas. The relevant internal migration flows, that likely reduced poverty in rural areas, have thus shifted a large portion of poor to urban areas, probably following a temporary job for the husband only, and the consequent deterioration of women's conditions.

If female poverty was a previously overlooked phenomenon, child poverty issues where recognized as early as the first living standard surveys were available (see Section 2 for more details). The intrahousehold inequality analysis performed in Section 4.1 reveals that children are on average better-off than adults, but this is driven by more affluent households. Looking at Figure 8, the evidence suggests that with respect to per-capita consumption, intrahousehold consumption of children has a more dispersed distribution, with a larger portion of population below the poverty

Table 7: Gender gaps in poverty by area of residence (female poverty/male poverty -100%)

| | | Country | Urban | Rural |
|---|---|---|---|---|
| Per-capita | | | | |
| | Headcount | 1.89% | 4.67% | -0.67% |
| | Depth | 5.95% | 13.78% | -2.01% |
| | Severity | 4.63% | 15.84% | -6.05% |
| Intrahousehold | | | | |
| | Headcount | 39.44% | 41.75% | 37.54% |
| | Depth | 55.38% | 69.18% | 43.06% |
| | Severity | 65.96% | 92.23% | 44.42% |
| Fuzzy | | | | |
| | Per-capita | 1.81% | 5.08% | -1.22% |
| | Intrahousehold | 35.18% | 41.03% | 29.85% |

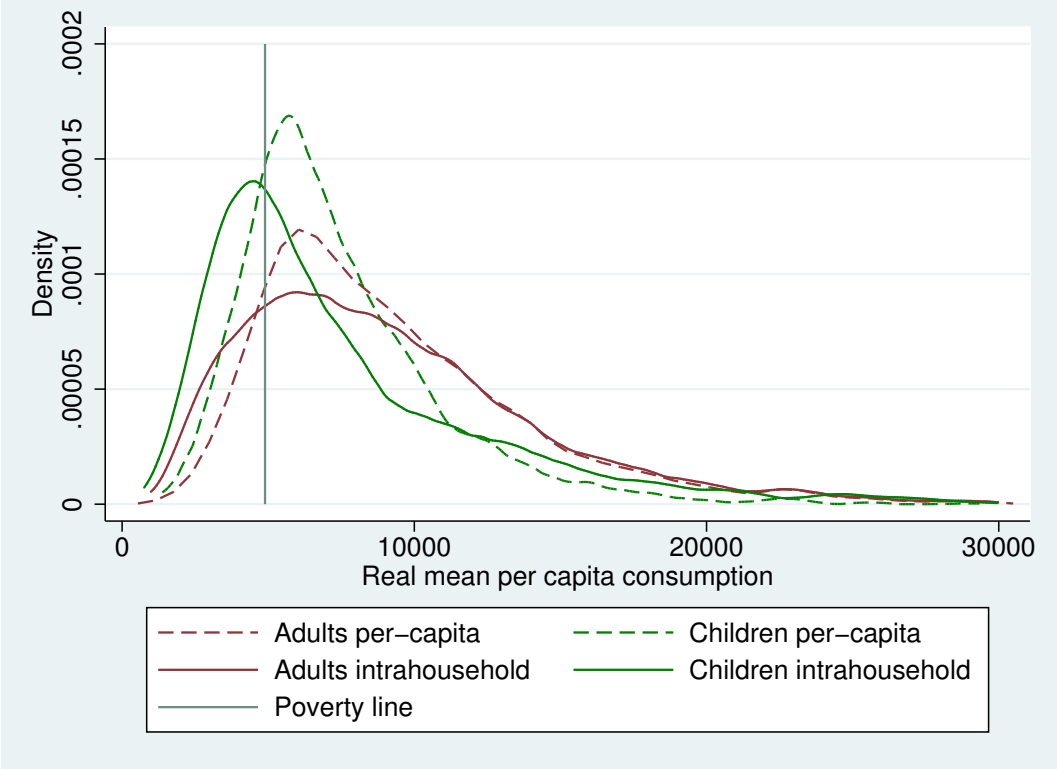
line, but also above 12,000 LEK. Child poverty figures are likely to be even larger than previously thought. Indeed, Table 5 shows that child poverty increases from the already worryingly 21% of the per-capita HCR to 24.5% of the fuzzy intrahousehold indicator (the figure would rise to more than 36% with the intrahousehold HCR). However, if compared with adult poverty rates, according to the per-capita HCR children are 68.9% more likely than adults to be poor, reducing only slightly to 65.5% with the fuzzy intrahousehold indicator. This suggests that children living in poor families do not benefit from larger shares of within household resources; this is at variance with children living in rich families.

Finally, a concern of early poverty analyses in Albania was the much larger incidence of poverty in rural areas. The gap had already reduced substantially by 2012 and the analysis of the fuzzy intrahousehold index provided by Table 5 does not provide further insights on the topic, confirming previous findings.

## 5 Conclusions

This work has analysed intrahousehold inequality in Albania and how it affects poverty measurement, both in general, and specifically for female and child poverty. To this aim the present study used a novel, widely applicable collective model to estimate intrahousehold inequality, together with a fuzzy poverty measure that overcome one of the most relevant limitations of the traditional poverty measures: the indifference to what happens just above the poverty line, with the resulting excessive sensitivity to small changes in the distribution around the poverty line. To the best of our knowledge, this is one of the first studies that propose truly individual poverty measures account-

Figure 8: Per-capita and intrahousehold consumption densities of adults and children




ing for the intrahousehold distribution of resources, and the first one that combines intrahousehold inequality with a fuzzy poverty measure.[7]

The estimation of system collective Engel curves reveals a surprisingly generalized phenomenon of gender discrimination in the intrahousehold distribution of resources. Women have on average access to 17% and 26% less resources than men for families with and without children respectively.

When analysing the impact of intrahousehold inequality on poverty with traditional FGT measures, figures are astonishing: poverty ramps up from 14.3% to 23.6%, mainly driven by female poverty that jumps from 14.4% to 27.5%, while male poverty increases by a smaller extent, from 14.2% to 19.7%. The reason of such a large increase stands on the excessive sensitivity of the HCR to an increase in the dispersion of consumption around the poverty line and the strong concentration of statistical units just above the poverty line.

When using the more reliable fuzzy poverty measure, the increase is still notable but more reasonable, to 16.9% for the whole population. The results become even stronger when analysing more closely the gender dimension. Female poverty remains much larger than male poverty (19.4% versus 14.4%), suggesting that women are 35% more likely to be poor than men. This finding is observed in all prefectures but to varying degrees, with the urban/rural dichotomy not playing a

[7]The proposed methodology comes with one caveat. At present, the empirical estimation of intrahousehold inequality does not account for economies of scales in consumption. This, however, is not an issue for the present study because the official poverty measurement strategy of The World Bank is based on per-capita consumption, which also does not account for economies of scale.

significant role. These findings strongly highlight a previously unperceived issue that should be addressed by the policy makers: female poverty.

Additional results on child and rural poverty substantially confirm previous findings of a strong and persistent relevance of the first, while the latter have been gradually but substantially reduced in the last decade.

The presence of intrahousehold inequality affecting women and the study of its impact on individual poverty suggest some policy intervention aimed at promoting gender-parity in Albania. An effective and popular way to promote gender equality it is the implementation of a conditional cash transfer aiming at reducing poverty and selecting a woman in the household to be the recipient of the transfer, as recently implemented in Macedonia (Almås et al., 2017). As the literature has shown (for a review, see Duflo, 2012) this kind of policies would improve the relative bargaining position of women in relation to men, reducing the risk of female discrimination within the household. Children, in turn, would benefit from such an equalization and empowerment in terms of nutrition and education (Fafchamps et al., 2009).

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