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An Asset-based Indicator of Wellbeing for a Unified Means Testing Tool: Money Metric or Counting Approach?*

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Abstract

As part of the Europe 2020 strategy, European member states have committed to modernize and harmonize their welfare systems and to improve the quality of the means testing tools adopted to correctly identify the beneficiaries of welfare policies. This study contributes to the literature on means testing by implementing and then comparing two alternative multidimensional targeting approaches: an asset-based money metric and a counting measurement of poverty. The two approaches aggregate poverty dimensions and implement inter-household comparisons of wellbeing differently. The study shows that in terms of targeting efficiency the approach based on the money metric is superior. The comparison is relevant both from an empirical and a policy point of view because a unified means testing tool would pave the road towards harmonized welfare policies across European countries.

Keywords: Means testing, multidimensional poverty, asset based poverty, wellbeing.

JEL Classification: D13, H31, I32, O15.

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1 Introduction

As part of the Europe 2020 strategy, European member States have committed to modernize and harmonize their welfare systems and to improve the quality of the means testing tools adopted to correctly identify the beneficiaries of welfare policies.

The harmonization of welfare systems across Europe may fail because of implementation problems due to the lack of a unified means testing tool. The achievement of this goal requires knowledge of the demographic profiles of those who lose and gain from the financial crisis and those who are effectively in need both at the national and local administrative levels. This task is made even more difficult if means testing tools and identifying information vary widely across countries. For instance, the Mutual Information System on Social Protection for the 28 EU Member States plus Iceland, Liechtenstein, Norway and Switzerland reports (MISSOC 2013) that not all European countries have the same perception of the part to be played by means-testing policies within a social protection system. Our purpose is to provide empirical evidence that can help the process of harmonization of European welfare programs by proposing the implementation of a unified means testing tool based on a multidimensional poverty concept.

Means-testing is traditionally used to identify eligibility of poor households to welfare programs and implement flexicurity systems for proactive job markets based on universal credit schemes or guaranteed minimum income programs.[1] In general, the identification of the poor is based on unidimensional metrics, usually income or expenditure per capita or per adult equivalent, correlated with household living standards (Skoufias and Coady 2007). Once the metric has been chosen, a household is defined as poor and eligible for cash transfers if the metric falls below a predetermined threshold.

In developed countries where people are mostly occupied in formal labor markets and their earnings are fairly traceable, disposable income can be considered a good and reliable measure of living standards. However, disposable income is only one of the dimensions of wellbeing, and, in general, is not sufficient to fully describe economic wellbeing of households or individuals (Atkinson 2003, Alkire and Foster 2011, Alkire and Santos 2014, Bourguignon and Chakravarty 2003). In times of crisis, individuals can rely on savings and ownerships to cope with persistent difficulties and unexpected events. Thus, financial and property assets have been increasingly recognized as important dimensions of economic wellbeing because they represent a vital component of family's economic security along with income, human and social capital (Brandolini, Magri, and Smeeding 2010, Carter 2008, Carter and Barrett 2006, Haveman and Wolff 2004, Weisbrod and Hansen 1968).

Assets also play a crucial role as a form of private insurance and are a direct determinant of permanent incomes (Attanasio, Hurst, and Pistaferri 2015, Blundell, Pistaferri, and Saporta-Eksten 2010, Meghir and Pistaferri 2010). For poor families, asset ownership has the potential to relieve poverty and to enhance resilience and the hope for a better future. Grinstein-Weiss, Williams Shanks, and Beverly (2014) note that if children in families owning some assets fare better than children without wealth, then helping poor families to have access to asset

[1] Eurostat defines means-tested benefits as those social benefits that are explicitly or implicitly conditional on the beneficiary's income and/or wealth falling below a specified level (MISSOC Secretariat 2013).

accumulation would be an effective strategy for programs having both the present and the future generation in mind.

In addition to monetary resources, other dimensions of wellbeing should be accounted for when the objective is to identify households or individuals who experience hardship. For instance, a family may be poor in income terms but rich in health and resilience thanks to a wider opportunity space to react to crisis because of the presence of both parents. However, it is intuitively difficult to compare the standard of living of a high income person with no wealth with an income poor but wealthy person. Or when a person living alone looses a job and is poor both in the income and in the asset dimension, the unemployment condition becomes deeply critical. These observations imply the need for interpersonal comparisons trying to rank in terms of wellbeing, for example, an unhealthy person living in a rich family or a healthy person living in a poor one. Therefore, the realization of theoretically admissible and implementable comparisons require a multidimensional approach to identifying who is poor that takes into account demographic differences among households properly.

Alkire and Seth (2013) note that there is an extensive literature on targeting methods which proxy unidimensional poverty. They also maintain that the accuracy of proxy means targeting methods can be limited and these techniques should be explored in a multidimensional space. Moving from unidimensional to multidimensional approaches to identifying the poor raises a number of challenges (Decancq, Fleurbaey, and Schokkaert 2015). There are value judgments regarding which dimensions of human development should be taken into account to define poverty and how they should be weighted. It is also relevant to be specific on the theoretical and normative principles that underlie the poverty measures of interest.

The challenge of our interest concerns with the aggregation methods of both poverty dimensions and household characteristics that correctly identifies who is poor and eligible for social programs. In the empirical part of the paper we contribute to the means-testing literature by establishing the "best" asset-based means testing tool in terms of the effectiveness in minimizing both the type I error of excluding individuals who should be included (exclusion error) and the type II error (inclusion error) associated with leakages due to the inclusion of individuals who should be excluded (Kanbur, Keen, and Tuomala 1995, Ravallion 2009, van de Walle 1998).

After presenting the welfare theory that encompasses alternative indices of wellbeing, we present the method adopted to aggregate the different dimensions of deprivation within the money metric and multidimensional approach. We then describe the experiment design used to evaluate the targeting efficiency of the competing means testing tools. The data used to simulate these two targeting indicators are based on the Survey of Households Income and Wealth (SHIW) conducted by the Bank of Italy in 2010 and are described in Section 4. The subsequent section reports the results of the comparison in targeting efficiency. The conclusive section summarizes the main findings and argues that the comparison is relevant both from an empirical and a policy point of view because a unified means testing tool could pave the road towards more harmonized welfare policies across European countries.

2 Asset-based Targeting of the Poor

2.1 An Encompassing Approach to the Multidimensional Measurement of Wellbeing

When the aim is the identification of who is poor and vulnerable, means testing should employ an efficient targeting tool based on multidimensional indicators of welfare. This can be done either with a money metric or an indicator that treats the deprivation dimensions separately. Both approaches can be placed within an encompassing theoretical framework.

Decancq, Fleurbaey, and Schokkaert (2015) point out that there are at least two sets of issues to be concerned with as a researcher moves beyond the single income dimension to describe wellbeing. One relates to the choice of the relevant dimensions of wellbeing to be considered. The second concern relates to the possibility of aggregating the relevant dimensions into one measure of wellbeing according to an acceptable normative logic.

Following Decancq, Fleurbaey, and Schokkaert's (2015) theory set up and notation to account for the multidimensional nature of wellbeing, we define

$$\ell_i = \{Y_i, W_i, D_i\} \tag{1}$$

as the vector of m life dimensions relevant to individual i, where Y_i is income, W_i is financial and non-financial wealth, and D_i represents demographics and other aspects of life. Individuals have full information about their own situation and can make an informed judgment about what makes their life good or bad. Individual i is thus able to uniquely rank the quality of life described in two different situations ℓ_i and ℓ_i': $\ell_i R_i \ell_i'$ where R_i is a preference ordering over the vectors ℓ_i and ℓ_i'.[2] Individuals also subjectively weight each relevant aspect of life through a "satisfaction function" $S_i(\ell_i)$.

In line with Decancq, Fleurbaey, and Schokkaert (2015), alternative concepts of wellbeing can be described by a function

$$WB_i\left(\ell_i, R_i, S_i\right), \tag{2}$$

which measures individual wellbeing given life dimension ℓ_i, preference ordering R_i, and satisfaction function S_i. A method of interpersonal comparisons of wellbeing must be able to rank life and satisfaction dimensions (ℓ_i, S_i) given each personal preference ordering R_i through an index that weights the elements of ℓ_i. The authors distinguish three aggregation modes illustrated below.

If one is willing to make the association between life dimensions and Sen's concepts of functionings and capabilities referring to what a person manages to do or be,[3] then wellbeing of person i can be derived from her/his specific valuations of the vector of functionings ℓ_i

$$WB_i^F\left(\ell_i, R_i, S_i\right) = \nu_i\left(\ell_i\right). \tag{3}$$

[2] Individual preference ordering R_i stands for weak, strict preference or for indifference.

[3] Commonly considered dimensions are: being in good health, being well-nourished, adequately clothed and sheltered, or taking active parts in social interactions or community life independently of what other individuals do.

Alkire and Foster (2011) method of multidimensional measurement of poverty and wellbeing belongs to this class. In this framework, the valuation $\nu_i(\ell_i)$ is an indicator of functioning failures in the life dimension ℓ_i considered socially relevant. The method identifies 'who is poor' by aggregating the multiple dimensions of deprivations. The Alkire-Foster method is also used (Alkire and Seth 2013) to target services or conditional cash transfers to poor beneficiaries who meet multiple criteria.

The equivalent income money metric is an index appropriate to implement interpersonal comparisons

$$WB_i^{EI}(\ell_i, R_i, S_i) = y_i^*. \tag{4}$$

The equivalent income money metric y_i^* is the level of income that makes an individual as well off in the actual and in a hypothetical reference situation.[4] An ordering based on equivalent incomes $y_i^* \geq y_i^{*\prime}$ is consistent with the preference ordering $\ell_i R_i \ell_i'$ if monotone in income. The equivalent income indicator of wellbeing formally accounts for differences in family compositions and needs of the members and can host a measure of asset-based poverty in a natural way as it will be explained in the next section. It also accounts for other relevant dimensions of wellbeing by composing them into a one dimensional vector of wellbeing using equivalence scales to adjust for demographic differences.

The subjective wellbeing approach summarizes life dimensions with an individual specific function S_i that maps the m dimensions onto a self-rated dimension of happiness

$$WB_i^{SA}(\ell_i, R_i, S_i) = S_i(\ell_i). \tag{5}$$

This aggregation procedure is the least appropriate in a means testing context that aims at identifying those who are objectively poor and therefore most in need as beneficiaries of a tangible transfer. While there is a positive association between income and life satisfaction evaluated "all things considered," that is also including both income and assets along with health status and other relevant dimensions of wellbeing, subjective wellbeing does not necessarily increase monotonically with income.[5] Thus, it could be admissible that an income-rich may be less happy than an income-poor. However, the income-rich has financial resources to afford health assistance without the need of public support.

Based on these arguments, and the associated implications for targeting, we restrict our attention to WB_i^{EI} and WB_i^{F} measures of wellbeing. For a thorough discussion about advantages and limitations of these alternative concepts of wellbeing see Decancq, Fleurbaey, and Schokkaert (2015).

[4] In this paper, we use the traditional definition of equivalent income, also termed distribution of welfare (King 1983, Lewbel 1989 and 1991, Blackorby and Donaldson 1991, Perali 2003), that admits full comparability because independent of the base income chosen for comparisons.

[5] In the SHIW 2010 data set used in our empirical application, the correlation between disposable income and the unhappy (1 to 3 of the Likert scale) is 0.07, for the fairly happy (4 to 7 of the Likert scale) is -0.20, and the very happy (8 to 10 of the Likert scale) is 0.15. They are all statistically significant at the 5% level. The proportion of unhappy Italians is 14 percent in the first income quintile and increases to 23 percent in the fifth quintile. This counter-intuitive pattern conveys that in our data the happiness measure of wellbeing violates monotonicity with respect to income and therefore it is not suitable as a targeting tool. Further, because happiness is self-rated, the measure is not fully incentive compatible, thus difficult to verify.

2.2 Multidimensional Means Testing Approaches

From the perspective of the effective implementation of social policies, assets may critically condition eligibility to means-tested public benefits (Brandolini, Magri, and Smeeding 2010). Ownership of tangible and financial assets is a major determinant of life projects (Carter and Barrett 2006, Carter 2008). To cope with daily needs and unexpected events individuals resort to real and financial assets. Assets and liabilities thus help smoothing consumption when income is uncertain or a shock occurs. The drop of current consumption below the poverty line has a structural nature when also permanent income falls below the poverty line (Morduch 1994) or asset holdings fall below a critical threshold (Carter and Barrett 2006).

2.2.1 The Asset-based Money Metric Approach

Weisbrod and Hansen (1968) and Haveman and Wolff (2004) contend that current income and current net worth are important determinants, although not the sole determinants, of the "economic position" of an individual clearly depending also on the flow of services over which she has command. Net worth, obtained as total assets minus total liabilities, is an indicator of "long-run economic security," while liquid assets are an indicator of the ability to cope with unanticipated emergencies.[6] Current net worth is made commensurable by converting net worth into an annuity value to be added to disposable income.

In line with Weisbrod and Hansen (1968) and Brandolini, Magri, and Smeeding (2010), in a given year current income CY_i of individual or household i is defined as the sum of after direct tax incomes Y_i and incomes from net worth rNW_i

$$CY_i = Y_i + rNW_i, \tag{6}$$

where after direct tax disposable income Y_i is the sum of net payroll labor, pensions and other transfers, r is the average rate of return on assets and NW_i is the net worth evaluated at the previous year.[7]

Household composition and other relevant intangible dimensions, such as health or working status, can be modeled by means of equivalence scales or weights. Within the set of household dimension weights C, we distinguish a subset C^d of data-driven scales and a subset of normative scales C^n. Weights are data-driven when they are estimated from observed consumption behavior. Data-driven weights are not based on any explicit value judgement about how the trade-offs between the dimensions should be. Normative weights for characteristics for which data are unavailable require a value judgement on the trade-offs and are

[6] An interesting case is the one of farmers who notoriously "live poor and die rich." El Osta, Mishra, and Morehart (2007) report that a majority of farm wealth (net worth) is in farm assets, especially land, although it is difficult to liquidate them on short notice. Average net worth of farm household has increased steadily over the years, mainly from the appreciation in farmland values. Access to financial or other "liquid" assets (including savings and inventories) can help forestall a tightening in household consumption. Likewise, income that exceeds consumption can be added to savings or used to repay debt. Interestingly, in the US farm households with higher income and higher wealth than the median US household (49% of farm households); farm households with higher income but lower wealth ($<$ 3% of farm households); farm households with lower income but higher wealth (43% of farm households); farm households with both lower income and lower wealth (6% of farm households).

[7] Detailed information about the definition of the components of current income and the rate of interests used in our analysis can be found in the Appendix.

not based on observational data (Decancq and Lugo 2013). Thus an extended representation of household i composition can be represented as follows

$$\varsigma_i(d,n) = 2D_0 + \sum_{k=1}^{K} C_k^d d_k + \sum_{l=1}^{L} C_l^n n_l, \tag{7}$$

where D_0 is a dichotomous variable taking the value of 0.5 when the family is composed of a single adult or 1 if it is composed of a couple, C_k^d is the cost of the demographic characteristic k, d_k is the size of the corresponding characteristic such as the number of children of a given age, C_l^n is the cost of the normative characteristic n_l such as being unemployed, a single parent, a disabled person or other normative characteristics for which data are not available or household surveys are not representative of the specific characteristic and therefore estimation of the corresponding weight is unreliable. Decancq and Lugo (2013) term equivalence scales combining statistical evidence and value judgments as hybrid. When the information set available to the policy maker is limited to objective demographic characteristics, household equivalence scales reduce to the data-driven scale

$$\varsigma_i(d) = 2D_0 + \sum_{k=1}^{K} C_k^d d_k. \tag{8}$$

Equation (8) estimates the number of equivalent adults in the household and is used in lieu of family size to construct corrected per capita expenditures. Though we may be willing to accept that both wage and non-wage incomes are recorded with precision, means testing may turn out to be a method with much higher leakage and inefficiency than traditionally believed if equivalence scales are not used properly. It is well known that the measurement of poverty and the targeting efficiency may significantly change depending on the choice of the scale used to generate the distribution of welfare (Atkinson 1995, Burkhauser, Smeeding, and Merz 1996, Cowell and Mercader-Prats 1999, de Vos and Zaidi 1997, Perali 2003).

For the purposes of this paper, the equivalent money metric index WB_i^{EI} specializes as

$$WB_i^{EI} = \begin{cases} CY_i^{*} = \frac{Y_i}{\varsigma_i(d)} + \frac{rNW_i}{\varsigma_i(d)}, \\ \\ CY_i^{**} = \frac{Y_i}{\varsigma_i(d,n)} + \frac{rNW_i}{\varsigma_i(d,n)}, \end{cases} \tag{9}$$

where CY_i^{*} is the equivalent money metric index adjusted using data-driven scales, while CY_i^{**} is adjusted using hybrid equivalence scales. In equation (9) income and wealth are scaled by demographic characteristics and circumstances describing relevant dimensions of wellbeing such as health, education, employment or marital status. Note that net wealth is scale invariant with respect to r if also the NW specific threshold is scaled by r.

In the empirical analysis, net worth NW_i is decomposed into its financial FW_i and non-financial NFW_i components because of the different policy relevance associated with each asset information. Therefore, equation (9) becomes

$$WB_i^{EI} = \frac{Y_i}{\varsigma_i} + \frac{r_1 FW_i}{\varsigma_i} + \frac{r_2 NFW_i}{\varsigma_i}, \tag{10}$$

with ς_i being either data-driven $\varsigma_i(d)$ or hybrid $\varsigma_i(d,n)$ equivalence scales. Note that financial assets net of liabilities and non-financial asset have a different "liquidifiability" rate r_1 and r_2.

An alternative representation of the welfare metric in equation (9) is as follows. Consider the following general wellbeing index $I_i(\xi)$ of individual i (Anand and Sen 1997, Bourguignon and Chakravarty 2003, Dutta, Pattanaik, and Xu 2003, Bossert, Chakravarty, and D'Ambrosio 2013, Decancq and Lugo 2013)

$$I_i(\xi) = \begin{cases} \left[w_1 I_{i1}(\xi_1)^\beta + ... + w_m I_{im}(\xi_m)^\beta\right]^{\frac{1}{\beta}} & \text{for } \beta \neq 0, \\ \\ I_{i1}(\xi_1)^{w_1} \times ... \times I_{im}(\xi_m)^{w_m} & \text{for } \beta = 0, \end{cases} \tag{11}$$

where $I_i(\xi)$ is a weighted mean of order β of the transformed achievements $I_{ij}(\xi_j)$ with $j = 1, ..., m$. The dimension specific weights w_j are non-negative and $\sum_{j=1}^{J} w_j > 0$. They may sum to one, but not necessarily.[8]

Assume the transformation functions $I_{ij}(\xi_j)$ are identities and that the parameter $\beta = 1$ as in Bossert, Chakravarty, and D'Ambrosio (2013). Then, the general index[9] specializes into

$$I_i(Y_i, NW_i, d_i, r) = w_1 \frac{Y_i}{\varsigma_i(d)} + w_2 \frac{r_1 FW_i}{\varsigma_i(d)} + w_3 \frac{r_2 NFW_i}{\varsigma_i(d)} = w_1 Y_i^* + w_2 FW_i^* + w_3 NFW_i^*, \tag{12}$$

where the numerator Y_i is disposable income, r_1 is the rate of return on financial assets, FW_i is the worth of financial wealth net of liabilities, r_2 is the rate of return on non-financial assets,

[8] The transformation function $I_i(\xi)$ may take the form of common scaling when normalized with respect to the mean or median of a population or can be linear as in the Human Development Index (HDI) based on the difference between the indicator variable and its minimum divided by the range (for $\beta = 0$) or a monotonically increasing transformation. The parameter β makes the wellbeing index generally concave and transforms the curvature of the index on the basis of society's perceived aversion to poverty. A higher β places greater weight to dimensions where deprivation is higher. The smaller the value of β, the smaller the substitutability between dimensions $\sigma = 1/(1-\beta)$ keeping the level of wellbeing constant. For $\beta = 1$, the index in equation (11) reduces to a weighted mean if the weights sum to 1. If $\beta = 0$ the substitution between dimensions is unitary. If $\beta \to -\infty$, the degree of substitutability is 0 meaning that they are complements.

[9] $I_i(Y_i, NW_i, d_i, r)$ has sound theoretical legitimacy. It is Cardinally Fully Comparable (CFC), that is, the class of associated household welfare functions is invariant with respect to affine transformations. Let $Y = C(u,p,d)$ be separable in prices p and demographic variables d thanks to the property of Independence of the income Base (IB) at which comparisons are performed (Lewbel 1989 and 1991, Blackorby and Donaldson 1991, Perali 2003) so that $C(u,p,d) = G(u,p)\varsigma(d)$. For illustrative purposes, assume that $\ln u$ be a "Gorman" affine transformation of the price aggregator functions $A(p)$ and $B(p)$ as $\ln(C(u,p,d)/\varsigma(d)) = \ln G(u,p) = \ln A(p) + B(p)\ln u$. As required by CFC, the class of individual welfare functions must be invariant with respect to affine transformations (D'Aspremont and Gevers 2002). In general, the IB property implies $C(u,p,d) = G(u,p)m_0(p,d)$ and $\ln(C(u,p,d)/m_0(p,d)) = \ln G(u,p) = \ln A(p) + B(p)\ln u$, where $\ln A(p)$ and $B(p)$ are price aggregators and $m_0(p,d)$ is a Barten-Gorman household equivalence scale and can be interpreted as the household specific number of household equivalents. The function $m_0(p,d)$ provides an exact estimate of equivalent adults conditional on the chosen set of demographic variables (Perali 2003). Note that the right-hand side does not depend on household characteristics and is the same for each household. This makes the distribution of equivalent expenditures $C(u,p,d)/m_0(p,d)$, also termed the distribution of welfare (Lewbel 1989 and 1991, Perali 2003), fully comparable across households under IB preferences, because it is independent of the base income at which comparisons are implemented. The measurement of household equivalence scale suffer from a fundamental identification problem that is not solved by the IB property (Perali 2003, Menon and Perali 2010). However, the IB property makes welfare comparisons using need-based equivalence scales operational. Note that in the present application, and as it is common practice in the design of an implementable means testing tool, exact household equivalence scales $m_0(p,d) = C(u,p,d)/G(u,p)$ are approximated by a household equivalence scale that is independent of prices $\varsigma(d)$ as illustrated in (7).

NFW_i is the net worth of non-financial assets and $\varsigma_i(d)$ is a data-driven equivalence scale. In equation (10) it has been assumed that each dimension has equal weight $w_1 = w_2 = w_3 = 1$.

We can represent the asset-based money metric of equation (9) in matrix notation with the help of a numerical example

$$I^* = [\xi^*]\,\iota' = \begin{bmatrix} Y^* & FW^* & NFW^* \\ 13.1 & 2 & 0 \\ 15.2 & 3 & 25 \\ 12.5 & 1.5 & 142 \\ 20 & 7 & 235 \end{bmatrix} \begin{bmatrix} \iota \\ 1 \\ 1 \\ 1 \end{bmatrix}', \tag{13}$$

where the rows of I^* correspond to individuals, the columns report dimensions of interest $Y^* = Y/\varsigma(d)$, $FW^* = r_1 FW/\varsigma(d)$, and $NFW^* = r_2 NFW/\varsigma(d)$, and ι is the identity vector. Note that in the example we have three main explicit dimensions (income, financial and non-financial wealth) corrected by the $\varsigma(d)$ data-driven household equivalence scale corresponding to the column space of matrix I, but we can accommodate as many implicit dimensions as there are family circumstances of interest by additively including them in the hybrid household equivalence scale while maintaining the same column space. This representation is intended to make the comparison between the asset-based money metric and the counting targeting method easier. This example will be extended in the next section devoted to the counting targeting method by hypothetically adding the dimensions associated with health status and the presence of a single parent. To match this situation with two extra dimensions, in the absence of objective information, the money metric index incorporates the normative judgment about the extra dimensions as follows

$$I^{**} = [\xi^{**}]\,\iota' = [Y^{**} \,\vdots\, FW^{**} \,\vdots\, NFW^{**}]\,\iota', \tag{14}$$

where $Y^{**} = Y/\varsigma(d,n)$, $FW^{**} = r_1 FW/\varsigma(d,n)$, and $NFW^{**} = r_2 NFW/\varsigma(d,n)$. In our empirical example, n includes the normative weight for poor health, single parenthood, unemployment, and retirement.

In order to identifying who is poor and vulnerable a cutoff has to be chosen. Suppose that one is interested in using data-driven equivalence scales but the extension to hybrid equivalence scales is straightforward. Let Z_{Y^*} be the relative poverty line or eligibility threshold expressed in terms of equivalent disposable income $Y_i^* = Y_i/\varsigma_i(d)$.[10] Equivalent income is the level of income that would make a comparison individual or household indifferent between her current situation and the hypothetical reference situation where she would be at the reference values for all non-income dimensions of life. A household is thus income poor or eligible when the equivalent money metric index CY_i^* is less than Z_{Y^*}

$$CY_i^* < Z_{Y^*} \implies Y_i^* < Z_{Y^*} - rNW_i^* \tag{15}$$

or when equivalent disposable income Y_i^* is lower than the threshold level decreased by a

[10]The relative poverty line depends on the choice of the equivalent income distribution and it is not fixed as in the case of thresholds determined on the basis of the cost of a reference basket of necessary goods. So, as equivalence scales change, also the relative poverty line does.

proportion r of the equivalent property income $NW_i^* = NW_i/\varsigma_i(d)$. The proportion of the population living in households with equivalent current income less than the poverty line gives the headcount index (H).

The asset specific poverty line can be obtained multiplying the income poverty line by a factor associated with a length of a hypothetical period of time during which assets can be effective in maintaining an acceptable minimum standard of living. For example, Gornick, Sierminska, and Smeeding (2009) choose six months as the length of the reference period of time implying an asset-poverty line at one-half of Z_{Y^*}. Figure 1 illustrates the income and asset poverty regions in light blue and red, respectively. The intersection area isolates the households who are poor in both dimensions. The dashed area refers to those households who would have been classified as poor if the wealth dimension had not be taken into account.

The money metric based on equivalent current incomes is a multidimensional measure of wellbeing that aggregates over dimensions of individual i producing a measure of equivalent income at the individual level, and to obtain poverty measures the money metric index can be aggregated across individuals (Aaberge and Brandolini 2015). Further, to measure poverty the money metric index refers to a single threshold, while alternative multidimensional poverty indices adopt separate thresholds for each dimension. In indices such as the Human Poverty Index (HPI) (UNDP 1997) this order of aggregation is inverted by first counting the proportion of people failing to achieve a minimum standard for each deprivation dimension, and then aggregating these proportions into a composite index.

2.2.2 The Counting Approach

The multidimensional methodology proposed by Alkire and Foster (2011) aims at identifying poor households and constructing aggregate measure of poverty by combining the "counting" approach to the measurement of multidimensional poverty (Atkinson 2003) with axiomatic approaches such as Bourguignon and Chakravarty (2003). The multidimensional poverty index (MPI) reflects deprivations in basic services and human functionings associated with human development. The MPI combines the deprivation dimensions that a household faces and it is an operationalization of WB_i^F. By convention, a household is identified as multidimensionally poor if it is deprived in some combination of dimensions whose weighted sum exceeds 30 percent of all deprivations.

Define an achievement matrix $x = [x_{ij}]_{N\times\Delta}$ that summarizes the joint distribution of Δ dimensions across N individuals. The element $x_{ij} \geq 0$ is the achievement of individual $i = (1, \ldots, N)$ with respect to $j = (1, \ldots, \Delta)$ dimensions. The weight of dimension j is denoted as w_j, where $\sum_{j=1}^{\Delta} w_j = 1$. The expression $\mid x \mid$ means the sum of all the elements of any vector x_j or matrix x and $\mu(x)$ represents the mean of $\mid x \mid$, or $\mid x \mid$ divided by the total number of elements in x.

We now extend the numerical example described above to the case of a counting poverty approach. Here, the MPI has the same number of individuals $N = 4$ and equally weighted dimensions $\Delta = 5$: income is disposable equivalent income Y^*, financial wealth is financial equivalent worth net of liabilities FW^*, non-financial assets is the equivalent worth of illiquid assets NFW^*, as above. Unlike equation (13), here we add two dimensions, the health status

H refers to the presence of a person with a chronic illness, and the variable SP represents single parent households

$$x = [x_1^* \,\vdots\, x_2] = \begin{bmatrix} Y^* & FW^* & NFW^* & \vdots & H & SP \\ 13.1 & 2 & 0 & \vdots & 0 & 0 \\ 15.2 & 3 & 25 & \vdots & 0 & 1 \\ 12.5 & 1.5 & 142 & \vdots & 0 & 1 \\ 20 & 7 & 235 & \vdots & 1 & 0 \end{bmatrix} \tag{16}$$

with $z = \begin{vmatrix} 13 & 3 & 120 & \vdots 1 & 1 \end{vmatrix}$ being the vector of deprivation cutoff containing the poverty line of each dimension. The row vector x_i denotes the achievements of household i in all Δ dimensions. The column vector x_j denotes the achievements of all i persons in dimension δ. Interpersonal comparison is a generally neglected aspect in the MPI literature, while it plays a central role in the definition of the money metric index. This aspect will receive special attention in our empirical application.

The deprivation matrix (1 if deprived) is defined as $g^0 = [g_{ij}^0]_{N\times\Delta}$ whose element g_{ij}^0 is the weight for dimension j when individual i is deprived in the j-th dimension and 0 otherwise according to the deprivation cutoff z_j.

$$g^0 = \left[g_1^0 \,\vdots\, g_2^0\right] = \begin{bmatrix} Y^* & FW^* & NFW^* & \vdots & H & SP \\ 0 & 1 & 1 & \vdots & 0 & 0 \\ 0 & 1 & 1 & \vdots & 0 & 1 \\ 1 & 1 & 0 & \vdots & 0 & 1 \\ 0 & 0 & 0 & \vdots & 1 & 0 \end{bmatrix}. \tag{17}$$

The column vector c of deprivation counts whose i-th entry is $c_i =\mid g_i^0 \mid$ described by the number of weighted deprivations suffered by individual i.

Following Bourguignon and Chakravarty (2003) and Alike and Foster (2011), we define an identification function $\rho = \Re_+^\Delta \times \Re_{++}^\Delta \rightarrow \{0,1\}$ that maps from person i's achievement vector $x_i \in \Re_+^\delta$ and cutoff $z \in \Re_{++}^\Delta$ to an indicator variable $\rho(y_i;z)$ equal to 1 if poor and 0 if not poor. Implementing the identification function $\rho(y_i;z)$ to all individual achievement vector in x generates the set $Z \subseteq \{1,\ldots,N\}$ of individuals who are poor in x given z. The aggregation of $\rho(y_i;z)$ generates an overall measure of multidimensional poverty $M(y,z)$. The identification criterion can follow either the union method, where an individual is multidimensionally poor if there is at least one dimension in which a person is deprived corresponding to the condition $\rho(y_i;z) = 1$ if $C_i \geq 1$, or the more restrictive intersection approach that identifies an individual as poor if deprived in all dimensions corresponding to the condition $\rho(y_i;z) = 1$ if $C_i = \Delta$. A person is identified as poor if her weighted deprivation count is greater than the poverty cutoff K, $C > K$. This can be called a dual cutoff identification method, because it uses the deprivation cutoff z_j to determine whether a person is deprived or not in each dimension, and the poverty cutoff K to determine who is to be considered multidimensionally poor.

By replacing the i-th row of g_i^0 where $C_i < K$ with a row vector of zeros, the censored deprivation matrix $g^0\,(K) = [g_{ij}^0\,(K)]_{N\times D}$ for $K = 3$ is

$$g^0(K) = \begin{bmatrix} Y^* & FW^* & NFW^* & \vdots & H & SP \\ 0 & 0 & 0 & \vdots & 0 & 0 \\ 0 & 1 & 1 & \vdots & 0 & 1 \\ 1 & 1 & 0 & \vdots & 0 & 1 \\ 0 & 0 & 0 & \vdots & 0 & 0 \end{bmatrix}. \tag{18}$$

Define the censored vector of deprivation counts $C(K)$ by $C_i(K) = \rho_k(y_i; z)C_i$ for $i = 1, \ldots, n$. Notice that $C_i(K)/\Delta$ represents the share of possible deprivations experienced by a poor person i, and hence the average deprivation share across the poor is given by $A = |C(K)|/(q\Delta)$. The censored deprivation matrix contains the weighted deprivations of exactly those persons who have been identified as poor and excludes deprivations of the non-poor. This partial index conveys relevant information about multidimensional poverty, namely, the fraction of possible dimensions δ in which the average poor person endures deprivation.

Consider the following multidimensional poverty measure $M_0(y; z)$, obtained as the mean μ of the matrix $g^0(k)$, which combines information on the prevalence of poverty and the average extent of a poor person's deprivation. The adjusted headcount ratio is given by

$$M_0 = \mu(g^0(K)) = H \cdot A. \tag{19}$$

M_0 can also be expressed as the product of the multidimensional head count ratio, H, and the average deprivation share among the poor, A.[11] The adjusted headcount ratio is consistently decomposable by population subgroups and by dimensions. The methodology (ρ_k, M_0) satisfies monotonicity, since if a poor person becomes deprived in an additional dimension, then A rises and so does M_0. The equivalent definition $M_0 = \mu(g^0(K))$ interprets M_0 as the total number of deprivations experienced by the poor, or $|C(K)| = |g^0(K)|$, divided by the maximum number of deprivations that could possibly be experienced by all people, or $N\Delta$. The adjusted headcount ratio can be used with purely ordinal data, which arises frequently in multidimensional approaches based on capabilities such as self-reported health, and cardinal data such as income.

Achievements can be linearly aggregated to form a household wellbeing score using alternative weighting structures (Cavapozzi, Han, and Miniaci 2015, Decancq and Lugo 2013). The choice of the most appropriate relative weights across dimensions is still a much debated empirical issue. In the context of multidimensional deprivation measurement, aggregation across dimensions is implemented defining "importance weights" inversely related to the degree of marginalization of the population sharing the same deprivation dimension (Desai and Shah 1988, Decancq and Lugo 2013). Such data-driven weights capture the subjective evaluation of individuals attaching a higher importance to deprivations experienced by minorities. In the context of the present study, we adopt normative weights assigning equal weights to each dimension. This is the weighting scheme also adopted by the HDI and MPI.

One of our concerns is not how dimensions should be weighted, but how to implement interpersonal comparisons independently of the measurement tool used. For example, Cavapozzi,

[11] As Aaberge and Brandolini (2015) note the M_0 index coincides with the Atkinson-type primal measure of deprivation (Atkinson 2003).

Han, and Miniaci's (2015) multidimensional poverty assessment specifies net income and net wealth dimensions in per capita terms. This choice, as compared to the adoption of equivalence scales, may critically affect the correct identification of the poor.

For the purpose of our simulation exercise, we present the union, the intermediate and the intersection identification strategy as illustrated in Figure 1. The intersection strategy would limit the attention to the especially deprived leaving out those who experience extensive deprivation such as a destitute but healthy person. The intersection strategy is also adopted to minimize targeting leakage and possible inclusion errors. Because the group of those who are deprived in all dimensions reduces as the number of dimensions increases (Table 7), the means testing experiment described in the next section is limited to either three or five dimensions.

3 The Means Testing Experiment: Targeting Efficiency Compared

There are many types of targeting tools. They have been traditionally classified in terms of the procedure adopted to reach the most in need by either targeting poor households or specific categories of the population grouped, for instance, by areas of residence or demographic characteristics (Coady, Grosh, and Hoddinott 2004). Means testing identifies the poor by measuring the standard of living[12] of each household and identifying a monetary eligibility criterion to select the beneficiaries. Means testing is used mainly to deliver cash transfers or allowances on the cost of welfare services. It is the most administratively expensive method, but it assures the lowest inclusion or exclusion errors if verified and professionally implemented (Castañeda *et al.* 2005).[13] In Europe most countries include some forms of immovable or movable assets in the means testing tool. In some cases the tool is designed as a money metric index, in others it is more similar to a counting approach.[14]

In the context of the present research, we are interested in studying the relevance for the targeting quality of taking into account asset information in means testing tools and the targeting efficiency of both the money metric and counting approach. In order to evaluate the targeting efficiency of the two means testing indicators, we define a benchmark of presumed poor households. For the sole purpose of our exercise, a household is classified as poor and

[12]The standard of living of the potential targets is traditionally estimated from income or consumption data including or not information about assets.

[13]Proxy means testing aims at reducing administrative costs and discouraging incentives to lie. Benefits are distributed on the basis of a ranking established by using short household-level questionnaires, with moderate screening costs, reporting information that correlates with welfare measures and can proxy for incomes. Under categorical targeting, generally implemented in accordance to conditionality rules without a formal verification of the means test, benefits are distributed to all the individuals living in a geographical area or belonging to a vulnerable group, selected on the basis of a threshold eligibility level. Further, a targeting tool can be designed either to reach households or individuals, but rarely individuals within household that requires knowledge about the distribution of resources within the household.

[14]For example, Italy adopts a means testing tool based on an index that composes disposable income and assets weighted by equivalence scales to account for differences across households (Baldini, Bosi, and Toso 2002). In the US, the income and asset dimensions are treated separately (Castañeda *et al.* 2005, Lindert 2005). The Inter-American Development Bank (IDB) has adapted and promoted the Alkire-Foster methodology to help governments in Latin America target beneficiaries of Conditional Cash Transfer Programmes (CCT). In 2008, the Alkire-Foster measure has been adopted in Mexico for targeting beneficiaries by Oportunidades. In India, the Below the Poverty Line (BPL) is an Alkire-Foster targeting method accounting also for non-financial assets such as land, housing and other ownerships (Alkire and Seth 2013).

belongs to the benchmark group of households if the following three qualifiers are jointly experienced 1) family needs are met with many difficulties, 2) in the last year, the family either has not been able to save money or had to use savings accumulated in the past in order to cover total expenditures, and 3) family's equivalent disposable income falls below a threshold set at 40th percentile of the income distribution corresponding to 6,500 euro.

Interestingly, the first qualifier is multidimensional in the sense that when a person is asked about meeting her family needs she presumably weights all dimensions of scarcity she faces. Criteria 2) and 3) help to fine-tune the identification of economically disadvantaged households by excluding those who subjectively feel to experience economic shortages. We acknowledge that the adopted criteria could be questionable. However, our purpose is not to identify the "true" poor households, but rather to select a sample with desired characteristics against which to compare the money metric and counting means testing tools. Our definition of who is the poor is only instrumental to the implementation of the efficiency comparison. The analysis that follows produces evidence suggesting that the benchmark poor households suffer from deprivation in many dimensions of life as expected (Table 3).

Because we live in a world of imperfect information, administrators of poverty reduction programs do not normally know who the poor are. The strategies they put in place cannot perfectly identify the poor. Imperfect information hence exposes targeting to two types of identification errors: inclusion error (Type 1 error) and exclusion error (Type 2 error).

In our context, let $N(T = 1, \text{Benchmark} = 0)$ be the number of households who are both classified as non-poor, because they do not belong to the benchmark group ($\text{Benchmark} = 0$), but, according to the means testing tool (either the money metric or multidimensional), are eligible for receiving transfers $T = 1$. $N\,(\text{Benchmark} = 0)$ is the number of non-poor households. Then, a Type 1 "inclusion" error occurs when a household is incorrectly classified as poor (Cornia and Stewart 1995, Ravallion 2009, Smolensky, Reilly, and Evenhouse 1995) and inaccurately benefiting from the program.

Definition 1. *Proportion of Type 1 errors (T1).* It is the proportion of (ineligible) non-poor who are included in the program

$$T1 \equiv N(T = 1, \text{Benchmark} = 0)/N(\text{Benchmark} = 0). \tag{20}$$

When an inclusion error occurs, the population proportion receiving cash benefits $P = N(T = 1)/N$, where $N(T = 1)$ is the number of households who are eligible for participating in welfare programs and N is the total population, is larger than it ought to be, thus, entailing a leakage of transfers to the non-poor. These errors raise the cost of the program without improving efficiency. By transferring resources to non-poor individuals, the program also increases the polarization between the poor and non-poor (Ravallion 2004).

Let $N(T = 0, \text{Benchmark} = 1)$ be the number of households who are classified as poor ($\text{Benchmark} = 1$) but, according to either of the two means testing tools, are not eligible for receiving cash transfers $T = 0$, and $N\,(\text{Benchmark} = 1)$ be the number of households belonging to the benchmark poor group. A Type 2 "exclusion" error incorrectly classifies a person as not poor, thus inaccurately not benefiting from the program.

Definition 2. *Proportion of Type 2 errors (T2).* It is the proportion of the poor who are excluded from the program

$$T2 \equiv N(T = 0, \text{Benchmark} = 1)/N(\text{Benchmark} = 1). \tag{21}$$

The exclusion of potential beneficiaries produces a lower program participation rate for the poor. Exclusion errors reduce the program's cost, but reduces efficiency because part of the transfers do not target the intended beneficiaries, thus possibly creating resentment and social instability (Bibi and Duclos 2007).

Inclusion and exclusion errors need to be minimized if the effectiveness of the targeted policies is to be improved. In most cases, when means testing is not effectively verified, there is a trade-off between Type 1 and Type 2 errors. The objective to reduce leakage is often achieved at the expenses of the coverage of poor individuals.

Definition 3. *Best Targeting Method.* The most efficient targeting method is the one that maximizes the proportion of correct classifications by minimizing the proportion of Type 1 and 2 errors.

Overall, efficiency depends on the incidence of both types of errors. In general, the worst targeting scenario occurs when all non-poor individual are assigned the program while all poor do not benefit from the program. The experiment compares and contrast the targeting efficiency of the asset-based money metric and the Alkire-Foster multidimensional approach.

4 Data

We use the 2010 Italian Survey of Household and Wealth (SHIW - Bank of Italy). The sample covers 7,951 households composed of about 19,836 individuals distributed over about 300 Italian municipalities. The survey contains information about individual and family characteristics (age, gender, education, working status), household and individual incomes, household expenditure and savings, and household wealth. There is also information about life satisfaction of the respondent and health status of each household member.

Table 1 describes how Italian families are distributed in terms of both their difficulties to meet monthly needs and disposable income. We are interested to document how the stated difficulties to reach the end of the month relate to income in order to support the choice of the benchmark subsample of poor households. About 40 percent of the sampled households do not state difficulties to meet monthly needs, while about 40 percent of the households reach the end of the month with or with some difficulties. The proportion of households facing many difficulties, those selected as our benchmark poor families, are 14.65 percent. Table 1 also shows that 56.82 percent of all households belonging to the first income quintile reach the end of the month with many difficulties. About 19 percent of the households of the upper three quintiles state to reach the end of the months with many difficulties. This evidence lends support to the "insufficiency of income" debate as the sole indicator of wellbeing. This group of households may indeed suffer from other poverty dimensions not necessarily related to income, such as health status or the presence of a single parent. On the other hand, only about 2.14 percent of the destitute in the lowest income quintile report to reach the end of the month easily or very easily. Those households declaring to meet monthly needs easily or very easily are mostly concentrated in the fifth quintile, 46.88 and 65.96 percent respectively.

Table 2 shows how family ability to save, the other dimension chosen to select the benchmark subgroup of poor households, is related to income. The proportion of households belonging to the first quintile declaring zero savings is 72.13 percent, while 11.30 percent state to have negative savings, corresponding to about 30 percent of all households with dissavings. Only 9.10 percent of the households of the lowest quintile state to have positive savings. This proportion corresponds to 16.57 percent of all households who save. The proportion of households meeting the requirements necessary to belong to the benchmark group of poor households is 11.31 percent (top of Table 3).

Table 3 reports the descriptive statistics of the poverty dimensions included in our experiment for the benchmark poor group and the remaining non-poor group of households. Mean disposable income of the non-poor amounts to 2.6 times the mean level of the benchmark group. The mean of income from financial assets for the poor group is negative. About 49.6 percent of them have not been able to save in the last year. The level of property income of the non-poor is about 2.5 times as large as the amount possessed by the poor. About 6 percent of the poor households are single-parent. This figure drops to 3 percent for the non-poor. Destitute households are more exposed to health risk given that 20.20 percent of the poor households, as opposed to 10.20, report at least one household member in "bad" or "very bad" health conditions. Table 3 also presents the level of current income along with the mean level of the household equivalence scale, which does not differ significantly across the two groups, and equivalent current incomes.

Table 4 presents the data-driven equivalence scales estimated for Italy by Menon and Perali (2010) using expenditure data. Interestingly, the cost of living of a person living alone is 60 percent higher than the cost of living of a member of a couple. This is because the fixed costs associated with household public goods, such as a rent or mortgage or electricity, are not shared within the couple. Children, depending on their age, cost between 0.30 to 0.40 of the cost of an equivalent adult in a couple. The presence of an extra-adult within the household adds 0.15 percent of the cost of an equivalent adult. Normative equivalence scales are illustrated in the lower part of Table 4.[15] The normative weights have been determined following Anand and Sen (1997:6) recommendation to determine them through "questioning and debating in public discussions" because "it is crucial that the judgments that are implicit in such weighting be made as clear and comprehensible as possible and thus be open to public scrutiny." The higher difficulties encountered by being a single parent, a pervasive risk factor of poverty, are recognized with a weight of 0.40. If we consider a threshold of 15,000 euros of equivalent income a year, the weight in absolute terms would correspond to an extra allowance of 6,000 euros. The risky state of being unemployed is acknowledged with a 0.40 weight, and the retired condition with a 0.20 weight. If the degree of invalidity is higher than 50 percent, then a 0.50 weight is recognized.

[15]They have been determined within a road test of the recent reform of the Italian means testing tool conducted in the years 2012-2014 in Castelnuovo del Garda a municipality of the Verona province called "Fattore Famiglia" (Menon, Perali, and Polin 2015).

The poverty cutoffs associated to the selected poverty dimensions are reported in Table 5. As shown in Table 6, the selected poverty dimensions are in most cases weakly, though significantly, correlated.

5 Results: Comparison of the Money Metric and Counting Approaches

Information about assets, when reliable, is clearly relevant for an efficient targeting. What has been less investigated is the relative contribution of the financial and non-financial components to the identification of the poor. Another important question that we address is whether we can use the money metric or the counting approach indifferently. In answering these questions, we place special attention on the role played by household heterogeneity and the way inter-household comparisons are implemented in defining the profile of the households identified as poor in the two competing methods. Results are presented following this plan.

Relevance of financial and property assets The simulation is performed on the basis of three income dimensions (disposable income, incomes from financial and property assets) and four household characteristics (single parenthood, health status, retirement, and unemployment). We see that the proportion of households non-poor in any dimension is 13.16 percent (Table 7). Households poor with respect to 1, 2 or 3 dimensions are 38.94, 25.23 and 14.22 percent respectively, thus affecting the mix of the profile of poor households depending on the type and number of deprivations. No households in the sample are simultaneously exposed to all seven dimensions of deprivation.

Table 8 shows the measurement of poverty based on asset, income, financial and property money metric indicators adopting both a data-driven and a hybrid equivalence scale that combines behavioral and normative information. The insufficiency of income argument finds strong support when noticing that an extra 9 percent of households are considered poor if assets are not taken into account as shown in the (second line of Table 8, then compare columns 1 and 2). About 44 percent of households are poor in the financial dimension, while about 30 percent are property deprived. This observation does not imply that the monetary dimension is more relevant than property ownership, because this social judgment would critically depend on the importance weight attributed to each dimension as shown in Cavapozzi, Han, and Miniaci (2015). Accounting for normative equivalence scales classifies as poor an extra 3 percent of asset poor and an extra 5 percent of income poor. Normative information affects about 0.60 percent of the financial poor and 1.90 percent of the property poor.

Comparing the targeting precision of the money metric index with and without the asset dimension (Table 9), we note that the proportions of Type 1 and 2 errors are significantly different. The use of hybrid scales reduces the error of type II significantly. Relying only on the income dimension leads to about 8 percent extra misclassifications when the income dimension is equivalised using data-driven equivalence scales and to about 10 percent when using hybrid equivalence scales.

Table 10 illustrates the measurement of multidimensional poverty taking the income, financial and property dimensions into account given the union, deprivation in at least 2 dimensions, MPI(2), and intersection identification strategy, MPI(3). Under the three strategies, the headcount ratio classifies as poor 59.30, 25.20 and 8.10 percent of the households respectively, while the adjusted headcount M_0 records 30.90, 19.50 and 8.10 percent. Considering a dimension weight of 1, for the union and deprivation in at least 2 dimension case, the relative importance of income ranges between 21 and 27 percent, financial deprivation is in the 47 and 39 interval, and property income between 32 and 34 percent. The availability of savings gives the most important dimension relative contribution in identifying the poor.

Enlarging the information set from 3 to 7 dimensions (Table 11), as analogously done for the money metric index when moving from a data-driven to a normative equivalence scale, under the union strategy the proportion of destitute increases from 59.30 to 86.80, while the intensity reduces to 23.90 percent. The intersection of at least 3 dimensions gives a proportion of poor households of 22.70 percent adjusted to 11.10 percent. Due to the presence of a larger number of dimensions, the relative contribution of each dimension is scaled down, especially for the financial component. The health dimension is relatively more important than the presence of a single-parent. When selecting at least five dimensions, the relative contribution of the three main poverty drivers (disposable, financial and property incomes) becomes more equal around 19 percent.

Non indifference between the money metric and counting approach Table 12 examines whether analysts can use the money metric or the multidimensional approach indifferently. If the indifference hypothesis were true, the proportion of correct classifications as poor or Type 1 or 2 errors should not be significantly different between the two approaches. Inspection of Table 12 reveals that the inclusion of data driven scales in the MPI index leads to a higher proportion of correct matchings of about two percentage points.[16] The proportion reduces to a negligible difference as the number of dimensions increase. A similar pattern can be observed for the mis-matchings. As the number of dimension increases the proportion of correct matchings for the non-poor increases, while the proportion of correct matching for those who are poor becomes very small going from about 10 percent with three dimensions and reaching about 1.4 percent for five dimensions. Table 12 shows that this is not the case either if we apply a data driven equivalence scale to the income and financial dimensions in the MPI or if we increase the number of dimensions included in the MPI.

The preferred targeting tool In order to establish a unique ranking between the money metric and the multidimensional approach we use the targeting efficiency criterion described in Definition 3 of Section 3. If we examine the effect of the presence of assets in the definition of the money metric described in the first two lines of Table 13 we observe that the inclusion error decreases from 17.5 percent to 7.6 percent. Assets almost double the size of the exclusion error from 18.5 to 37.9 percent even though the size of the error of type 2 is in general much smaller as compared to the size of the exclusion error in the counting approach.

[16]Note that it is not possible to add normative scales in the MPI because the MPI already includes the respective dimensions.

When considering the intersection of at least 3 dimensions, the introduction of data-driven equivalence scales improves the targeting efficiency of the counting approach. We observe a remarkable reduction of the exclusion error (from 58 to 28 percent) but there is also a simultaneous increase of the proportion of Type 1 errors, from 7 to 16 percent (Table 13) accompanied by a sharp reduction in exclusion errors. However, moving from three to five dimensions out of seven, we see that the proportion of Type 1 errors decreases until it reaches zero, independently of correcting income dimensions by equivalence scales. Thus, the multidimensional index would sensibly cut down leakage of welfare programs. On the other hand, the proportion of exclusion errors drastically increases, almost reaching the totality of the population to the point that almost no households would participate into welfare programs. These results demonstrate that the counting approach, unlike the money metric means testing, is extremely sensitive to the number of dimensions taken into account.

Given that the sum of the inclusion and exclusion error for the money metric approach is smaller with respect to the sum of the counting approach in all cases considered, by Definition 3 we may conclude that the most precise targeting method is the one based on the money metric index.

Targeting efficiency and inter-household comparisons Considering that there are significant mismatches when comparing the money metric and multidimensional approaches as shown in Table 12, the likelihood of significant differences among who are assigned a program and who are not is substantial. As a matter of fact, not only the proportion of poor households changes as assets or heterogeneity are taken into account, but the profile of who is poor changes as well. We therefore compare household heterogeneity of the group of households identified as poor using the money metric index corrected by hybrid equivalence scales CY^{**} and the counting MPI indicator with intersection of at least four dimensions, either corrected with a data-driven equivalence scale or not (Table 14). The differences among potential beneficiaries that would be selected are remarkable. If we do not account for family characteristics, such as living alone, we may be exposed to a high likelihood of inclusion errors because the income of a single is, in general, lower with respect to the income of a household with two earners. We may incur in an inclusion error also if we identify as a true beneficiary households with single parents or with at least one member in poor health condition, but sufficiently rich not to be eligible for monetary subsidies. At the same time, we may exclude couples with children that may be in real need. Interestingly, the profile of the poor is relatively more similar for both the money metric index and the MPI with scaled income components. The logit regressions reported in Table 15 coherently summarize these facts.

6 Conclusions

This study compares a money metric index based on equivalent current incomes and an indicator of exclusion based on a counting approach. The experiment design places special emphasis on asset poverty and the treatment of household heterogeneity. The comparison exercise has been evaluated in the country context of Italy. The results depend on the structure of the Italian data used in the exercise but are sufficiently robust to be generalized.

When using incomplete information, we are clearly performing comparisons across households with little control for the different circumstances specific to each household. As a consequence, the reference and comparison households may confront a highly dissimilar set of opportunities and capabilities. Using all the available wealth and demographic information in order to properly describe the real space of functionings and life dimensions faced by beneficiaries may reduce the risk of making comparisons across units that do not have similar capabilities or share equal opportunities. The efficient use of detailed asset and demographic information, as shown in this study, would be highly desirable in order to make comparisons that are fair in applying the eligibility criteria.

The experiment finds that assets and heterogeneity are crucial for the correct identification of the poor for both the money metric and multidimensional approaches. The study also shows that in terms of targeting efficiency and minimum leakage the approach based on a money metric index is superior. The comparison is relevant both from an empirical and a policy point of view because the goal of reaching efficiency in targeting social programs to the desired beneficiaries and to overcome the money metric versus multidimensional dichotomy is a pressing priority in the economic and administrative context of an enlarged Europe, where public resources to be redistributed are limited and fiscal consolidation is likely to be accompanied by losses in equity.

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Figure 1: Income and Asset Poverty

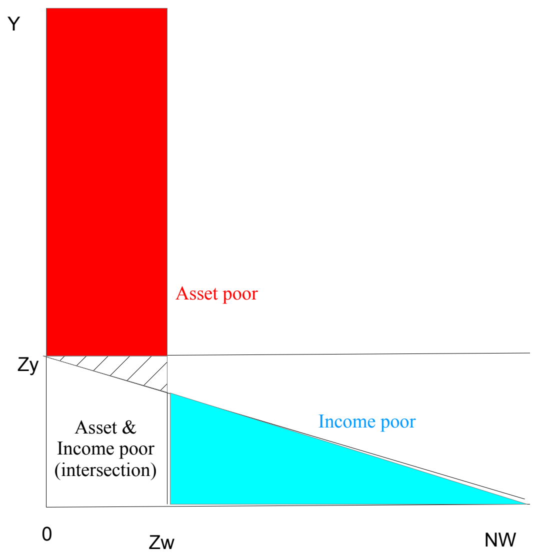

Table 1: Relationship between Needs Satisfaction and Income Quintiles

	Income Quintile				
Needs Satisfaction	1	2	3	4	5
With many difficulties	56.82	23.86	12.02	5.32	1.97
	41.56	16.96	9.10	3.89	1.45
With difficulties	30.51	30.83	19.25	14.44	4.98
	23.48	23.06	15.33	11.12	3.84
With some difficulties	17.37	24.96	23.15	22.61	11.91
	25.99	36.3	35.87	33.86	17.88
Fairly easily	4.77	14.45	20.93	26.71	33.14
	6.84	20.13	31.06	38.32	47.67
Easily	3.65	7.31	15.98	26.18	46.88
	1.51	2.93	6.82	10.80	19.40
Very easily	4.26	4.26	11.91	13.62	65.96
	0.63	0.61	1.82	2.01	9.76

Note: Needs satisfaction refers to the question: "How does the income of your family allows meeting monthly needs?". For each of the six categories, figures reported in the first line are row percentages, while those reported in the second one are column percentages. Number of households 7,951.

Table 2: Relationship between Savings and Income Quintiles

	Income Quintile				
Savings	1	2	3	4	5
Dissavings	29.90	19.60	16.94	17.44	16.11
	11.30	7.20	6.63	6.60	6.11
Zero	25.83	23.88	19.85	17.76	12.68
	72.13	64.8	57.37	49.62	35.52
Positive	9.10	15.82	19.10	24.03	31.95
	16.57	28.00	36.00	43.78	58.38

Note: Savings refers to the question "All family incomes considered, in this year your family: 1) have borne expenditures exactly equal to all family incomes without being able to save money, 2) have spent less of all family incomes, thus being able to save money, or 3) have spent more of all family incomes, thus using savings accumulated in the past." For each of the three categories, figures reported in the first line are row percentages, while those reported in the second one are column percentages. Number of households 7,951.

Table 3: Descriptive Statistics of Dimensions of Welfare by Benchmark Poor and Non-poor Households

	Poor	% of zero	Non-poor	% of zero
No. observations (%)	899 (11.31)		7052 (88.69)	
Disposable income (Y)	10458	4.34%	27470	0.52%
	6060		*19226*	
Income from financial assets (FW)	-191^a	49.61%	10.9^b	10.88%
	999		*2026*	
Income from property assets (NFW)	3180	41.49%	8107	15.60%
	6397		*10361*	
Single parent (SP)	6.23%		2.99%	
Poor health status (U)	20.20%		10.20%	
Double earner (DE)	27.80%		44.50%	
Retired (RE)	41.70%		48.50%	
Unemployed (U)	30.80%		9.91%	
Asset-based money metric	13447	1.11%	35589	0.06%
	8915		*24758*	
Data-driven equivalence scales $\varsigma(d)$	3.12		3.07	
	1.14		*1.07*	
Hybrid equivalence scales $\varsigma(d,n)$	3.45		3.27	
	1.13		*1.07*	
Equivalent asset-based money metric adjusted by:				
Data-driven scales	4643	1.11%	12266	0.06%
	2691		*8224*	
Hybrid scales	4129	1.11%	11467	0.06%
	2462		*7810*	

Note: A household is classified as poor if the following criteria are jointly experienced 1) family needs are met "with many difficulties," 2) the family has either zero savings or dissavings (as defined in note of Table 2), and 3) family's equivalent disposable income falls below a threshold defined as the 40-percentile of the income distribution. Standard deviations are in italic. [a] 21.13% of negative values, [b] 17.77% of negative values.

Table 4: Data-driven and Normative Equivalence Scales

Equivalence scales	Weight
Data-driven	
Single	1.60
Couple	2.00
Child 0-5	0.40
Child 6-13	0.30
Child 14-18	0.35
Extra adult	0.15
Normative	
Single parent	0.40
Poor health status	0.50
Retired	0.20
Unemployed	0.40

Note: Data-driven equivalence scales are from Menon and Perali (2010). Normative equivalence scales have been determined within a road test of the recent reform of the Italian means testing tool for a municipality of the province of Verona (Menon, Perali, and Polin 2015).

Table 5: Identification of Deprivation Cutoffs of Welfare Dimensions

Dimensions (D_{im})	Definition	Level ($Z_{D_{im}}$)
Equivalent Asset-based Money Metric (CY^*)	$0.6 \cdot median(CY^*)$	5816.25 euro
Equivalent Disposable Income (Y^*)	$0.6 \cdot median(Y^*)$	4500 euro
Equivalent Financial Income (FW^*)	$0.6 \cdot median(FW^*)$	6.23 euro
Equivalent Non-Financial Income (NFW^*)	$0.6 \cdot median(NFW^*)$	1170 euro
Single parent (SP)	if single parent	1
Poor health status (H)	if at least one member is "bad" or "very bad"	1
Retired (RE)	if household head retired	1
Unemployed (U)	if household head unemployed	1

Note: Equivalent incomes calculated using data-driven equivalence scales.

Table 6: Pairwise Correlation among Welfare Dimensions

	Y^*	FW^*	NFW^*	SP	H	RE	U
Y^*	1						
FW^*	0.119*	1					
NFW^*	0.289*	0.169*	1				
SP	−0.011*	−0.049*	−0.010*	1			
H	−0.075*	0.011*	−0.046*	−0.027*	1		
RE	−0.019*	0.143*	0.098*	−0.104*	0.201*	1	
U	−0.219*	−0.013*	−0.093*	0.026*	−0.001*	−0.357*	1

Note: Equivalent incomes (Y^*,FW^*, NFW^*) calculated using data-driven scales. * indicates significance at 5 percent level.

Table 7: Distribution of Welfare Deprivations

No. of dimensions	Frequency	Percentage
0	1,046	13.16
1	3,096	38.94
2	2,006	25.23
3	1,131	14.22
4	560	7.04
5	108	1.36
6	4	0.05

Note: We report frequency and percentage of households who suffer from deprivation in some dimensions. Dimensions are those listed in Table 5.

Table 8: Headcount Ratio by Money Metric Indices

	Dimensions of poverty			
	CY	Y	FW	NFW
Poverty line	Z_{Y^*}	Z_{Y^*}	Z_{FW^*}	Z_{NFW^*}
Headcount (data-driven scales) - %	10.62	19.52	43.63	29.49
Headcount (hybrid scales) - %	13.72	24.75	44.18	31.38

Note: The proportion of asset poor, CY, is defined by the relative poverty line of the equivalent income distribution, Z_{Y^*}.

Table 9: Targeting Efficiency Comparison between Income and Asset-based Means Testing Tools

	$T1 = \frac{N(T=1,B=0)}{N(B=0)}$ Error of Type I	$T2 = \frac{N(T=0,B=1)}{N(B=1)}$ Error of Type II
With data-driven scales		
Income-based means testing	13.30	31.70
Asset-based means testing	5.50	49.28
With hybrid scales		
Income-based means testing	17.51	18.46
Asset-based means testing	7.56	37.93

Note: Figures are percentages. B stands for Benchmark. N is the total sample size.

Table 10: Multidimensional Poverty Analysis with Three Welfare Dimensions

Three dimensions	Union		MPI(2)		MPI(3)	
(Y^*, FW^*, NFW^*)	H	M_0	H	M_0	H	M_0
	0.593	0.309	0.252	0.195	0.081	0.081
	0.006	*0.004*	*0.005*	*0.004*	*0.003*	*0.003*
Relative contributions (%)						
Y^*		21.07		26.88		33.33
		0.36		*0.41*		*0.00*
FW^*		47.09		39.12		33.33
		0.42		*0.29*		*0.00*
NFW^*		31.84		33.99		33.33
		0.40		*0.37*		*0.00*

Note: Income dimensions (Y^*, FW^*, NFW^*) are calculated using data-driven equivalence scales. Digits between squared brackets indicate the number of dimensions used to calculate the multidimensional index MPI. Standard errors in italic.

Table 11: Multidimensional Poverty Analysis with Seven Welfare Dimensions

Seven dimensions	Union		MPI(3)		MPI(4)		MPI(5)	
$(Y^*, FW^*, NFW^*,$	H	M_0	H	M_0	H	M_0	H	M_0
$SP, H, RE, U)$	0.868	0.239	0.227	0.111	0.085	0.050	0.014	0.010
	0.004	*0.002*	*0.005*	*0.002*	*0.003*	*0.002*	*0.001*	*0.001*
Relative contributions (%)								
Y^*		11.66		18.75		19.54		19.68
		0.22		*0.31*		*0.35*		*0.19*
FW^*		26.07		24.92		22.75		19.86
		0.27		*0.24*		*0.21*		*0.07*
NFW^*		17.62		20.53		21.01		19.33
		0.25		*0.30*		*0.30*		*0.31*
SP - Single parent		2.01		2.11		2.50		4.79
		0.12		*0.18*		*0.28*		*0.80*
H - poor health status		6.79		9.31		11.06		16.67
		0.20		*0.31*		*0.45*		*0.69*
RE - retired		28.50		15.39		13.09		11.35
		0.36		*0.35*		*0.46*		*0.93*
U - unemployed		7.34		8.99		10.06		8.33
		0.21		*0.31*		*0.46*		*0.93*

Note: Income dimensions (Y^*, FW^*, NFW^*) are calculated using data-driven equivalence scales. Digits between squared brackets indicate the number of dimensions used to calculate the multidimensional index MPI. Standard errors in italic.

Table 12: Matching between Asset-based Money Metric and Counting Means Testing Tools

MPI without scale		Money metric (CY^{**})		MPI with data-driven scales		Money metric (CY^{**})	
		Non-poor	Poor			Non-poor	Poor
MPI(3)	Non-poor	73.89	3.82	MPI(3)	Non-poor	75.80	1.52
	Poor	12.39	9.90		Poor	10.48	12.20
MPI(4)	Non-poor	82.93	8.26	MPI(4)	Non-poor	84.69	6.85
	Poor	3.35	5.46		Poor	1.58	6.87
MPI(5)	Non-poor	85.81	12.29	MPI(5)	Non-poor	86.27	12.38
	Poor	0.47	1.43		Poor	0.01	1.35

Note: Digits between squared brackets indicate the number of dimensions used to calculate the multidimensional index MPI.

Table 13: Targeting Efficiency Comparison between Asset-based Money Metric and Counting Means Testing Tools

	$\frac{N(T=1,B=0)}{N(B=0)}$	$\frac{N(T=0,B=1)}{N(B=1)}$
	Type 1 error	Type 2 error
	Asset-based money metric approach	
Income	17.51	18.46
Asset-based	7.56	37.93
		Counting approach
Without scales		
MPI(3)	7.22	58.06
MPI(4)	1.05	87.88
MPI(5)	0.04	98.67
With data-driven scales		
MPI(3)	16.41	28.14
MPI(4)	4.55	60.96
MPI(5)	0.47	91.66

Note: Figures are percentages. B stands for Benchmark. N is the total sample size.

Table 14: Poverty Profile by Means Testing Tools

	Asset-based money metric	Counting index with 4 dimensions	
	(CY^{**})	without scales	with data-driven scales
No. of observations (%)	1091 (13.72)	700 (8.80)	672 (8.45)
Head age (mean)	55.42	64.39	60.16
No. of adults (mean)	2.12	1.76	2.19
No. of children (mean)	0.68	0.35	0.54
Couple	74.79%	37.28%	68.30%
Living alone	17.05%	44.12%	17.11%
Single parent	5.68%	11.14%	10.42%
Poor health status	23.47%	47.57%	46.13%
Retired	37.67%	68.14%	54.61%
Double earner	26.86%	4.29%	4.46%
Unemployed	35.93%	28.14%	41.96%

Table 15: Logit Regressions: Determinants of the Poverty Profile by Means Testing Tools

	Asset-based money metric (CY^{**})		Counting index with 4 dimensions			
			without scales		with data-driven scales	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Head age	-0.016^{**}	0.004	-0.021^{**}	0.005	-0.021^{**}	0.005
No. of adults	-0.329^{**}	0.060	-0.282^{**}	0.094	-0.191^{*}	0.077
No. of children	0.313^{**}	0.052	0.201^{*}	0.087	0.291^{**}	0.077
Couple	1.190^{**}	0.158	-0.268	0.170	1.071^{**}	0.192
Living alone	0.497^{**}	0.189	0.966^{**}	0.217	0.386	0.240
Single parent	1.046^{**}	0.199	2.883^{**}	0.280	2.996^{**}	0.280
Poor health status	1.457^{**}	0.097	2.505^{**}	0.110	2.622^{**}	0.116
Retired	-1.016^{*}	0.471	1.177^{*}	0.547	1.966^{**}	0.472
Double earner	-1.739^{**}	0.466	-2.156^{**}	0.526	-1.444^{**}	0.431
Unemployed	0.279	0.476	1.961^{**}	0.567	2.977^{**}	0.480
Pseudo R^2	0.146		0.328		0.329	

Note: The asset-based money metric index is demographically adjusted using hybrid equivalence scales. ** and * indicate significance at 1 and 5 percent level, respectively.

Appendix: Definition of net worth in the context of the SHIW 2010 data base

Definition 4. *Income* Y is net (after tax) disposable income given by the sum of payroll income from net wages and salaries including fringe benefits YL, non-labor income from pension and net transfers YT including scholarships, alimony and gifts and net self-employment income YM.

$$Y = YL + YT + YM$$

Definition 5. *Income from financial assets net of liabilities* YCF given by interests from deposits $YCF1$ evaluated at $r_1 = 0.633\%$, interests from government securities $YCF2$ evaluated at $r_2 = 1.759\%$, interests from other securities $YCF3$ evaluated at $r_3 = 5.639\%$ minus interest payments on financial liabilities $YCF4$ evaluated at $r_4 = 4.433\%$.

$$YCF = YCF1 + YCF2 + YCF3 - YCF4$$

Definition 6. *Property income* YC given by income from real estate as actual rents $YCA1$ or as imputed rents (if the house is fully owned) $YCA2$

$$YCA = YCA1(+YCA2)$$

Total net worth is given by the sum of the financial net worth minus home equity. Liquid assets are the value of checking and saving accounts, value of stocks, value of bonds, cash value in a life insurance, and others.

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