Estimating uncertainty for child poverty indicators: The Case of Mediterranean Countries

La stima dell'incertezza negli indicatori di povertà infantile: il caso dei paesi Mediterranei

Benedetti Ilaria, Crescenzi Federico, De Santis Riccardo

Abstract Over the last few years, there has been increased interest in compiling poverty indicators for children, as well as in providing uncertainty measures associated with point estimates. In this paper, we provide child point and bootstrapped relative standard error estimates for the At-risk-of-poverty Rate and Gini coefficient for Mediterranean countries. Using the 2018 EU-SILC survey, our results show that for these categories, poverty tends to be higher when compared to the national estimates for most of the analysed countries.

Abstract *Negli ultimi anni, c'è stato un crescente interesse nella compilazione di indicatori di povertà infantile e giovanile, nonché nel fornire misure di incertezza associate a stime puntuali. In questo lavoro, forniamo stime puntuali e degli errori standard del tasso di rischio di povertà e indicatore di disuguaglianza di Gini infantile per i paesi mediterranei. A questo scopo, abbiamo adottato il metodo di replicazione Bootstrap grazie alle sue proprietà convenienti. Utilizzando l'indagine EU-SILC 2018, i nostri risultati rivelano che le stime puntuali e gli errori standard per la povertà infantile sono più elevati rispetto alle stime nazionali per la maggior parte dei paesi analizzati.*

Key words: Child poverty indicators, Uncertainty estimates, Mediterranean countries

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Benedetti Ilaria
Department of Economics, Engineering, Society and Business organizzation, University of Tuscia. e-mail: i.benedetti@unitus.it

Crescenzi Federico
Department of Statistics, Computer Science, Applications, "G.Parenti", University of Florence. e-mail: federico.crescenzi@unifi.it

De Santis Riccardo
Department of Statistical Sciences, University of Padova. e-mail: riccardo.desantis.1@phd.unipd.it

1 Introduction

In the context of poverty and social exclusion indicators, measuring child poverty is a key topic in social science research, due to its importance for national governments and international organizations. The first of the Sustainable Development Goals (SDGs) has brought out the need to ensure successful outcomes for today's children by building the foundations of our societies' future well-being [2]. The persistence of child poverty at rather high levels compared to national poverty rates explains why reducing child poverty is now high on the social policy agenda of many OECD countries [3].

Despite the fact that several initiatives have been carried out for measuring and monitoring children's poverty over time and European countries, to the authors' knowledge the issues of uncertainty measurements have not yet been fully explored. Given the key role played by poverty indicators in designing and monitoring social progress in the EU, it is essential that the indicators used for measuring poverty are of sufficient high quality, especially in terms of their accuracy and reliability.

During the last years, several statistical authorities and organisations have started investing in identifying ways to measure and communicate data uncertainty. From a methodological point of view the formulae for calculating standard errors also depend on the statistics to be computed and the sampling design included in the survey adopted by each country [5]. A first contribution of this paper provide updated figures regarding child poverty of the population in the Mediterranean countries. Among the income-poverty measures, we selected the at-risk-of-poverty rate (AROP) while among the income-inequality indicators, we selected the Gini coefficient. In order to provide standard error estimations we provide an empirical application using the Bootstrap replication method.

The rest of this paper is organized as follows: Section 2 focuses on the child economic and inequality situation in the Mediterranean countries, in addition it addresses the issue of measuring uncertainty for poverty indicators. Section 3 discussed the Bootstrap approach for variance estimation, while Section 4 illustrates the main characteristics of the EU-SILC data and the main results obtained for the Mediterranean countries. Section 5 reports conclusions and suggestions for further research.

2 Child poverty in Mediterranean countries and the issue of uncertainty measurement

Around 23.4% of European children live in income poverty, 8.5% live in severe material deprivation and 9.3% in workless households. Child poverty is a problem for all Member States though prevalence and intensity is highest in some of the Central Eastern European, Baltic and Mediterranean states. Moreover, children and young people were some of the main victims of the 2008 financial crisis. In particular,

some Mediterranean countries such as Italy and Greece suffered from the economic crisis more than other European countries [1].

In the Mediterranean countries, in 2015 more than a third of children were at risk of poverty or social exclusion. The highest rate was observed in Greece (37.8%), Spain (34.4%) and Italy (33.5%). Moreover, in approximately half the EU member states, the at-risk-of-poverty or social exclusion rate grew from 2010 to 2015, with the highest increases recorded in Greece (from 28.7% in 2010 to 37.8% in 2015), Cyprus (+7.1 percent points) and Italy (+4.0 percent points). The persistence of child poverty at rather high levels compared to national poverty rates and its rebound with the economic crisis explains why reducing child poverty is now high on the social policy agenda of many OECD countries [3]. Several factors could affect child poverty and inequality [13]. Since children's circumstances almost always depend on their parents' and family backgrounds, a lack of education can be a major risk factor for child poverty or social exclusion. Lower educational levels can often mean that parents have less disposable income from wages or salaries. Moreover, children's likelihood of being AROP is also determined by their parents' country of birth. Household composition is a further factor influencing the probability to be at risk of poverty or social exclusion. The study of children's well-being is characterized by a plurality of approaches and measures [1], [6]. Although a wide stream of literature addressed the multidimensional aspect of child poverty, relative monetary measures of poverty are crucial for evaluating children's well-being over time and represent the main indicator to measure child poverty.

This paper contributes to this stream of literature by providing a detailed picture of the current economic and inequality situation in the Mediterranean countries. We used data collected on a regular basis through the EU-SILC survey. To this aim, we focus on the EU-SILC Laeken indicators which comprise both income-poverty and income-inequality measures. In this paper we selected one income-poverty measures, the AROP, which belong to the class of the Foster-Greer-Thorbecke (FGT) measures, and one income-inequality measures: the Gini coefficient. AROP is computed by Eurostat as the share of people with an equivalised disposable income below the at-risk-of-poverty threshold (ARPT), which is set at 60% of the national median equivalised disposable income after social transfers. While, the Gini coefficient measures the extent (0 to 100) to which the distribution of income deviates from a perfectly equal distribution. Given the key role played by poverty indicators in designing and monitoring social progress in the EU, it is paramount to produce and communicate to the public measures of the associated inherent and unavoidable uncertainty of point estimates. Indeed, measuring uncertainty around point estimates is a complex and challenging task, which may involve the use of sophisticated statistical methods as well as the adoption of econometric techniques and subjective judgement [4]. Regarding the issue of uncertainty measurement, numerous variance estimation approaches have been developed for measuring uncertainty of poverty indicators, such as linearization and re-sampling methods. Focusing on re-sampling methods, bootstrap tests based on the FGT poverty measure perform very well as soon as sample sizes are large enough for there to be more than around 10 observations below the poverty line [8].

3 Bootstrap replication method for estimating uncertainty uncertainty

To obtain a variance estimate for the nonlinear statistics considered in this paper we followed an approach based on the bootstrap. In particular, we make use of the so-called naive bootstrap approach to estimate confidence intervals as implemented in [9]. Let $X = (X_1; ...; X_n)^{'}$ denote a survey sample of n observations. The algorithm is implemented as follows:

1. Draw R independent samples $X_1^*, ..., X_R^*$ from X, where each one contains n observations drawn with replacement;
2. Compute the bootstrap replicate estimates $\hat{\lambda_r^*} = \hat{\lambda}(X_r^*)$ for each X_r^* $r = 1, ..., R$ where $\hat{\lambda}$ denotes an estimator of the poverty indicator of interest.
3. Estimate the variance $V\left(\hat{\lambda}\right)$ by using the variance of the R bootstrap replicate estimates: $\hat{V}\left(\hat{\lambda}\right) = (R-1)^{-1} \sum_{r=1}^{R} (\hat{\lambda}(X^r) - R^{-1} \sum_{j=1}^{R} \hat{\lambda}(X^j))^2$
4. The confidence interval at confidence level $(1-\alpha)$ is then calculated as:

$$\left[2\hat{\lambda} - \hat{\lambda}^*_{\left((R+1)\left(1-\frac{\alpha}{2}\right)\right)}, 2\hat{\lambda} - \hat{\lambda}^*_{\left((R+1)\left(\frac{\alpha}{2}\right)\right)}\right]$$

where $\hat{\lambda}^*_{(1)} \leq \hat{\lambda}^*_{(2)} \leq ... \leq \hat{\lambda}^*_{(R)}$. In the case of sampling designs that involve different strata, the observations are re-sampled independently within each stratum.

4 Data and results

We use cross-sectional data from the EU-SILC survey collecting timely and comparable cross-sectional and longitudinal microdata on income, poverty, social exclusion and living conditions.

In this paper, we have selected the following Mediterranean countries: Italy (IT),France (FR), Malta (MT), Spain (ES), Portugal (PT), Cyprus (CY), Greece (EL), Croatia (HR) according to their sampling design by using cross-sectional data for years 2018, corresponding to the income year 2017. Point estimates and relative standard error estimates are reported in Table 1.

It is evident that the most significant discrepancies existing between the group of children (0-15) and youngsters (16-24) are to be found in Greece and Cyprus. On the contrary, very little differences exist in these two strata for Italy and Portugal. On average, we are able to obtain satisfactory estimates of variability for each country - either for the Gini index and at-risk-of-poverty - suggesting a good level of accuracy for the point estimates.

Focusing on (relative) standard error estimates at the national level, it is essential to note that our results show a satisfactory level of reliability, since the estimated relative standard errors are lower than 5%, as emphasized in [12]. Indeed, even

if precision thresholds are generally survey specific and depend on the required reliability and resource-related political decision, specifying the degree of precision is an important step when planning a sample survey.

Table 1 Arop and Gini estimates for mediterranean countries

		Gini		Arop	
Country	stratum	Est.	RSE	Est.	RSE
PT	child	32.230	2.29%	18.189	5.94%
	young	33.717	2.52%	18.174	4.34%
	national	33.577	1.23%	17.506	2.72%
MT	child	25.646	2.69%	10.419	11.46%
	young	27.982	3.82%	11.159	10.95%
	national	27.468	1.16%	11.807	3.76%
IT	child	33.511	1.63%	24.064	2.95%
	young	35.086	1.95%	24.299	2.98%
	national	33.336	0.97%	19.906	1.63%
FR	child	28.585	6.12%	18.107	6.35%
	young	27.105	3.24%	16.472	5.57%
	national	28.706	3.02%	13.091	3.23%
HR	child	31.305	3.08%	20.923	7.70%
	young	29.476	2.19%	22.267	6.71%
	national	30.800	1.36%	21.894	3.03%
ES	child	32.647	2.13%	22.377	4.85%
	young	34.048	1.77%	24.833	3.71%
	national	32.843	1.22%	20.576	3.22%
EL	child	32.749	3.67%	20.546	4.12%
	young	32.900	1.96%	25.579	2.54%
	national	31.249	1.62%	16.897	2.44%
CY	child	31.089	4.23%	20.866	19.75%
	young	28.317	4.29%	16.635	10.34%
	national	30.052	1.90%	17.683	5.58%

5 Conclusion

In this paper we computed measures of uncertainty in children's AROP and Gini indicators based on Mediterranean European countries. Information about the sampling variability of point estimates is essential when comparing poverty rates in different geographical areas or socio-economic groups. The bootstrap method is implemented in order to obtain relative standard error estimates for the AROP and Gini indicators. The computation of standard errors for the main official poverty

measures is a complex task due to the characteristics of these indicators, which are often expressed as non-linear statistics.

The bootstrap turned out to be an easy and effective approach to compare countries that adopt different sampling designs. In fact, there are not particular constraints on the design such as a minimum number of units inside PSUs. The results emerged from this study suggest the existence of relevant differences among mediterranean countries in terms of child AROP and Gini indicators. However, there exist significant differences in the percentage of at-risk-of-poverty children and youngsters when compared to the national values. An integrated and child rights-based approach should be a priority for the EU approach on child poverty. Thus, it is necessary to monitor the effectiveness of the already implemented policies and possibly to propose *ad-hoc* policies to combat and eradicate poverty and exclusion halving education.

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