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Poverty Without Poverty Line

Olivier Sterck*

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Abstract

I propose a new cardinal measure of poverty, which builds on the intuitive notion that a person with half the income of another is twice as poor. Mathematically, this implies that poverty is the reciprocal of income. The resulting aggregate measure has a simple interpretation: it is the average number of days needed to get a reference level of income. I call the measure *average poorness*, to reflect the fact that poverty is a spectrum and not a binary status. The new measure has excellent properties, being additively decomposable in population subgroups, fully accounting for the depth and severity of poverty, and generating orderings and comparisons that are robust to the choice of reference level of income. Using data from a survey experiment, I show that the new measure is consistent with how a majority of experts and members of the public think about poverty.

JEL: D63, I32, O15.

Keywords: Poverty, Average Poorness, Poverty line, Focus Axiom.

*University of Oxford and University of Antwerp. Email: olivier.sterck@qeh.ox.ac.uk. I thank Matthew Adler, Paul Collier, Benoit Decerf, Angus Deaton, Maya Eden, Francisco Ferreira, James Foster, Dean Jolliffe, Charles Kenny, Talip Kilic, Aart Kraay, Christoph Lakner, Daniel Mahler, Berk Ozler, Paolo Piacquadio, Lant Pritchett, Natalie Quinn, Laurence Roope, and Nishant Yonzan for feedback, suggestions, and encouragements. I also thank seminar and conference participants at the Normative Economics and Economic Policy e-seminar, the Conference in Memoriam of Martin Ravallion (Georgetown University), the University of Sheffield, the University of Antwerp, the 11th Annual Christmas Meeting of Belgian Economists, the Ragnar Frisch Centre for Economic Research, FAO's Technical Network on Poverty Analysis, and the 2024 CSAE conference for their comments. I also thank all the participants in the surveys. I gratefully acknowledge financial support from the University of Antwerp through a ZAPBOF startkrediet. The survey experiment received Institutional Review Board (IRB) clearance from the Ethics Committee for the Social Sciences and Humanities (EASHW) at the University of Antwerp, under protocol EX_SHW_2023_18_1. This paper is a companion paper to Kraay (r) et al. (2023). An earlier version of the paper was circulated with the title "Sterck, O. (2020) On the measurement of poverty and social welfare."

Centre for the Study of African Economies
Department of Economics · University of Oxford · Manor Road Building · Oxford OX1 3UQ
T: +44 (0)1865 271084 · F: +44 (0)1865 281447 · E: csae.enquiries@economics.ox.ac.uk · W: www.csae.ox.ac.uk

"Poverty is not really a discrete condition. One does not immediately acquire or shed the afflictions we associate with the notion of poverty by crossing any particular income line. The constriction of choice becomes progressively more damaging in a continuous manner."

Harold W. Watts (1968), proponent of the first distribution-sensitive poverty measure

1 Introduction

Virtually everyone would agree that a 20-meter tree is twice as tall as a 10-meter tree. Conversely, everyone would agree that the 10-meter tree is twice as short as the 20-meter tree. There is no threshold or "shortness line" above or under which these relationships cease to hold: a 5-meter tree is twice as short as a 10-meter tree, a 1-meter tree is twice as short as a 2-meter tree, and so on. This reasoning remains valid when considering other multiples: a 1-meter tree is three times shorter than a 3-meter tree. To be sure, when assessing the height of a single tree, different people may disagree whether it is short or tall, as their judgment will depend on the benchmark they use for their assessment. However, when comparing two different trees, virtually everyone would make similar cardinal comparisons. In mathematical terms, shortness is the reciprocal of tallness.

People have similar intuitions about the measurement of many cardinal variables that range between zero and infinity, including distance, weight, and speed. In fact, for many physical quantities, scientists distinguish a variable from its reciprocal, for example slowness and speed in seismology, pace and speed in sport (e.g. running), resistance and conductance in electricity, specific volume and density in thermodynamics, or period and frequency in physics.

In this paper, I apply the same logic to define a new poverty measure, which is consistent with the intuition that a person A with half the income of B is twice as poor as B. This intuition frames poverty as a spectrum rather than a binary status. Accordingly, I use the term *poorness* instead of *poverty* to emphasize that deprivation exists on a continuum.[1] In mathematical terms, income poorness is the reciprocal of income (richness).[2] At the individual level, individual poorness p_i is simply the reciprocal of individual richness: $p_i = z/y_i$, where y_i is individual i's income and z is a constant. At the aggregate level, for any population of size n, I show that the only aggregate measure

[1] The term *poorness* is also used with a similar meaning in the literature on *pro-poorness* growth, which examines the extent to which growth is tilted towards the bottom of the income distribution (Duclos, 2009).

[2] Consistent with the literature, I use the generic term *income* broadly, to refer to a measure of individual or household wellbeing, recognizing that actual datasets usually combine income and consumption data (see e.g., PIP data base from the World Bank). I use *income* and *income richness* interchangeably.

of income richness R that satisfies the above logic and is additively decomposable in population subgroups is average income ($\bar{y}$):

$$R = \bar{y} = \frac{1}{n}\sum_{i=1}^{n}\frac{y_i}{z}, \tag{1}$$

where z is a constant that determines the unit of measurement. Similarly, the only aggregate measure of income poorness P that satisfies the above logic and is additively decomposable in population subgroups is:

$$P = \frac{1}{n}\sum_{i=1}^{n}\frac{z}{y_i}, \tag{2}$$

where z is a constant. P is simply the average of the reciprocals of individual incomes. I call this measure *average poorness*.

For four reasons, I argue that average poorness nicely complements existing measures of poverty and welfare.

First, average poorness has a simple and intuitive interpretation, which stems from the fact that income poorness is the reciprocal of income richness. The unit of income poorness is simply the inverse of the unit of income richness. If income is measured in dollars per day ($/day), income poorness is expressed in days per dollar (days/$). To aid interpretation, the constant z can be purposefully selected to represent a meaningful reference level of income, for example a poverty or a prosperity line. If one considers the extreme poverty line of the World Bank ($z = 2.15$ in 2017 PPP $), then average poorness is the average number of days needed to get $2.15.[3] For instance, in 2019, people in Zimbabwe needed on average two days to get $2.15, compared to one day in Tanzania, a quarter of a day in China, and one-tenth of a day in the US.

Second, average poorness appears to correspond well to how a majority of experts and members of the public think about poverty. I conducted an online survey among 248 academics and policy makers who attended presentations of this study, along with 2,268 participants from Kenya, India, South Africa, and the US, which are part of an online panel managed by Cloudresearch. Participants were asked to compare individuals with different levels of income. Survey results show that a majority of respondents from both the expert and general public samples provided answers that are consistent with average poorness. For most participants, poverty is viewed as a continuous function that is inversely proportional to income, rather than a binary status that abruptly changes above or below a poverty line. Only a quarter of responses are consistent with the

[3] All amounts in $ in this paper are expressed in constant 2017 Purchasing Power Parity dollars ($PPP).

headcount view of poverty, and less than 15 percent of answers are consistent with the poverty gap and squared poverty gap.

Third, average poorness has very interesting properties, which are discussed in detail in a companion paper by Kraay ⓡ et al. (2023).[4] Average poorness (1) is additively decomposable in population subgroups; (2) it is distribution sensitive, fully accounting for the depth and severity of poverty; and (3) its changes can be meaningfully decomposed into average income growth and changes in a new inequality measure (which has interesting properties as well). While these properties are briefly described below, interested readers are encouraged to read the article of Kraay ⓡ et al. (2023) for more details.

In this paper, I instead discuss at length one property that average poorness does not satisfy: the focus axiom. Rather than being a weakness, I argue that not satisfying the focus axiom can be a strength for conceptual, empirical, and theoretical reasons. Conceptually, there is little evidence of a sharp discontinuity in subjective well-being, nutritional status, health, access to services, or income dynamics around the extreme poverty line of the World Bank or other thresholds (Pritchett, 2013, 2024). Empirically, results from the online survey show that most respondents attach little importance to information on the poverty line when comparing incomes or allocating resources between low-income individuals. Most answers are consistent with poverty being a continuous function of income, without sharp threshold effect. Theoretically, the absence of cut-off has an interesting implication. Average poorness generates orderings[5] and comparisons[6] that are robust to the choice of reference level of income z. Indeed, z is just a scaling factor in equation (2), which only affects the measurement unit of $P(y, z)$. By contrast, poverty measures that rely on the focus axiom are often not robust to the choice of poverty line. The label *average poorness* was specifically chosen to distinguish the new measure from traditional poverty measures that satisfy the focus axiom, and to convey the the idea that poorness is a continuum of various degrees and not a dichotomous status.

Finally, I argue that average poorness is relevant for policymaking, distinguishing two functions. First, average poorness is relevant for describing and monitoring poverty. Its intuitive interpretation and unit, in terms of days per dollar, corresponds well to how experts and the general public understand poverty. Average poorness also has desirable properties and its data requirement are limited enough to permit practical use by policymakers. Second, average poorness may be relevant to guide policies. This is the case if the social welfare function (SWF) underlying the index is consistent with how people

[4]The article by Kraay ⓡ et al. (2023) and the present paper are complementary. While Kraay ⓡ et al. (2023) describes the properties of the new measure and its application for the measurement of global welfare and shared prosperity, the present paper focuses on the conceptual origin and the empirical support of the measure. I also expand the discussion of key properties.

[5]For example, the ranking of countries according to average poorness.

[6]For example, the ratio of average poorness in countries A versus B, or the ratio of average poorness in country A at time t versus $t + 1$.

or governments would take decisions, e.g. for redistributing money between individuals. It is straightforward that minimizing average poorness is equivalent to maximizing a utilitarian SWF with iso-elastic utility functions and a coefficient of inequality aversion of 2. Data from the survey suggests this is a reasonable value: the average estimate of inequality aversion is 2.11 in the sample of experts (95% CI:1.93-2.30, median=2) and 2.41 in the general public sample (95% CI: 2.35-2.47, median = 2.75). I show that the framework can be easily generalized to allow for different degrees of inequality aversion.

This article primarily contributes to the literature on the measurement of poverty, which involves two fundamental sets of questions (Sen, 1979). The identification question examines how and where to place the poverty line and thereby split a population of interest into poor and non-poor individuals. The aggregation question explores how to summarize the poverty characteristics of different people into one unique number satisfying desirable properties. Both questions have been the sources of heated debates and disagreements. First, there is no consensus on how to identify global and local poverty lines (Deaton, 2010; Reddy et al., 2010; Ferreira et al., 2016; Allen, 2017; Decerf, 2023a).[7] As a result, there are as many poverty lines as there are countries (Jolliffe et al., 2022). The lack of uniform benchmark generates confusion when studying poverty trends across countries and over time, because comparisons and orderings resulting from the empirical applications of existing measures are often not robust to the choice of poverty line. Second, no existing poverty aggregate is both intuitive and distribution sensitive. The poverty headcount, poverty rate, and poverty gaps are intuitive, but they are insensitive to the distribution of income among the poor (Sen, 1976). This problem is not only conceptual: these measures may mislead policy makers and generate perverse incentives because they do not put higher weight on the poorest of the poor (Bourguignon and Fields, 1990). Many scholars built on Sen's critique and proposed new classes of measures satisfying evermore demanding requirements (see Zheng 1997 and Foster 2006 for excellent reviews). Yet these more complex measures are difficult to interpret and hence rarely used by practitioners.

This paper contributes to this literature by jointly addressing the identification and the aggregation questions. First, the identification question becomes practically irrelevant with the average poorness measure because comparisons and orderings are independent of the choice of the reference level of income z. As a result, debates on how to identify the poverty line become less consequential and tests of stochastic dominance become mostly irrelevant (Atkinson, 1987; Foster and Shorrocks, 1988; Ravallion, 1999). This contribution is directly related to Ravallion (1994)'s discussion of whether social welfare

[7] Other related points of discussion include: how to best account for the various dimensions of poverty (Duclos et al., 2006; Ravallion, 2011; Alkire and Foster, 2011); how to identify poverty lines at the local or national level (Ravallion, 1998, 2016; Allen, 2017); and whether the poverty lines should be absolute, relative, or hybrid (Foster, 1998; Decerf, 2017; Ravallion, 2020).

should be measured with or without poverty line. Second, average poorness addresses the identification question, as this index has a straightforward interpretation and excellent properties in terms of distribution sensitivity and decomposability.

Another contribution of this paper is to estimate inequality aversion, both among experts and the general public. With social discounting, the degree of inequality aversion is probably the most important parameter in normative and welfare economics. Yet surprisingly few papers attempted to estimate this parameter (Clark and d'Ambrosio, 2015) and the few existing attempts focused on samples in high-income countries (Amiel et al., 1999; Johansson-Stenman et al., 2002; Pirttilä and Uusitalo, 2010). This paper extends this literature by estimating inequality aversion in several developing and developed countries as well as among experts.

This article serves as a companion piece to the work of Kraay ⓡ et al. (2023), which explore the properties of the new measure and its application for the measurement of global welfare and shared prosperity. Kraay ⓡ et al. (2023) also provide a thorough discussion on data requirements, particularly addressing challenges related to mismeasurement at the lower end of the income distribution. In contrast, this paper takes a more foundational approach, examining the conceptual and axiomatic basis of the measure, as well as its empirical support in expert and general populations. I also further elaborate on essential properties of the measure, such as by generalizing existing definitions of distribution sensitivity, examining the pros and cons and implications of the focus axiom, and extending the measure to account for varying levels of inequality aversion.

The framework presented in this paper can have interesting applications beyond the literature on aggregate measures of poverty and welfare. In applied econometrics, individual or household poorness z/y_i can be a useful complement to individual or household income. The inverse transformation is concave (as the log transformation). As a result, it is magnifying impacts at the bottom of the income distribution and reducing the importance of outliers at the top of the distribution. In impact evaluations, individual poorness can be a useful outcome variable when programs or shocks are expected to impact the bottom of the income distribution. Average treatment effect estimates have the advantage of being directly and meaningfully interpretable in terms of days per $. More generally, while this paper focused on the measurement of income richness and poorness, the framework and formulas can be directly transposed to the (aggregate) measurement of other quantities and their reciprocal, not only in economics but also in other sciences.

The paper is organized as follows. In Section 2, I use an axiomatic approach to derive the measure of average richness and poorness described in equations (1) and (2) respectively. In Section 3, I describe the survey experiment I conducted to assess general views on poverty and inequality aversion. In Section 4, I describe the interesting features of average poorness in terms of its easiness of interpretation (Section 4.1), its empirically-

grounded intuition (Section 4.2), its desirable properties (Section 4.3), and its relevance for policy (Section 4.4). In Section 5, I examine different pathways to generalize the new measure and discuss its limitations. Section 6 concludes.

2 Axiomatic derivation

I use an axiomatic approach to derive the cardinal measures of average richness and poorness described in equations (1) and (2) respectively.[8] I focus on a population of size n with an income distribution $Y = (y_1, ..., y_n)$, with $y_i > 0$ for all i in $1, ...n$. The population can be divided into m subgroups according to some characteristic of interest (e.g. regions within a country). I denote n_j the population size of subgroup j and Y_j the vector of incomes in the subgroup j, with $n = n_1 + n_2 + ... + n_j$, and $Y = (Y_1, Y_2, ..., Y_m)$. I also define a constant z, which is a reference level of income; for example a poverty or a prosperity standard.

The main theorem in this paper builds of four axioms. First, I first rely on the well-known Decomposability Axiom proposed by Foster et al. (1984), which ensure subgroup consistency (Foster and Shorrocks, 1991). Then, the Proportionality Axiom (A2) and Inverse Proportionality Axiom (A3) generalize the tree analogy used in the introduction and the intuition that, if a person A has half the income of B, then B is twice as rich as A and, conversely, A is twice as poor as B. These axioms will determine the functional form of f. The Normalization Axiom (A4) defines the unit of measurement of the index.

(A1) Decomposability Axiom: A measure $M(Y, z)$ is additively decomposable in population subgroups if, for every population and partition into subgroups, the following is true: $M(Y, z) = \sum_{j=1}^{m} \frac{n^j}{n} M(Y^j, z)$.

(A2) Proportionality Axiom: For every income y_i and y_j, $M(y_i, z) = \delta M(y_j, z)$ with $\delta = y_i/y_j$.

(A3) Inverse Proportionality Axiom: For every income y_i and y_j, $M(y_i, z) = \delta M(y_j, z)$ with $\delta = y_j/y_i$.

(A4) Normalization: For every population of size n, if $Y = (z, ...z)$ then $M(Y, z) = 1$.

These four axioms are combined to uniquely characterize the measures R and P defined in the introduction.

[8] I specifically thank Benoit Decerf, whose ideas and generous support were instrumental in shaping this axiomatization.

Theorem 2.1. *An index $M(Y,z)$ satisfies Decomposability (A1), Proportionality (A2), and (A4) Normalization if and only if:*

$$M(Y,z) = R = \bar{y} = \frac{1}{n}\sum_{i=1}^{n}\frac{y_i}{z},$$

An index $M(Y,z)$ satisfies Decomposability (A1), Inverse Proportionality (A3), and (A4) Normalization if and only if:

$$M(Y,z) = P = \frac{1}{n}\sum_{i=1}^{n}\frac{z}{y_i},$$

Proof. For the necessary part of the theorem, Decomposability (A1) implies that $M(Y,z) = 1/n\sum_{i=1}^{n} f(y_i,z)$ for some individual poverty function f of the individual income y_i and the reference level of income z (Foster and Shorrocks, 1991). Proportionality (A2) implies that $f(y_i,z)$ is homogeneous of degree 1 in y_i: $f(y_i,z) = g(z)\ y_i$. Inverse Proportionality (A3) implies that $f(y_i,z)$ is homogeneous of degree -1 in y_i: $f(y_i,z) = h(z)/y_i$. Normalization (A4) implies $g(z) = 1/z$ and $h(z) = z$.

For the sufficiency part of the theorem, it is straightforward that R satisfies A1, A2, and A4; and that P satisfies A1, A3 and A4.

■

In this section, I focused on the measurement of income richness and poverty, but the axioms and theorem can be easily applied to any finite population and quantity $x \in]0,+\infty[$.

3 Survey experiment

I ran a survey experiment among experts and the general public to understand how people think about poverty. The survey of experts targeted 245 participants to talks I gave at the University of Sheffield (N=32), the University of Ghent (N=63), the Ragnar Frisch Centre for Economic Research (N=14), FAO's Technical Network on Poverty Analysis (N=34), and the University of Oxford (N=102).[9] An email with a link to the survey was sent to potential participants a few days before each talk. To maximize response rates and quality, the questionnaire included only seven questions, which are described in Table A.1 in the Appendix. The median respondent took 5 minutes to complete the survey.

[9] Questions to assess the extent of inequality aversion were not asked to participants at the University of Sheffield (N=32) and the University of Ghent (N=63), implying that the sample size for that analysis is reduced to N=147.

The survey among the general public targeted 2,762 participants in Kenya, India, South Africa and the US. Participants were recruited from an online panel managed by Cloudresearch.[10] Out the 2,762 targeted participants, 494 respondents (18%) are excluded from the analysis because they failed an attention check question.[11] The sample used in the analysis therefore includes 2,268 participants. The questionnaire had 13 questions (see Appendix Table A.1), including five questions on demographics that are used to assess how responses vary with observables and thereby provide a basic evaluation of external validity. A note in the consent form explained that some of the decisions taken by participants would be randomly chosen to be applied in practice. The median respondent took 8 minutes to complete the questionnaire.

Several elements of the questionnaire were randomized. First, the ordering of possible answers was randomized. Second, different question parameters were randomly assigned to different respondents. Some of these variations affected whether the respondents' decisions could impact the number of people below and above the poverty line. The analysis of these random variations provides useful information on the extent to which respondents account for the poverty line when taking their decision. Finally, about a quarter of participants in the general public survey did not receive information about the level of the poverty line.[12] All amounts were expressed in $ in the survey of experts and in local currency units in the general public surveys.[13]

[10] I initially targeted 500 valid participants per country but Cloudresearch oversampled participants in some countries.

[11] The attention check question is a very simple question with an unambiguous answer: *"The World Bank has determined that it is impossible for a person to meet their basic needs if they have an income below $2.5 per day per person. Individual A earns $1 per day while individual B earns $3 per day. Which statement is consistent with how you think about poverty?"*. Possible answers, provided in a random order, were: (1) A and B earn the same amount, (2) A earns $1 per day, (3) A earns $2 per day, (4) B earns $1 per day, and (5) B earns $2 per day. The participants who failed the attention check question were significantly faster and also 25 percentage points more likely to provide at least one unusual answer to other questions, where unusual answers are defined as answers provided by less than 10% of respondents. This justifies their exclusion.

[12] For three quarter of the sample, the phrasing was: *"The World Bank has determined that it is impossible for a person to meet their basic needs if they have an income below $2.5 per day per person."*. For a quarter of the sample, the sentence did not include a reference to the level of the poverty line: *"The World Bank has determined that it is impossible for a person to meet their basic needs if they have an income below a certain level."*

[13] In the expert survey and the main US survey, the poverty line was set at $2.5 which, at the time of the survey, was approximately equivalent to the World Bank's $2.15 extreme poverty line expressed in current dollars. In Kenya, all amounts were multiplied by 40 and the poverty line was set at 100 Kenyan Shillings (KSh), which was approximately equal to the World Bank's $2.15 extreme poverty line expressed in Kenyan Shillings. In India, all amounts were multiplied by 20 and the poverty line was set at 50 rupees, which was approximately equal to the World Bank's $2.15 extreme poverty line expressed in rupees, and to India's urban poverty line. In South Africa, all amounts were multiplied by 20 and the poverty line was set at 50 Rands, which was approximately equal to the World Bank's $6.85 poverty line for upper-middle income countries, and to South Africa's upper-bound poverty line.

4 Why should one use average poorness?

To be most useful, a measure should (1) have a simple interpretation, (2) be intuitive and consistent with how people think about the quantity that is measured, (3) have excellent properties, and (4) be policy relevant. In this section, I argue that average poorness satisfies these four criteria.

4.1 Average poorness has a simple interpretation

Average poorness is a cardinal measure that has a clear interpretation and simple units, stemming directly from the fact that income poorness is the reciprocal of income richness. The unit of measurement of a reciprocal is simply the inverse of the unit of the original measure. For instance, as speed is defined as distance traveled per unit of time (e.g. km/h or miles/h), slowness is measured as a unit of time divided by a unit of distance. In running for example, pace is the reciprocal of speed and is usually measured in minutes per kilometer or mile.

The unit of income poorness is therefore the inverse of the unit of income which, in the literature on poverty, is typically expressed in dollars per day. If the constant z is set as 1, average poorness is expressed in days per dollar. It is the average number of days needed to get one dollar.

The constant z can fixed at another level to change the unit of average poorness. As discussed below, z is a scaling factor, implying that changing z has no impact on rankings and comparisons. For example, to aid interpretation, z can be selected to represent a meaningful reference level of income, such as a poverty or prosperity threshold. Let us consider the World Bank's extreme poverty line, where z equals \$2.15 in constant 2017 Purchasing Power Parity dollars. In this case, average poorness represents the average number of days required to get just \$2.15.[14]

Figure 1 depicts average poorness and average income for 218 countries in 2019, using data from the Poverty and Inequality Platform (PIP) of the World Bank.[15] In 2019, the inhabitants of four countries needed more than two days on average to get \$2.15, namely Madagascar, South Sudan, the Central African Republic, and Zimbabwe. For instance, in South Sudan, it took people 2.1 days on average to get what the World Bank defines as the extreme poverty line, underscoring the severe depth of destitution in the

[14] In the companion paper by Kraay ⓡ et al. (2023), we focus on an alternative interpretation of average poorness: it is the average factor by which individual incomes must be multiplied to attain the reference level of income z. Setting z as a prosperity standard equal to \$25, we propose P as a new indicator of shared prosperity. Since 2013, boosting shared prosperity is one of the twin objectives of the World Bank (World Bank, 2018).

[15] See Kraay ⓡ et al. (2023) for details on the data. Income is measured in 2017 \$PPP per person per day. The income distribution is bottom coded at \$0.25 to reduce the impact of mismeasurement error. Average poorness is calculated with $z = 2.15$. Average income is measured in \$ per day ($z = 1$).

country. The inhabitants of another 16 countries needed more than one day on average to get \$2.15, including Burundi, Mozambique, the Democratic Republic of Congo, Somalia, Malawi, the Republic of Congo, Syria, Yemen, Niger, Rwanda, Uganda, and Tanzania. By contrast, the inhabitants of India, China, and the US needed 0.6, 0.2, and 0.1 days respectively.

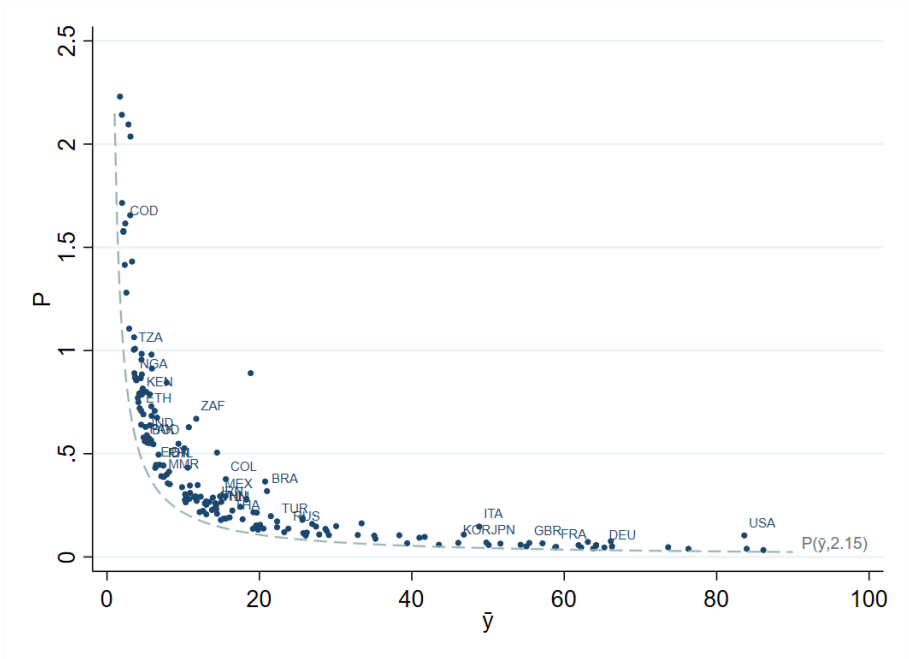


Figure 1: Average poorness and average income in 2019 in 218 countries

Data source: PIP data (World Bank). Income is measured at 2017 \$PPP per person per day and the distribution is bottom coded at \$0.25 (see Kraay ⓡ et al. 2023 a discussion). Average poorness P is calculated with z set as the extreme poverty line of the World Bank (\$2.15 per person per day); It can therefore be interpreted as the average number of days needed to get \$2.15. Average income $R = \bar{y}$ is measured in \$ per day. The green dashed line represents $P(\bar{y}, 2.15)$ that is, average poorness if income were equally distributed; It is the minimum possible value of P for given $(\bar{y})$. Country codes are shown when the population size is above 50 million.

4.2 Average poorness is intuitive

Average poorness directly stems from the Inverse Proportionality axiom. Conceptually, this axiom is consistent with how other physical quantities and their reciprocal are measured. Empirically, I also find evidence supporting this axiom in the results of the survey experiment. A substantial proportion of participants think about poverty in ways that align with the Inverse Proportionality axiom and the notion of average poorness.

The first question of the survey was: *"The World Bank has determined that it is impossible for a person to meet their basic needs if they have an income below \$2.5 per day per person. Individual A earns \$0.5 per day while individual B earns \$1.5 per day. Which statement is consistent with how you think about poverty?"* Seven possible answers were proposed to respondents, in random order:

(1) A and B are equally poor

(2) A is poor and B is not poor

(3) Both A and B are not poor

(4) A is approximately 2 times poorer than B

(5) A is approximately 3 times poorer than B

(6) A is approximately 4 times poorer than B

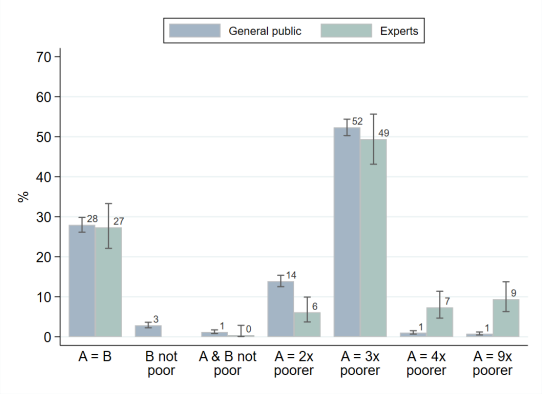
(7) A is approximately 9 times poorer than B

The answers (1), (4), and (6) are consistent with the poverty headcount, the poverty gap, and the squared poverty gap respectively. These are the most widely used poverty measures, which are part of the Foster-Greer-Thorbecke class (Foster et al., 1984). The answer (5) is consistent with average poorness.

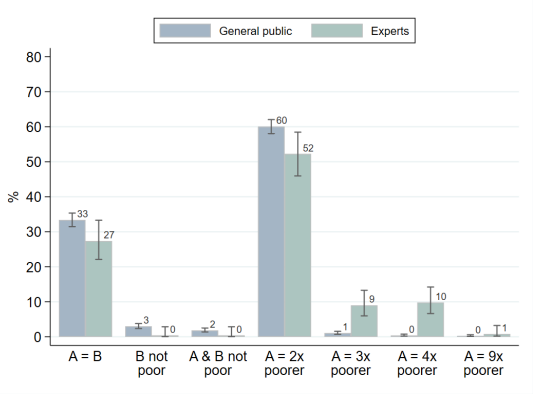
Results are shown in Figure 2(a). About a quarter of respondents replied that *"A and B are equally poor"*, in line with the headcount view of poverty. Only 14 and 6 percent of participants in the general public and expert samples replied that *"A is approximately 2 times poorer than B"*, in line with the poverty gap view of poverty. Very few respondents replied that *"A is approximately 4 times poorer than B"*, which is the answer that is consistent with the squared poverty gap. The answer that garnered the highest number of replies states that *"A is approximately 3 times poorer than B"*. This response aligns with the Inverse Proportionality Axiom, which is underlying average poorness. About 52 percent of the general public sample and 49 percent of the sample of experts selected this answer. Results are qualitatively similar in the different countries (Appendix Figures A.2 to A.4).

Results are very similar if parameters are changed. In a second version of the question, individual A earns \$1 and individual B earns \$2 per day. A majority respondents in each sample selected that *"A is two times poorer than B"*, which is consistent with the Inverse Proportionality Axiom and average poorness (Figure 2(b)). Less than a third of participants reported that *"A and B are equally poor"* in line with the poverty headcount. Very few respondents replied that *"A is approximately 3 times poorer than B"* or *"A is approximately 9 times poorer than B"*, which are the answers that are consistent with the poverty gap and squared poverty gap.

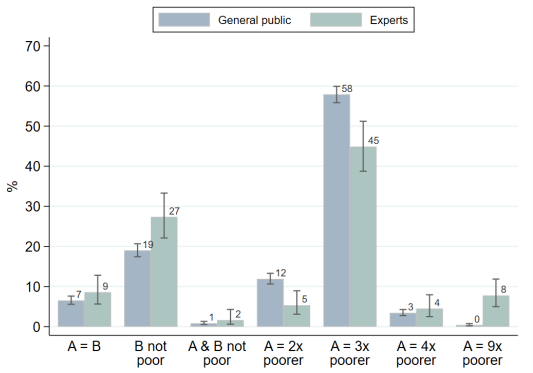
In fact, even if B's income is above the poverty line, many answers are consistent with the new measure. In a third version of the question, individual A earns \$1 and individual B earns \$3 per day. This time, respondents who think with the poverty headcount in mind should answer that *"A is poor and B is not poor"*. About 19 percent of respondents from the general public sample and 27 percent of experts selected this answer. The most frequent answer was again the one that is consistent with average poorness. About 58 percent of respondents from the general public sample and 45 percent of experts replied that *"A is three times poorer than B"*.



(a) A earns \$0.5 and B earns \$1.5 per day



(b) A earns \$1 and B earns \$2 per day



(c) A earns \$1 and B earns \$3 per day

Figure 2: Survey results: views on poverty

Data source: survey data, with participants from Kenya (N=569), India (N=581), South Africa (N=629), the US (N=489), and the survey of experts (N=245). The question was: *"The World Bank determined that it is impossible for a person or family to meet basic needs below an income of \$2.5 a day per person. A earns \$X and B earns \$Y per day. Which statement is consistent with how you think about poverty."* Possible answers, whose order was randomized, are: (1) A and B are equally poor, (2) A is poor and B is not poor, (3) Both A and B are not poor, (4) A is approximately 2 times poorer than B, (5) A is approximately 3 times poorer than B, (6) A is approximately 4 times poorer than B, and (7) A is approximately 9 times poorer than B.

Of course, results from any online survey experiment should be interpreted with caution, as participants may not necessarily be representative of the underlying population and the framing of questions may influence answers. I find reassurance in three observations. First, the characteristics of participants in the general public survey are weak predictors of their answers, except for gender (Table A.3 in the Appendix). About 52 percent of the sample self-identified as female, which is very close to the percentage of female in the general population. This suggests gender and other socio-demographic variables are unlikely to drive the results. Second, several studies found similar results with online versus offline populations or with different approaches to recruit online participants (see Haaland et al. 2023 for a review). Finally, to justify the present article, I only need a non-negligible proportion of answers that are consistent with the the Inverse Proportionality axiom and average poorness, not necessarily a majority of answers. Indeed, my objective is not to demonstrate that average poorness should replace all existing poverty measures,

but rather to show that there is room for another, more-continuous, measure of poverty that can coexist with existing measures. The present analysis would be viable even if survey results were much less favorable.

4.3 Average poorness has excellent properties

Average poorness has excellent properties. First, it is additively decomposable in population subgroups (see Kraay ⓡ et al. 2023 for details). Decomposability is a crucial property because it allows to understand how poverty aggregates across different segments of society. When a poverty measure is additively decomposable, the overall poverty level can be broken down into contributions from different subgroups, such as regions, gender, or income groups. Such decomposition may shed light on disparities between subgroups and differential trends, enabling policymakers to target interventions effectively. Decomposability also implies subgroup consistency, meaning that changes that occur in subgroups are consistently reflected at the global level (Foster and Shorrocks, 1991). Except for the poverty measure introduced by Sen (1976), most poverty measures are additively decomposable.

Second, average poorness is distribution sensitive because it gives more weight to changes that take place at the bottom of the income distribution. The simplest definition of distribution sensitivity requires P to satisfy both the Monotonicity and Transfer axioms (Zheng, 1997). The Monotonicity axiom dictates that P should increase when an individual's income decreases.[16] The transfer axiom states that P should increase following a regressive transfer. It is straightforward that average poorness satisfies these two axioms (see Kraay ⓡ et al. 2023 for a proof). By contrast, neither the poverty headcount nor the poverty gap are distribution sensitive because they do not satisfy the Transfer axiom.

A more demanding definition of distribution sensitivity also requires P to satisfy the Transfer Sensitivity axiom, which asserts that P should assign greater importance to transfers taking place lower in the distribution of incomes (Kakwani, 1980). Average poorness also satisfies this more demanding definition (see Kraay ⓡ et al. 2023 for a proof).

I generalize the definitions of distribution sensitivity beyond transfer sensitivity, keeping the same notation as in Section 2. Zheng (1997) shows that, if a measure $M(Y, z)$ is decomposable and its underlying individual poverty function $f(y_i, z)$ is continuously differentiable (C^1), then the Monotonicity axiom is equivalent to having $\frac{\partial f}{\partial y_i} < 0$. Similarly, if $M(Y, z)$ is decomposable and $f(y_i, z)$ is twice-continuously differentiable (C^2),

[16] In the context of poverty measures that rely on the focus axiom, these definitions should be adjusted to focus on (1) individuals below the poverty line and (2) transfers that do not induce individuals to cross the poverty line (Zheng, 1997).

the Transfer axiom is equivalent to having $\frac{\partial^2 f}{\partial {y_i}^2} > 0$. Going one step further, if $M(Y, z)$ is decomposable and $f(y_i, z)$ is C^3, the Transfer Sensitivity axiom is equivalent to having $\frac{\partial^3 f}{\partial {y_i}^3} < 0$. In each step, the "derivative of the previous step" changes sign to reflect the fact that higher priority is given to changes that take place at the bottom of the distribution. I extend this sequence and define s-th degree sensitivity. If $M(Y, z)$ is decomposable and $f(y_i, z)$ is s times continuously differentiable (C^s), then $M(Y, z)$ satisfies s-th degree sensitivity if $\frac{\partial^s f}{\partial {y_i}^s}$ is negative when s is an odd number, and positive when s is an even number. It is straightforward that average poorness satisfies s-th degree sensitivity for s approaching infinity.[17]

A third interesting property of average poorness is that it can be meaningfully decomposed into average income and a new inequality measure: $P(Y, z) = \frac{z}{\bar{y}} P(Y, \bar{y})$, where $P(Y, \bar{y})$ is a new inequality measure (Kraay ⓡ et al., 2023). The relationship between average poorness and inequality can be visualized in Figure 1. For a given level of average income, countries that are higher on the chart are more unequal, reflecting the fact that average poorness is a distribution sensitive measure. The green dashed line represents the hypothetical level of average poorness if incomes were equally distributed: $P(\bar{y}, z) = z/\bar{y}$. It is the minimum possible value of P given $\bar{y}$. It is straightforward that $P(Y, z) = P(\bar{y}, z) \times P(Y, \bar{y})$. As a result, the green dashed line represents the (multiplicative) contribution of average income to average poorness, and the vertical gaps between the green dashed line and each observation in Figure 1 represent the (multiplicative) contribution of inequality to average poorness.

For instance, the United States of America (USA) and Luxembourg have about the same average income, about $84 per person per day. Yet, average poorness in the USA is 2.5 times higher than in Luxembourg (0.1 versus 0.04) because inequality is much higher in the USA than in Luxembourg (4.1 versus 1.6). Similarly, Morocco and South Africa have similar average incomes, around $12 per person per day. However, average poorness is 2.3 times higher in South Africa than in Morocco (0.7 versus 0.3) because inequality is much higher in South Africa than in Morocco (3.6 versus 1.6).

The associated inequality measure $P(Y, \bar{y})$ also has unique properties. First, it can be interpreted intuitively, unlike many other inequality indices. It is the average number of days needed to get average income. For instance, the inequality measure in the US is 4.1, meaning that US inhabitants need on average more than four days to get the average income. The inequality measure is also the expected ratio between the incomes of two randomly selected individuals. For instance, pick two individuals randomly in the US, then the expected ratio of their income is 4.1 (but only 1.6 if you do the same in Luxembourg, where inequality is much lower).[18] Second, $P(Y, \bar{y})$ satisfies the key axioms in the

[17] The class of measures proposed by Chakravarty (1983) also exhibits this property, but it is scarcely used because it lacks an intuitive interpretation.

[18] When calculating the expected ratio of incomes, the random selection is done with replacement,

measurement of inequality, including Scale Invariance, Transfer, and Transfer Sensitivity.[19] Third, the inequality measure $P(Y, \bar{y})$ allows for a (multiplicative) decomposition into within-group and between-group inequality components (Kraay ⓡ et al., 2023).[20] This feature can for instance be used to split global inequality into contributions coming from different regions or countries and thereby relate global and local inequality trends (Shorrocks, 1984).

So far, this section showed that average poorness has excellent properties in terms of distribution sensitivity and decomposability. Yet, there is one fundamental property that average poorness does not satisfy: the Focus axiom. Formalized by Sen (1982), the Focus axiom has been central in the literature on poverty. It requires a poverty measure to be independent of the income distribution above the poverty line. Instead of being a drawback, I argue that not satisfying the focus axiom can actually be advantageous for conceptual, empirical, and theoretical reasons.

Conceptually, thresholds can be justified, for example if they have scientific or practical implications. Borrowing an example from Pritchett (2013), thresholds are for example justified when studying temperature, which exhibit different lines. One of them is at 0 degrees Celsius, below which water is solid and above which water is liquid. When it comes to fever, the line is very different, around 37.5 degrees Celsius. By contrast, there is little evidence of discontinuity or sharp non-linearity around the extreme poverty line of the World Bank or other lines, including in relation with subjective well-being, nutritional status, health, access to services, or income dynamics (Pritchett, 2013, 2024).[21] As eloquently expressed by Watts (1968) – a pioneer in poverty research – *"Poverty is not really a discrete condition. One does not immediately acquire or shed the afflictions we associate with the notion of poverty by crossing any particular income line. The constriction of choice becomes progressively more damaging in a continuous manner."*

Empirically, results from the online survey suggest that only a minority of respondents attach some importance to information on the poverty line when comparing incomes or allocating resources between low-income individuals. I highlight four pieces of evidence from the survey. The analysis of the first question, described in Section 4.2, shows that

with the first income selected in the numerator and the second one in the denominator (i.e. not always putting the highest income in the numerator). Kraay ⓡ et al. (2023) focus on a third interpretation of $P(Y, \bar{y})$: it is the average factor by which incomes must be multiplied to reach average income.

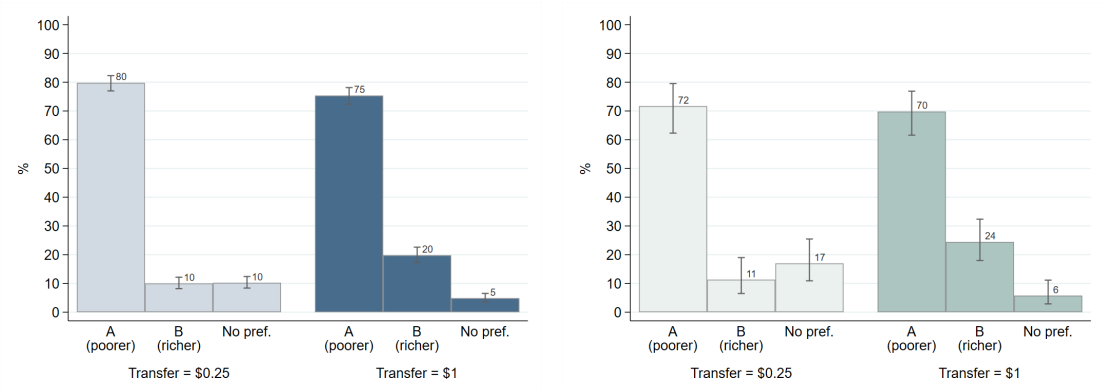
[19] Among well-known inequality indices, only the Atkinson inequality index and some members of General entropy class (for $\alpha < 2$) satisfy the Transfer and Transfer Sensitivity axioms (Shorrocks and Foster, 1987). The Palma ratio and other indices based on quantiles do not satisfy the Transfer axiom and the Gini index does not satisfy the Transfer Sensitivity axiom.

[20] Only the members of the class of General Entropy indices can also be easily decomposed into within-group and between-group inequality (the decomposition is additive) (Shorrocks, 1984). For $\alpha < 2$, the members of this class also satisfy the Transfer and Transfer Sensitivity axioms. However, General Entropy indices are typically regarded as difficult to interpret and hence rarely used in practice.

[21] See also Adler (2011) for a critique of the focus axiom in the context of well-being measurement and Adler (2019) for a critique of *sufficientist* Social Welfare Functions that use thresholds.

only 19 percent of the general public sample and 27 percent of experts provided answers that are consistent with the focus axiom, stating that *"A is poor and B is not poor"* if their daily incomes are \$1 and \$3 respectively (Figure 2). This percentage drops to just 6 percent among general public respondents who were not informed about the poverty line value (Appendix Figure A.5). This indicates that participants generally do not consider the extreme poverty threshold in their judgments unless explicitly prompted.

In the second question of the survey, participants could allocate additional income either to individual A, who earns \$1 a day, or to individual B, who earns \$2 a day.[22] The amounts – either \$0.25 or \$1 per day – were randomly assigned. By design, participants allocating the \$1-a-day transfer had the possibility to push B above the poverty line, but not those assigned to the \$0.25-a-day transfer. Results in Figure 3 show that a large majority of respondents allocate the additional income to the poorest individual, even if they have the possibility to push the richest individual above the line. This is true in both samples as well as across countries (Appendix Figure A.7). Less than 20 percent of answers are consistent with either the headcount or poverty gap views of poverty, which rely on the focus axiom.[23] Results are even stronger among participants who were not informed about the value of the poverty line (Appendix Table A.5).



(a) General public sample

(b) Experts

Figure 3: Survey results: allocation of resources

Data source: survey data, with participants from Kenya (N=428), India (N=438), South Africa (N=489), the US (N=369), and the survey of experts (N=245). Participants who did not get information on the level of the poverty line are excluded. The question was: *"An individual A earns \$1 per day while individual B earns \$2 per day. You have the possibility to increase the income of one of these two individuals by \$X per day. To which individual do you give the money to reduce poverty?"* The amount X was randomly assigned as 0.25 or 1. Possible answers, whose order was randomized, are: (1) Individual A, (2) Individual B, (3) I have no preference.

[22] The question was phrased as follows: *"The World Bank has determined that it is impossible for a person to meet their basic needs if they have an income below \$2.5 per day per person. Individual A earns \$1 per day while individual B earns \$2 per day. You have the possibility to increase the income of one of these two individuals by \$X per day. To which individual do you give the money to reduce poverty?".*

[23] Participants seeking to minimize the poverty headcount should be indifferent if they can allocate \$0.25 per day, but give the money to B if they can allocate \$1 per day. Participants seeking to minimize the poverty gap should be indifferent if they can allocate \$0.25 per day, but give the money to A if they can allocate \$1 per day.

The third question was similar, except that the amounts that could be allocated to A and B were different (the question and parameters are described in Tables A.1 and A.2). About half of the trade-offs involved the possibility to push B, the richest individual, above the poverty line. In Table A.4, I exploit the random assignment of parameters to assess the extent to which responses are impacted by this possibility. I find that participants from the general public and expert samples are 7.3 and 17 percentage points more likely to allocate the additional income to the richest individual, B, if the question involves the possibility to push her above the line. Excluding participants who would always allocate the additional income to B, as they are not expected to react to the treatment, I estimate that only 10 and 26 percent of the general public and expert surveys respectively react to the possibility of pushing B out of poverty. Interestingly, this effect is largely driven by respondents whose responses to Question 1 were consistent with the headcount view of poverty (Table A.4, Columns 2 and 4). Most respondents do not push B above the line when given the possibility to do so.

In the fourth question, which was only asked in the general public sample, respondents were invited to provide a qualitative assessment of A and B's incomes. The income of A was set at \$2.4, just below the poverty line, while the income of B was randomly assigned as \$2.6, \$3, \$4, or \$5, that is, above the line. Figure 4 shows that only a minority of respondents think B is not poor when her income \$2.6 or \$3. Slightly more than half of respondents reply that B is not poor when her income is \$4 or \$5. However, if the level of the poverty line is not provided, less than a quarter of respondents think B is not poor, whatever the assigned income. The results from this question suggest a majority of respondents think poverty is a spectrum, which does not suddenly stops above \$2.5.

Overall, the survey results indicate potential for a more continuous measure of poverty or poorness that does not rely on the focus axiom.

From a theoretical perspective, the absence of a cut-off yields an interesting implication. The measures of average richness and average poorness generate orderings (i.e. rankings) and comparisons that are robust to the choice of reference level of income z. Indeed, z serves as a simple scaling factor in equations (1) and (2), impacting only the measurement unit of $R(Y, z)$ and $P(Y, z)$. For example, if we compare average poorness in contexts A and B – where A and B can be two different countries or period of time – we have :

$$\frac{P(Y^A, z)}{P(Y^B, z)} = \frac{n^B}{n^A} \frac{\sum_{i=1}^{n^A} \frac{1}{y_i^A}}{\sum_{i=1}^{n^B} \frac{1}{y_i^B}} \tag{3}$$

which does not depend on z. As a result, comparisons in ratio or percentage terms and

Figure 4: Qualitative comparisons of individual A who is just below the poverty line and B who is above the poverty line

Data source: survey data, with participants from Kenya (N=569), India (N=581), South Africa (N=629) and the US (N=489) (no data from the sample of experts). The question was: *"The World Bank has determined that it is impossible for a person to meet their basic needs if they have an income below $2.5 per day per person. Individual A earns $2.4 per day while individual B earns $X per day. Which statement is consistent with how you think about poverty?"* The amount X was randomly assigned as 2.6, 3, 4, or 5. About a quarter of the sample did not get information about the level of the poverty line. Possible answers, whose order was randomized, are: (1) B is extremely poor, almost as poor as A, (2) B is extremely poor, albeit a bit less than A, (3) B is poor, but much less poor than A, (4) B is not poor.

rankings do not depend on the scaling factor z.[24]

By contrast, poverty measures that rely on the focus axiom generate comparisons and orderings that often depend on the choice of poverty line. This problem was identified early on and scholars have proposed to apply tests of stochastic dominance to determine whether poverty comparisons and orderings are robust or not to the choice of poverty line and poverty measure (Atkinson, 1987; Foster and Shorrocks, 1988; Ravallion, 1999). While mathematically rigorous, these tests are rarely used in practice because quite complex and often inconclusive (Blackburn, 1994; Duclos et al., 2006).

The lack of robustness of traditional poverty measures is problematic, both because it creates confusion and because stakeholders with different agendas can argue in favor of the poverty line that best serves their interests. As a matter of fact, virtually every country uses a distinct poverty line and the World Bank itself is promoting four different poverty lines, one for each income category. Many participants in high-level debates on

[24]To further emphasize the importance of this property, I quote the late Ravallion (1999), who asserted that *"The most important reason for measuring poverty is probably not the need for a single number for some place and date, but rather to make a poverty comparison."* In the same article, he also argued that, because *"a certain amount of arbitrariness is unavoidable in defining any poverty line in practice, one should be particularly careful about how the choices made affect the poverty comparisons, for these are generally what matter most to the policy implications."*

poverty have argued in favor of using different global poverty lines (Pritchett, 2003; Basu, 2015; Kenny, 2017, 2023; Crawfurd, 2024). Average poorness circumvent these issues by relaxing the focus axiom and thereby avoiding its undesirable implications.

To be sure, I do not to claim that the focus axiom should be rejected in all circumstances. An analogy is again useful, this time using speed as an example. Speeding tickets are typically based on thresholds which may vary depending on the circumstances (e.g. within a city or on a motorway). In some context, having thresholds may therefore be justified, often for normative or practical reasons. However, when describing a runner's performance in a marathon, average speed and pace (slowness) are the relevant measures to use, without imposing any specific threshold. Depending on the context and objectives, one might prefer a binary reasoning (too fast or not) or consider the full distribution of the variable of interest. Both types of reasoning can be sometimes combined: speeding tickets are typically given above a certain speed, but the amount might vary depending on the "gap".

Drawing from this analogy, it becomes less contentious to assert that the focus axiom is neither necessary nor sufficient for constructing a poverty measure. Its relevance hinges on the specific purpose and context in which it is applied. While thresholds can serve practical purposes – such as helping development agencies determine eligibility for cash transfers – there are other contexts where a measure like average poorness may prove more relevant, because it is distribution-sensitive and it takes into account the entire income distribution, without relying on potentially arbitrary thresholds.

4.4 Average poorness is policy relevant

A poverty measure can serve at least two purposes. First, it can be used to effectively describe or monitor a situation (*descriptive* purpose). To achieve this, it should possess a straightforward interpretation and a clear unit that resonates with policymakers. Its variations should be intuitive. Additionally, the measure should exhibit desirable properties and impose minimal data requirements for practical applicability. I emphasize here that satisfying desirable properties is not just a *"nice-to-have"*; it is essential to avoid paradoxes and counter-intuitive conclusions. Based on the above sections, I contend that average poorness fulfills these criteria.

Secondly, a poverty index can also serve as a valuable tool for informing policy decisions (*normative* purpose). However, this holds true only if the social welfare function (SWF) underlying the measure corresponds to how individuals or governments want to take decisions that may impact poverty. If applied strictly, this criteria is most-likely impossible to achieve given the many dimensions that individuals and governments may incorporate in their decision-making process. To be practically relevant, this criteria needs to be applied more loosely, for example by asking whether the SWF underlying the

measure broadly reflects how experts and the general public would make decisions in a controlled environment.

It is straightforward that minimizing average poorness is mathematically equivalent to maximizing a utilitarian SWF with iso-elastic utility functions and an inequality aversion coefficient of 2:

$$\min \; P(Y,z) \quad \Leftrightarrow \quad \max \; U = \frac{1}{n}\sum_{i=1}^{n} u(y_i) \quad \text{with} \quad u(y_i) = \frac{y_i^{1-\theta}}{1-\theta} \quad \text{and} \quad \theta = 2, \qquad (4)$$

where U is usually referred to as the Atkinson SWF (Atkinson et al., 1970).[25] A relevant question is whether $\theta = 2$ is a reasonable parameter value. Does it broadly corresponds to how experts and the general public would make decisions, for instance when allocating aid?

The experimental literature on inequality aversion is limited, with the only estimates coming from high-income countries and based on trade-offs involving relatively high levels of income. Two experimental approaches have been employed. In leaky bucket experiments, participants decide whether to tax a wealthier individual to transfer a certain amount to a poorer individual, but the process entails administrative costs. Meanwhile, wage-distribution experiments prompt respondents to choose between two hypothetical societies with different income distributions, under a veil of ignorance (Harsanyi, 1955). Estimated median values of θ are below 0.5 in leaky-bucket experiments (Amiel et al., 1999; Pirttilä and Uusitalo, 2010) and above 2 in wage-distribution experiments (Johansson-Stenman et al., 2002; Pirttilä and Uusitalo, 2010). I argue that the leaky bucket experiment may underestimate inequality aversion because it fails to distinguish inequality aversion from aversion to taxation, government inefficiency, and loss aversion.

I use the data from the online surveys to provide new estimates of inequality aversion. I extend the literature by providing estimates from developing and developed countries and from experts, by focusing on trade-offs that are around the extreme poverty line of the World Bank, and by carefully framing the question to avoid mixing up inequality aversion with other dimensions.

The general phrasing of the question was: *"The World Bank has determined that it is impossible for a person to meet their basic needs if they have an income below $2.5 per day*

[25] I note that R and P are ordinally equivalent to two members of the Atkinson class of SWFs, with an inequality aversion parameter equal to 0 and 2 respectively. The Atkinson class of SWFs is commonly employed in economic research but rarely used beyond academia because its formula is complex and generally not additively decomposable in population subgroups. The objective of this paper is not to design an ordinal measure of welfare (see Adler 2011 and Adler 2019 for excellent references on this, including on the axioms behind Atkinson's SWF), but to propose a new cardinal measure that has clear units, excellent properties (including decomposability), and reflects how people think about poverty and poorness.

per person. Individual A earns $1 per day while individual B earns $X per day. You have two options to reduce poverty. 1) You can increase the daily income of A by $Y. 2) You can increase the daily income of B by $Z. Which option would you implement to reduce poverty? Each participant had to answer three questions with this phrasing and different parameters. Depending on answers, respondents followed different pathways to narrow down their individual degree of inequality aversion. The parameters and pathways are described in Table A.2 and Figure A.1.

Results are shown in Figure 5. The average estimate of θ is 2.11 among experts (95% CI:1.93-2.30, median=2) and 2.41 among general public participants (95% CI: 2.35-2.47, median = 2.75). For the general public, the average estimates vary by country, ranging from 2.14 in Kenya to 2.71 in South Africa. I find some evidence that more educated participants are less averse to inequality (Appendix Table A.5).[26] The average estimate of θ is 2.34 for participants with a bachelor degree or higher, 2.22 for respondents with at least a master's degree, and 2.12 for the few respondents with a PhD degree. The latter estimates align closely with those derived from the expert survey. Other demographic characteristics do not predict inequality aversion.[27]

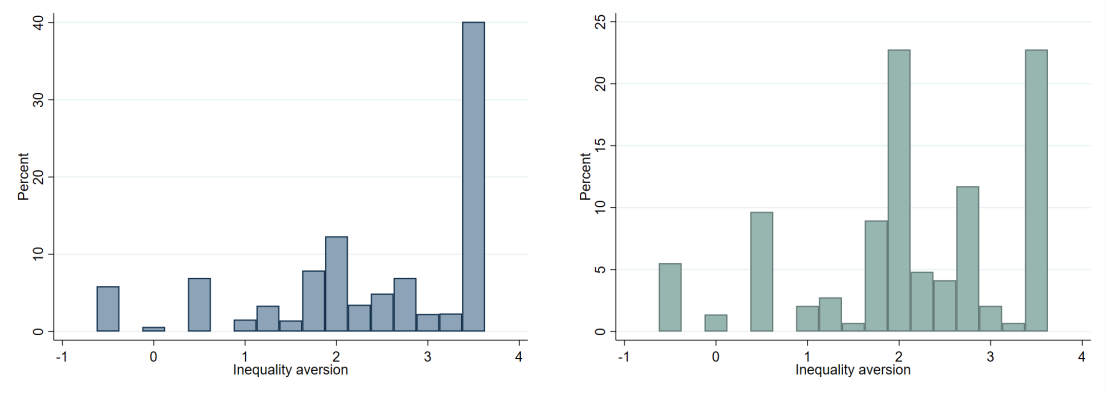
Overall, the degree of inequality aversion of average poorness appears to be relatively consistent with how people would allocate cash assistance to the poor, highlighting the policy relevance of this new measure. Nearly all respondents exhibit aversion to inequality both below and across the poverty line, in line with the new measure. By contrast, measures lacking distribution sensitivity – such as the widely used poverty headcount and poverty gap – may be comparatively less relevant for guiding policy.

5 Generalizations and limitations

In this section, I develop two generalizations of the new framework proposed in this paper. First, I generalize average poorness for different degrees of inequality aversion. Second, I examine how individual poorness – and more generally the inverse transformation – can be used in applied work. I conclude the section by discussing the limitations of the new

[26]The general public sample is highly educated, with 13 years of education on average. This suggests estimates of the degree of inequality aversion may be higher in representative samples.

[27]Estimates of inequality aversion are significantly higher if respondents are not informed about the value of the extreme poverty line (Appendix Table A.5). As a robustness check, I also tested four other versions of the question, which were randomly assigned to a subset of US participants (these observations are excluded from the main analysis). The first version emphasized that taxation is used to redistribute income, as in original leacky-bucket experiments. In line with the findings of Pirttilä and Uusitalo (2010). The average estimate of θ is significantly lower with this phrasing, around 1.13. The second version only revealed the final distribution of incomes, as in wage-distribution experiments. Results are not significantly different with this latter phrasing. In the third and fourth versions, all amounts in the questionnaire were multiplied by 10 or 20. Results are not statistically different from the benchmark version, which is consistent with Atkinson et al. (1970)'s assumption of *constant relative inequality aversion*. These results will be detailed in a separate paper on inequality aversion.



(a) General public sample (b) Experts

Figure 5: Survey results: inequality aversion

Data source: survey data, with participants from Kenya (N=412), India (N=430), South Africa (N=472), the US (N=357), and the survey of experts (N=145). The figures focus on participants assigned to the benchmark phrasing of the question Q3 as described in Table A.1. The parameters of the question are described in Table A.2. Figure A.1 shows the different pathways that participants could follow depending on their answers. Respondents who were indifferent in all questions are excluded.

measure.

5.1 Inequality aversion $\neq$ 2

Average poorness implicitly assumes a degree of inequality aversion θ equal to 2. Average richness, on the other hand, assumes no inequality aversion ($\theta = 0$). It is straightforward to generalize the formulas in equations (1) and (2) to allow for different degrees of inequality aversion:

$$M^{\theta}(Y, z) = \frac{1}{n} \sum_{i=1}^{n} \left(\frac{y_i}{z} \right)^{1-\theta}. \tag{5}$$

When $\theta > 1$, $M^{\theta}(Y, z)$ is a measure of poorness that is additively decomposable and satisfies s-th degree sensitivity for s approaching infinity. As θ increases, the index becomes more sensitive to the poorest incomes. Only M^0 and M^2 have a straightforward interpretation and intuitive units. M^0 is average income and M^2 is average poorness. Other members of this class are less likely to be relevant for policy.

It is straightforward that the members of this class also generate comparisons and orderings that are independent of the choice of reference level of income, because $z^{1-\theta}$ is just a scaling factor. I formalize this idea in an axiom and demonstrate that equation (5), with $\theta > 1$, defines the class of additively decomposable poverty measures that satisfy monotonicity and generate comparisons and orderings that are independent of the choice of reference level of income.

(A5) Comparison Invariance Axiom: For every reference levels of income z and z' and any income distributions X and Y, $\frac{M(X,z)}{M(Y,z)} = \frac{M(X,z')}{M(Y,z')}$.

(A6) Monotonicity: If X is obtained from Y by decreasing the income of an individual, then $M(X,z) > M(Y,z)$.

Theorem 5.1. *The only indices satisfying Decomposability (A1), Normalization (A4), Comparisons Invariance (A5), and Monotonicity (A6) are defined in equation (5) for* $\theta > 1$.

Proof. For the necessary part of the theorem, I note that Decomposability (A1) implies that $M(Y,z) = 1/n \sum_{i=1}^{n} f(y_i, z)$ for some individual poverty function f of the individual income y_i and the reference level of income z (Foster and Shorrocks, 1991). Decomposability (A1) also implies Scale Invariance, which means that $f(y_i, z) = l(y_i/z)$ (Foster and Shorrocks, 1991). Comparisons Invariance (A5) further implies that $f(y_i, z) = g(y_i)h(z)$. For $n = 1$, we therefore have that $f(y_1, z) = g(y_1)h(z) = l(y_1/z)$. Aczél (1966) shows that the solutions to this equation takes the form: $g(y_1) = a{y_1}^c$ and $h(z) = bz^{-c}$ and $l(y_1/z) = ab(y_1/z)^c$. Normalization (A4) implies $ab = 1$ while Monotonicity (A6) implies $c < 0$. This establishes the necessity part of the theorem.

For the sufficiency part of the theorem, it is straightforward that $M^{\theta}(Y,z)$ satisfies A1, A4, A5, and A6 when $\theta > 1$.

■

5.2 Individual income poorness and inverse transformation

In applied econometrics, a variable capturing individual or household poorness z/y_i can be a useful complement to a variable measuring individual or household income y_i. Because the inverse transformation is concave, considering individual or household poorness will magnify effects that are taking place at the bottom of the income distribution and reduce the importance of outliers at the top of the distribution. Thanks to its intuitive unit, e.g. in days/$, results are easily interpretable and meaningful.

The inverse transformation can of course be applied to other quantities that range from 0 (excluded) to infinity (e.g. calorie intake, distance, speed, height, or weight). This transformation may prove particularly useful for researchers interested to explore effects that are likely to take place at the bottom of the variable distribution. This transformation also reduces the importance of outliers at the top of the distribution. In fact, the inverse transformation is somewhat similar to the log-transformation that is prevailing in applied work. In impact evaluations with a discrete treatment, the log-transformation has however one limitation that is often ignored. It requires calculating $e^{\beta} - 1$ to be (only approximately) interpretable in percentage terms, especially when

impacts are large or heterogeneous. Using the inverse transformation may allow a more direct interpretation of results.

5.3 Limitations

I discuss three limitations and explore how they connect to potential pathways for future research. First, this paper focused on income poorness, implicitly assuming that poverty is unidimensional. Many authors have argued that poverty is multidimensional and proposed poverty measures that integrate various dimensions of poverty (Duclos et al., 2006; Ravallion, 2011; Alkire and Foster, 2011; Decerf, 2023b). The framework presented in this paper could be expanded to account for multiple dimensions.

Second, average poorness is distribution sensitive and, like other distribution sensitive measures, it is sensitive to mismeasurement at the lower end of the income distribution. To some extent, this issue parallels the sensitivity of average income to the mismeasurement of higher incomes. Consider a population of 10 individuals living on \$2.15 per day, implying that average income is \$2.15 per day and average poorness is 1 day to get \$2.15. Now, suppose an enumerator mistakenly records one individual's income as \$21.5 instead of \$2.15. Average income would be severely overestimated (\$4.1 per day) while average poorness would be slightly underestimated (0.91 days to get \$2.15). Conversely, if the enumerator recorded the income as \$0.215, average income would be slightly underestimated (\$1.96 per day) while average poorness would be severely overestimated (1.9 days to get \$2.15). This simple example shows that both average income and average poorness are sensitive to mismeasurement, at the top of the distribution for the former and its bottom for the latter. At the extreme, average poorness cannot be calculated when income (or consumption) is zero or negative.

The companion paper by Kraay ⓡ et al. (2023) examines solutions to this issue and proposes to bottom-code incomes at \$0.25, which is the minimum cost across countries of the least expensive bundle providing 2,330 calories (kcal) per day. They show the issue is limited, as only 0.13 percent of 2019 observations have to be bottom-coded. As a robustness check, they vary the threshold used for bottom-coding from \$0.1 to \$0.5 and show that global and country-level estimates of average poorness are quite robust.[28] Future research could examine the causes of mismeasurement at the top and bottom of the income distribution and propose tools to address the issue, for instance using machine-learning techniques.

Finally, average poorness may be criticized for assigning strictly positive weights to high incomes, such as \$1,000 or \$10,000 per day, even though most would agree that

[28]Using PIP data, Kraay ⓡ et al. (2023) obtain the threshold 0.1 by applying the bottom-coding methodology proposed by Neugschwender (2020) and the threshold 0.5 by applying the consumption floor methodology proposed by Ravallion (2016).

individuals earning these amounts are not poor. I note that with such high incomes, average poorness values are 0.00215 and 0.000215, respectively – so small that they are nearly indistinguishable from zero. Thus, the effect of high incomes on average poorness is negligible, with little impact on aggregate measures. This critique may also reflect a present bias, as what constitutes a high income is likely to change over time and across different contexts. In the US survey, I tested how people react when all amounts are multiplied by 10 or 20 (Appendix Figure A.6). Two-third of respondents still report that A is three times poorer than B if they earn \$1 versus \$3, or \$10 versus \$30, or \$20 versus \$60, suggesting the Inverse Proportionality axiom still holds for the majority of respondents, even with higher income levels.

6 Conclusion

Credible and intelligible measures of poverty are needed to inform policy makers, donors, and the public about living conditions and needs at the bottom of the income distribution and monitor progress towards national and international goals. Rigorously measuring poverty is also essential to indicate which people, regions, or countries should receive attention first.

However, existing poverty measures have limitations. The widely used poverty headcount and poverty gap metrics are intuitive, but these measures are not distribution sensitive, failing to prioritize the most impoverished individuals. Although alternative poverty measures have been proposed to mitigate these shortcomings, their adoption remains limited due to their inherent complexity (see Zheng 1997 and Foster 2006 for excellent reviews).

This paper introduced a novel measure – average poorness – which is grounded in the intuitive principle that a person A with half the income of B is twice as poor as B. In mathematical terms, this intuition implies that income poorness is the reciprocal of income richness. Average poorness has a simple interpretation with intuitive units: it is the average number of days needed to get a reference level of income.

Average poorness has interesting properties, being distribution sensitive and additively decomposable in population subgroups. Moreover, the measure generates comparisons and orderings that are independent from the (difficult) choice of a reference level of income. Changes in average poorness can be decomposed into income growth and shifts in inequality, offering a policy-relevant framework that connects poverty, living standards, and inequality.

Average poorness proposes a transformative approach to poverty measurement, by challenging the traditional view that poverty is a binary condition. By treating poverty as a continuous function of incomes, the new measure more accurately reflects the reality

of poverty's spectrum. Although the proposed paradigm shift may face resistance from people accustomed to binary frameworks, the new measure should better resonate with most people's view that poverty is a continuum that does not end at the $2.15 threshold.

Survey results indeed indicate that average poorness aligns well with public and expert views on poverty, underscoring its relevance and potential for widespread adoption. Data requirements are limited, permitting practical and immediate use. Average poorness can be used as an interesting complement or substitute to existing measures of poverty, shared prosperity, and inequality. Beyond poverty analysis, the framework and formulas presented in this article can be easily applied to study other quantities and their reciprocals. This versatility extends not only within economics but also to other scientific domains.

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Online Appendix

A Questionnaire

Table A.1: Survey Questions

#	Question	Variations	Rand.	Answers	Sample: General public	Sample: Experts
(Q1)	The World Bank has determined that it is impossible for a person to meet their basic needs if they have an income below $2.5 per day per person. Individual A earns $X while individual B earns $Y per day. Which statement is consistent with how you think about poverty.	(Q1.a) $X = 0.5, Y = 1.5$ (Q1.b) $X = 1, Y = 2$ (Q1.c) $X = 1, Y = 3$	1 1 1	(1) A and B are equally poor (2) A is poor and B is not poor (3) Both A and B are not poor (4) A is approximately 2 times poorer than B (5) A is approximately 3 times poorer than B (6) A is approximately 4 times poorer than B (7) A is approximately 9 times poorer than B	Yes	Yes
(Q2)	The World Bank has determined that it is impossible for a person to meet their basic needs if they have an income below $2.5 per day per person. Individual A earns $1 per day while individual B earns $2 per day. You have the possibility to increase the income of one of these two individuals by $X per day. To which individual do you give the money to reduce poverty?	(Q2.a) $X = 0.25$ (Q2.b) $X = 1$	1/2 1/2	(1) Individual A (2) Individual B (3) I have no preference	Yes	Yes
(Q3)	The World Bank has determined that it is impossible for a person to meet their basic needs if they have an income below $2.5 per day per person. Individual A earns $1 per day while individual B earns $X per day. You have two options to reduce poverty. 1) You can increase the daily income of A by $Y. 2) You can increase the daily income of B by $Z. Which option would you implement to reduce poverty?	See Table A.2 and Figure A.1	3	(1) Option 1 (2) Option 2 (3) I have no preference	Yes	Yes*
(Q4)	The World Bank has determined that it is impossible for a person to meet their basic needs if they have an income below $2.5 per day per person. Individual A earns $X per day while individual B earns $Y per day. Which statement is consistent with how you think about poverty?	(Q4.a) $X = 2.4, Y = 2.6$ (Q4.b) $X = 2.4, Y = 3$ (Q4.c) $X = 2.4, Y = 4$ (Q4.d) $X = 2.4, Y = 5$	1/4 1/4 1/4 1/4	(1) B is extremely poor, almost as poor as A (2) B is extremely poor, albeit a bit less than A (3) B is poor, but much less poor than A (4) B is not poor	Yes	No
(Q5)	The World Bank has determined that it is impossible for a person to meet their basic needs if they have an income below $2.5 per day per person. Individual A earns $1 per day while individual B earns $3 per day. Which statement is consistent with how you think about poverty?		1	(1) A and B earn the same amount (2) A earns $1 per day (3) A earns $2 per day (4) B earns $1 per day (5) B earns $2 per day	Yes	No
(Q6)	How old are you?		1	*Integer*	Yes	No
(Q7)	What is the highest level of education you successfully completed?		1	(1-12) Grade 1-12 (13) Associate or technical degree (14) Bachelor's degree (15) Master's or professional degree (16) Doctoral degree (PhD)	Yes	No
(Q8)	How many people live in your household?		1	*Integer*	Yes	No
(Q9)	In a typical month, what is the disposable income of your household, after paying taxes?		1	*Integer*	Yes	No

* These questions were not asked to participants at the University of Sheffield (N=32) and at the University of Ghent (N=63). In the expert and US surveys, all amounts were expressed in $. In Kenya, all amounts were multiplied by 40 and expressed in Kenyan shillings (KSh). In India and South Africa, all amounts were multiplied by 20 and expressed in rupees and rands respectively.

Table A.2: Inequality aversion questions (Q2 and Q3): parameters

Variation	A (poorest)			B (richest)			ϵ if indifferent
	Initial income	Transfer	Income if gets transfer	Initial income	Transfer	Income if gets transfer	
V0a	1	1	2	2	1	3	0
V0b	1	0.25	1.25	2	0.25	2.25	0
V1a	1	0.2	1.2	1.5	0.3	1.8	1
V1b	1	0.5	1.5	2	1	3	1
V1c	1	0.5	1.5	1.5	0.75	2.25	1
V2a	1	0.25	1.25	1.25	0.35	1.6	1.5
V2b	1	0.5	1.5	1.5	1	2.5	1.5
V2c	1	0.2	1.2	1.3	0.3	1.6	1.5
V3a	1	0.5	1.5	1.5	1.5	3	2
V3b	1	0.2	1.2	1.2	0.3	1.5	2
V3c	1	0.2	1.2	1.5	0.5	2	2
V4a	1	0.25	1.25	1.25	0.5	1.75	2.5
V4b	1	0.5	1.5	1.5	3.5	5	2.5
V4c	1	0.25	1.25	1.5	1	2.5	2.5
V5a	1	0.3	1.3	1.3	1	2.3	3
V5b	1	0.4	1.4	1.4	5.6	7	3
V5c	1	0.25	1.25	1.5	2	3.5	3

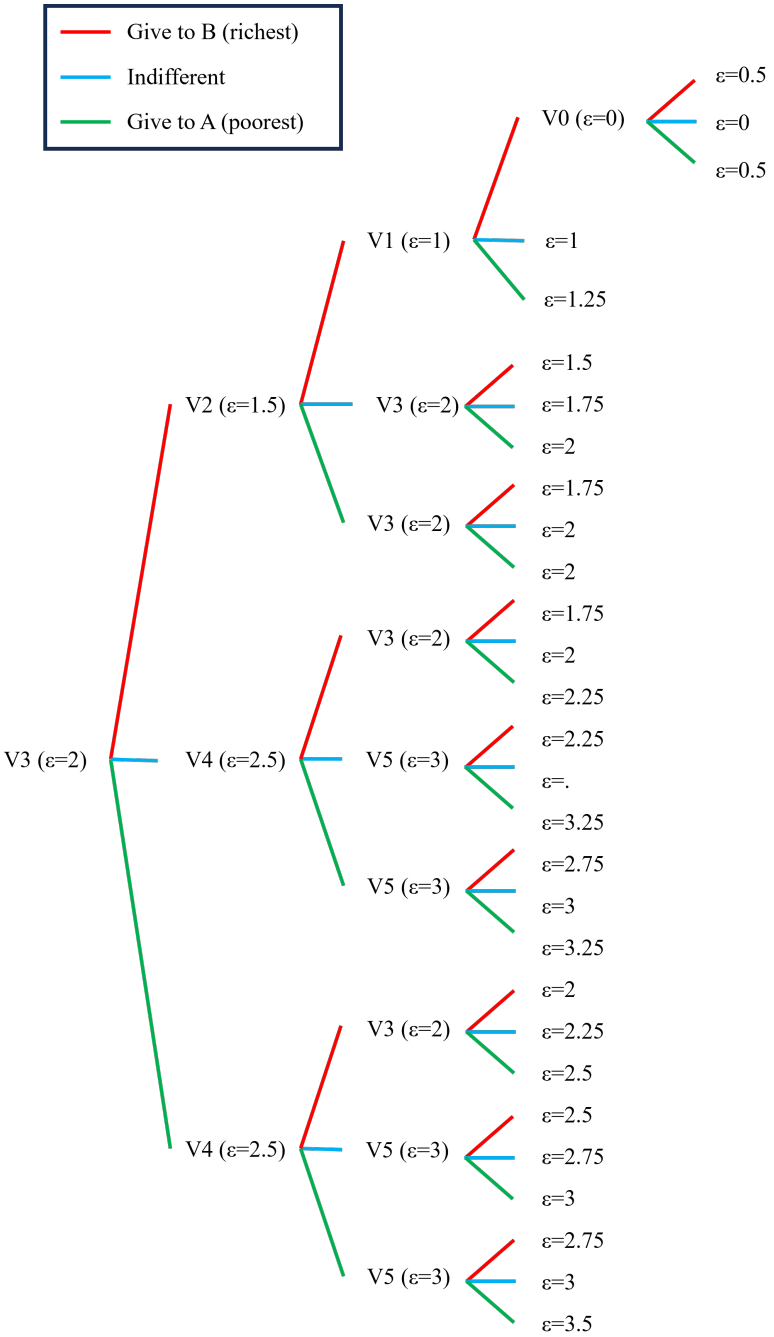
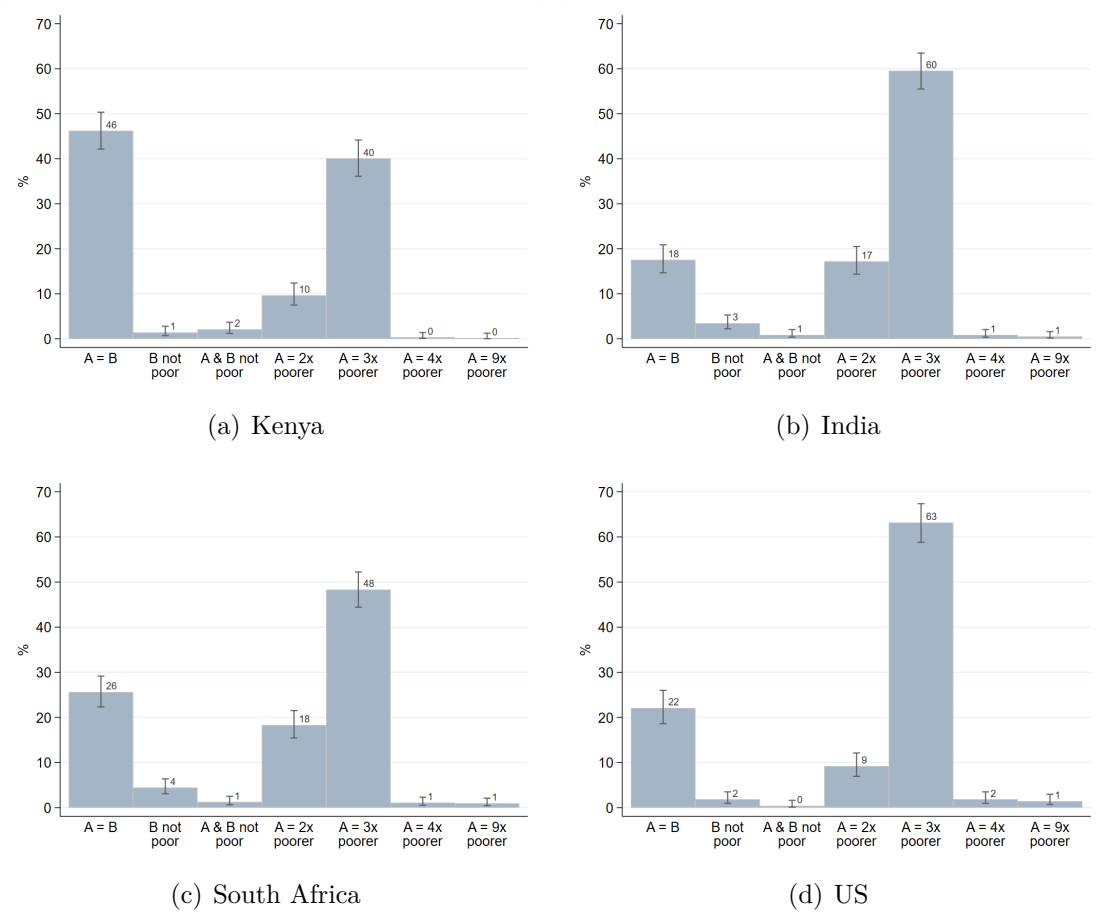


Figure A.1: Inequality aversion questions (Q2 and Q3): pathways and resulting ϵ

The different versions and associated parameters are described in Table A.2. Each respondent was asked one version of Q3 and three versions of Q4. The questions followed the pathways described in this figure. Within each version (V0-V5), the sub-versions a,b,c were randomized.

B General public survey: additional figures



(a) Kenya

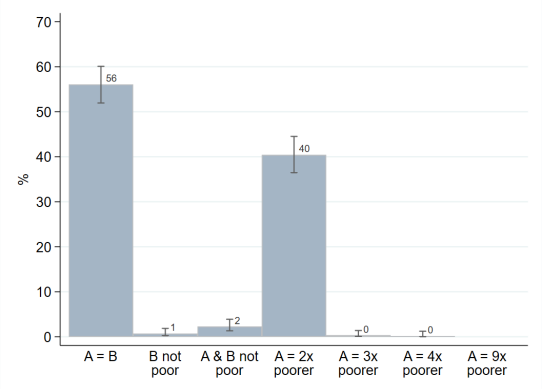
(b) India

(c) South Africa

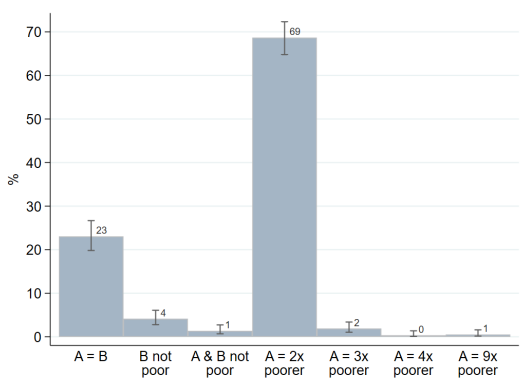
(d) US

Figure A.2: Survey results: views on poverty, by country (Question 1.a)

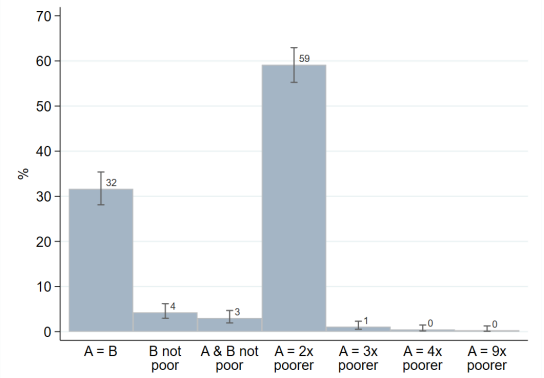
Data source: survey data, with participants from Kenya (N=569), India (N=581), South Africa (N=629) and the US (N=489). The question was: *"The World Bank determined that it is impossible for a person or family to meet basic needs below an income of $2.5 a day per person. A earns $0.5 and B earns $1.5 per day. Which statement is consistent with how you think about poverty."* Possible answers, whose order was randomized, are: (1) A and B are equally poor, (2) A is poor and B is not poor, (3) Both A and B are not poor, (4) A is approximately 2 times poorer than B, (5) A is approximately 3 times poorer than B, (6) A is approximately 4 times poorer than B, and (7) A is approximately 9 times poorer than B. All amounts were expressed in local currency units as described in Section 3.



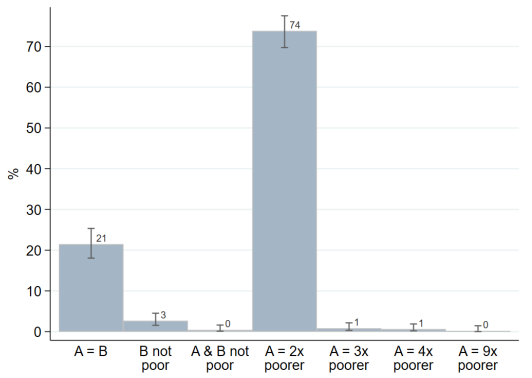
(a) Kenya



(b) India



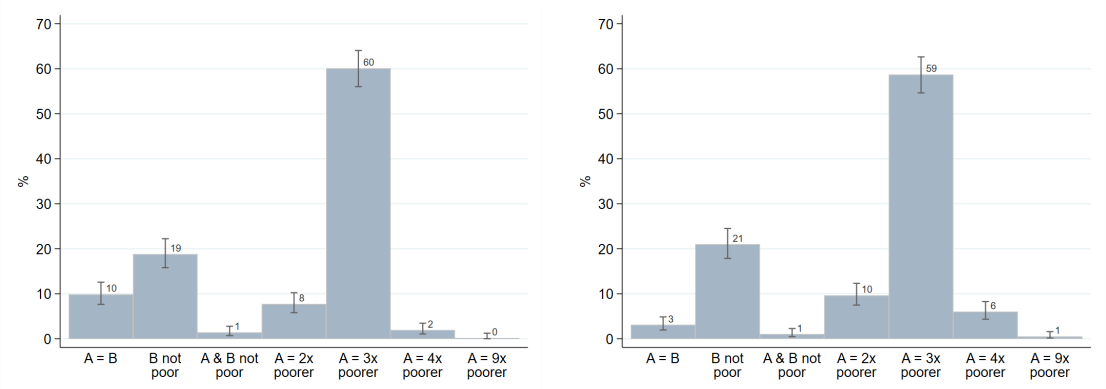
(c) South Africa



(d) US

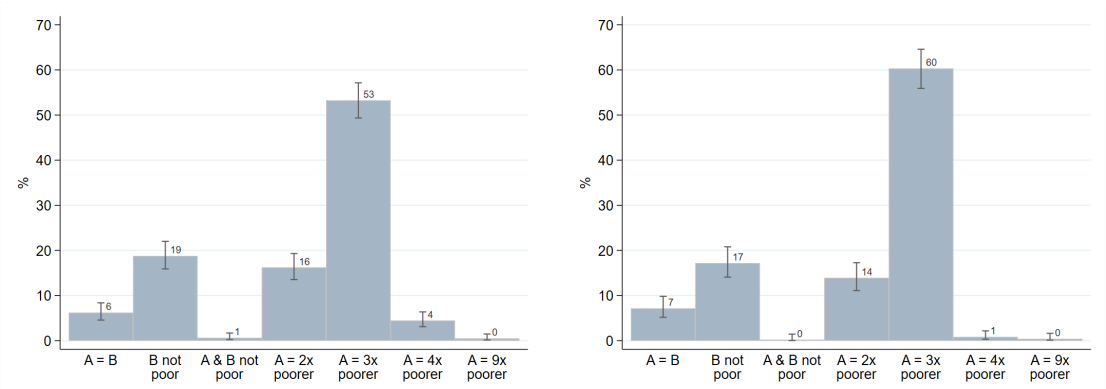
Figure A.3: Survey results: views on poverty, by country (Question 1.b)

Data source: survey data, with participants from Kenya (N=569), India (N=581), South Africa (N=629) and the US (N=489). The question was: *"The World Bank determined that it is impossible for a person or family to meet basic needs below an income of $2.5 a day per person. A earns $1 and B earns $2 per day. Which statement is consistent with how you think about poverty."* Possible answers, whose order was randomized, are: (1) A and B are equally poor, (2) A is poor and B is not poor, (3) Both A and B are not poor, (4) A is approximately 2 times poorer than B, (5) A is approximately 3 times poorer than B, (6) A is approximately 4 times poorer than B, and (7) A is approximately 9 times poorer than B. All amounts were expressed in local currency units as described in Section 3.



(a) Kenya

(b) India



(c) South Africa

(d) US

Figure A.4: Survey results: views on poverty, by country (Question 1.c)

Data source: survey data, with participants from Kenya (N=569), India (N=581), South Africa (N=629) and the US (N=489). The question was: *"The World Bank determined that it is impossible for a person or family to meet basic needs below an income of $2.5 a day per person. A earns $1 and B earns $3 per day. Which statement is consistent with how you think about poverty."* Possible answers, whose order was randomized, are: (1) A and B are equally poor, (2) A is poor and B is not poor, (3) Both A and B are not poor, (4) A is approximately 2 times poorer than B, (5) A is approximately 3 times poorer than B, (6) A is approximately 4 times poorer than B, and (7) A is approximately 9 times poorer than B. All amounts were expressed in local currency units as described in Section 3.

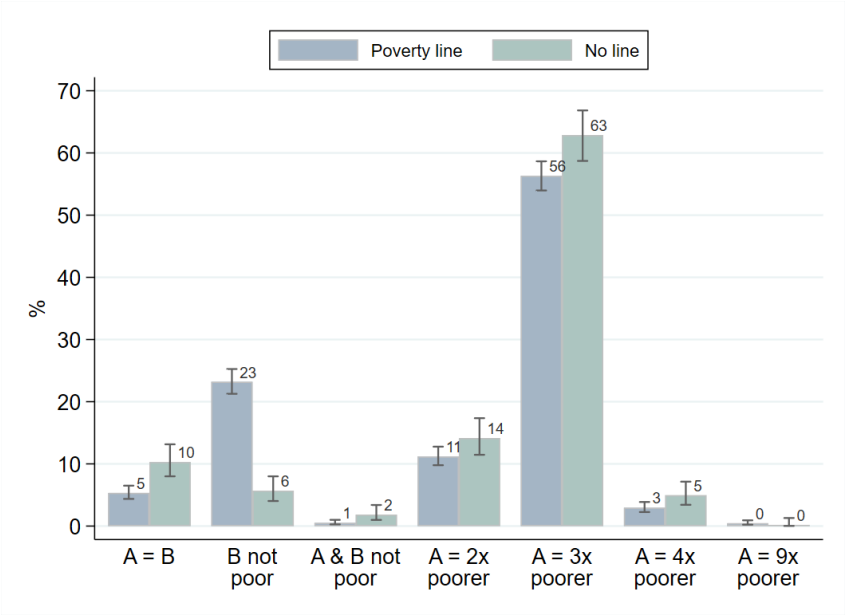
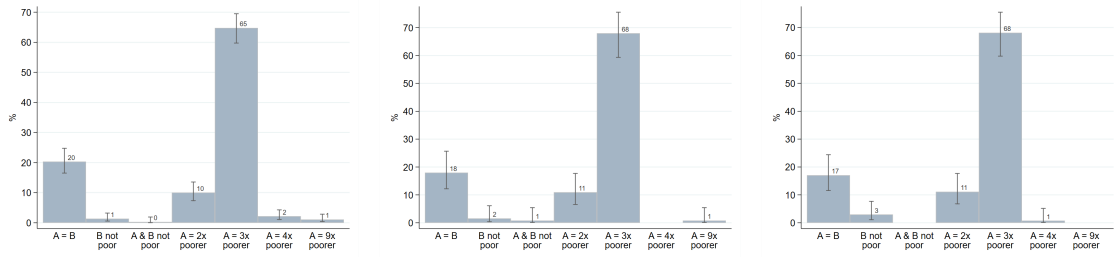


Figure A.5: Survey results: views on poverty, with and without information on the poverty line (Question 1.c)

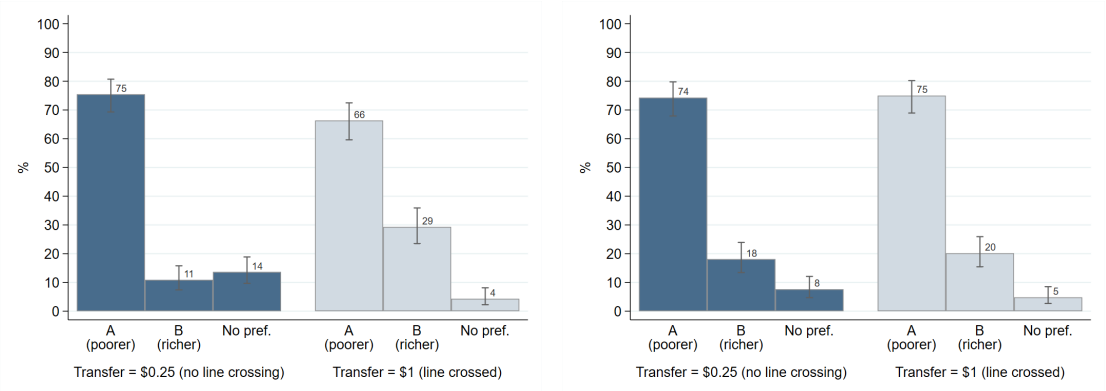
Data source: survey data, with participants from Kenya (N=569), India (N=581), South Africa (N=629) and the US (N=489). For about three quarter of participants, the question was: *"The World Bank determined that it is impossible for a person or family to meet basic needs below an income of $2.5 a day per person. A earns $1 and B earns $3 per day. Which statement is consistent with how you think about poverty."* For a quarter of the sample, the first sentence did not include the reference to the level of the poverty line: *"The World Bank has determined that it is impossible for a person to meet their basic needs if they have an income below a certain level."*. Possible answers, whose order was randomized, are: (1) A and B are equally poor, (2) A is poor and B is not poor, (3) Both A and B are not poor, (4) A is approximately 2 times poorer than B, (5) A is approximately 3 times poorer than B, (6) A is approximately 4 times poorer than B, and (7) A is approximately 9 times poorer than B. All amounts were expressed in local currency units as described in Section 3.



(a) Benchmark amounts (b) Amounts multiplied by 10 (c) Amounts multiplied by 20

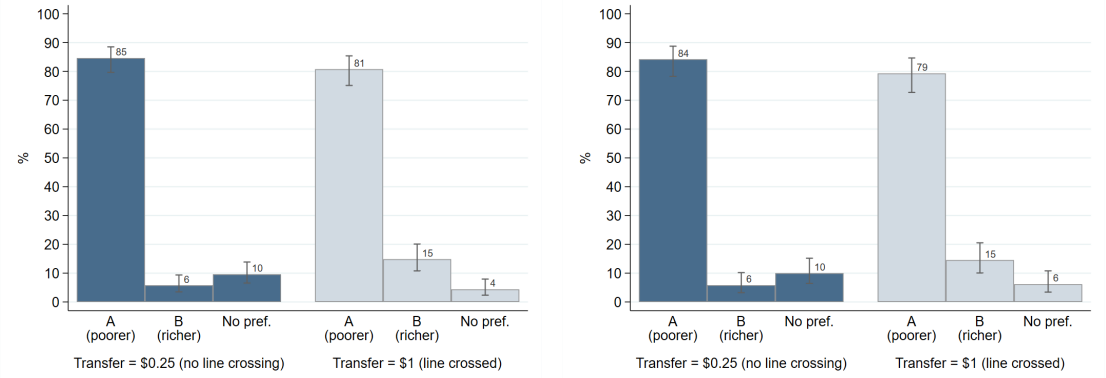
Figure A.6: Survey results: views on poverty in the US (Question 1.a)

Data source: survey data, with participants from the US. The benchmark question was: *"The World Bank determined that it is impossible for a person or family to meet basic needs below an income of $2.5 a day per person. A earns $0.5 and B earns $1.5 per day. Which statement is consistent with how you think about poverty."* For some randomly selected participants, all amounts were multiplied by 10 or 20. Possible answers, whose order was randomized, are: (1) A and B are equally poor, (2) A is poor and B is not poor, (3) Both A and B are not poor, (4) A is approximately 2 times poorer than B, (5) A is approximately 3 times poorer than B, (6) A is approximately 4 times poorer than B, and (7) A is approximately 9 times poorer than B. All amounts were expressed in local currency units as described in Section 3.



(a) Kenya

(b) India

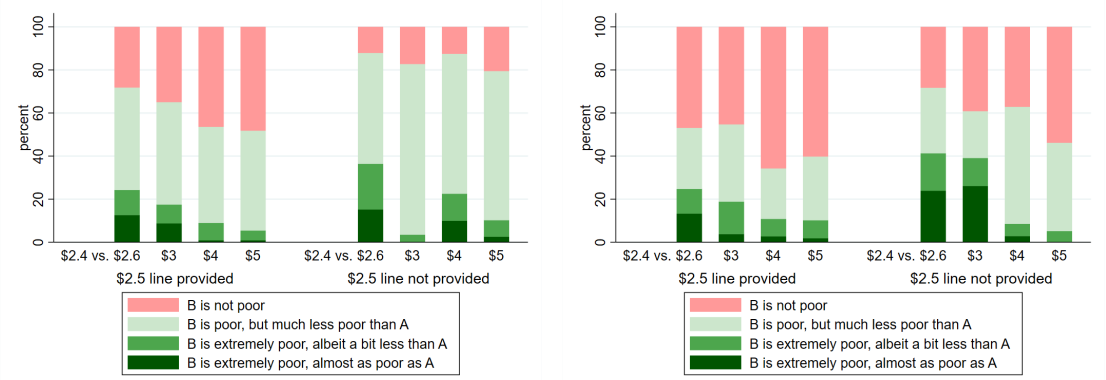


(c) South Africa

(d) US

Figure A.7: Survey results: allocation of resources

Data source: survey data, with participants from Kenya (N=428), India (N=438), South Africa (N=489) and the US (N=369). Participants who did not get information on the level of the poverty line are excluded. The question was: *"An individual A earns $1 per day while individual B earns $2 per day. You have the possibility to increase the income of one of these two individuals by $X per day. To which individual do you give the money to reduce poverty?"* The amount X was randomly assigned as 0.25 or 1. Possible answers, whose order was randomized, are: (1) Individual A, (2) Individual B, (3) I have no preference. All amounts were expressed in local currency units as described in Section 3.



(a) Kenya

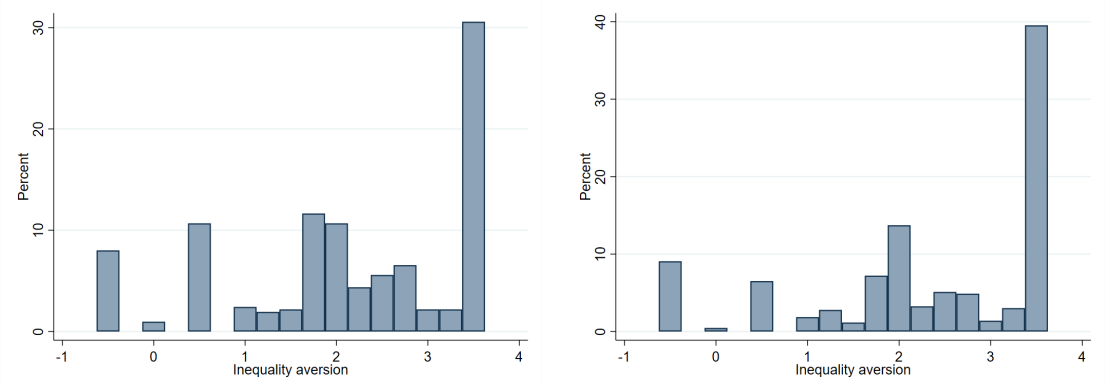
(b) India

(c) South Africa

(d) US

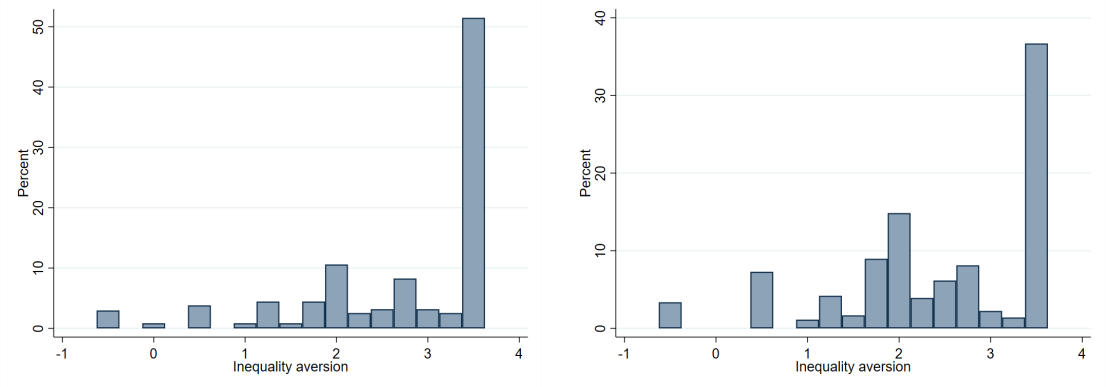
Figure A.8: Qualitative comparisons of individual A who is just below the poverty line and B who is above the poverty line, by country

Data source: survey data, with participants from Kenya (N=569), India (N=581), South Africa (N=629) and the US (N=489). The question was: *"The World Bank has determined that it is impossible for a person to meet their basic needs if they have an income below $2.5 per day per person. Individual A earns $2.4 per day while individual B earns $X per day. Which statement is consistent with how you think about poverty?"* The amount X was randomly assigned as 2.6, 3, 4, or 5. About a quarter of the sample did not get information about the level of the poverty line. Possible answers, whose order was randomized, are: (1) B is extremely poor, almost as poor as A, (2) B is extremely poor, albeit a bit less than A, (3) B is poor, but much less poor than A, (4) B is not poor. All amounts were expressed in local currency units as described in Section 3.



(a) Kenya

(b) India



(c) South Africa

(d) US

Figure A.9: Survey results: inequality aversion, by country

Data source: survey data, with participants from Kenya (N=412), India (N=430), South Africa (N=472) and the US (N=357). The figures focus on participants assigned to the benchmark phrasing of the question Q3 as described in Table A.1. The parameters of the question are described in Table A.2. Figure A.1 shows the different pathways that participants could follow depending on their answers. Respondents who were indifferent in all questions are excluded.

C Robustness checks

Table A.3: Robustness tests for question 1

	Question 1.a =1 if answer is A = 3x poorer		Question 1.b =1 if answer is A = 2x poorer		Question 1.c =1 if answer is A = 3x poorer	
	(1)	(2)	(3)	(4)	(5)	(6)
Age	-0.0000868	-0.0000752	-0.000110	-0.000108	0.0000891	0.0000908
	(0.000115)	(0.000115)	(0.000111)	(0.000111)	(0.000115)	(0.000115)
Female	-0.0814***	-0.0819***	-0.0573***	-0.0574***	-0.0846***	-0.0847***
	(0.0214)	(0.0214)	(0.0207)	(0.0207)	(0.0215)	(0.0214)
Education years	0.00643	0.00660	0.00506	0.00521	-0.00389	-0.00328
	(0.00751)	(0.00750)	(0.00726)	(0.00726)	(0.00754)	(0.00751)
Household size	-0.0103	-0.00992	-0.00315	-0.00291	-0.00931	-0.00874
	(0.00677)	(0.00677)	(0.00655)	(0.00655)	(0.00680)	(0.00678)
Income (log+1)	0.0102	0.0103	0.000692	0.000593	0.00193	0.00143
	(0.00688)	(0.00688)	(0.00665)	(0.00666)	(0.00691)	(0.00689)
Survey duration (log)	0.00646	0.00893	-0.00530	-0.00399	-0.00128	0.00325
	(0.0202)	(0.0202)	(0.0195)	(0.0196)	(0.0203)	(0.0203)
Random order answers (d2)		0.0268		0.0200		0.0854***
		(0.0256)		(0.0248)		(0.0256)
Random order answers (d3)		-0.0133		0.0119		0.0630**
		(0.0253)		(0.0245)		(0.0254)
No poverty line		0.0517**		0.0257		0.0641***
		(0.0241)		(0.0233)		(0.0241)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2262	2262	2262	2262	2262	2262
R^2	0.042	0.045	0.070	0.071	0.012	0.020

Data source: survey data, with participants from Kenya (N=569), India (N=581), South Africa (N=629) and the US (N=489). Question 1 is *""The World Bank determined that it is impossible for a person or family to meet basic needs below an income of $2.5 a day per person. A earns $X and B earns $Y per day. Which statement is consistent with how you think about poverty."*. Possible answers were: (1) A and B are equally poor, (2) A is poor and B is not poor, (3) Both A and B are not poor, (4) A is approximately 2 times poorer than B, (5) A is approximately 3 times poorer than B, (6) A is approximately 4 times poorer than B, and (7) A is approximately 9 times poorer than B. In Columns (1) and (2), $X = 0.5$ and $Y = 1.5$ and the dependent variable is a dummy equal to 1 if the participant selected the answer (5). In Columns (3) and (4), $X = 1$ and $Y = 2$ and the dependent variable is a dummy equal to 1 if the participant selected the answer (4). In Columns (5) and (6), $X = 1$ and $Y = 3$ and the dependent variable is a dummy equal to 1 if the participant selected the answer (5). Three different orderings of answers were randomly assigned: [1,2,3,4,5,6,7], [4,5,6,7,1,2,3], and [1,4,5,6,7,2,3]. The second ordering is identified by the binary variable "Random order answers (d2)". The third ordering is identified by the binary variable "Random order answers (d3)". For a quarter of participants (randomly selected), the introductory sentence did not include information on the level of the poverty line: *"The World Bank has determined that it is impossible for a person to meet their basic needs if they have an income below a certain level."*. These respondents are identified using the dummy variable *"No poverty line"*. Country fixed effects are included in all regressions. Standard errors in parentheses. Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.4: Impact of possibility to push B above the poverty line z in Questions 2 and 3

	Dependent variable = 1 if gives to B (richest)			
	General public		Experts	
	(1)	(2)	(3)	(4)
B can cross z	0.0732***	0.0238	0.170***	0.0741
	(0.0139)	(0.0157)	(0.0434)	(0.0469)
# Answers consistent with headcount	0.0407***	0.0142**	0.0658***	0.00579
	(0.00508)	(0.00650)	(0.0159)	(0.0212)
Interaction		0.0562***		0.125***
		(0.0101)		(0.0312)
Observations	6896	6896	678	678
R^2	0.171	0.175	0.216	0.235

Data source: survey data, focusing on participants who were informed about the level of the poverty line. I use data from Questions 2 and 3, which are described in Table A.1. One observation corresponds to one answer provided by a participant. The dependent variable is equal to 1 if the participant decides to allocate the money to B (the richest individual). The variable *"B can cross z"* identify questions for which the respondent had the possibility to push B above the poverty line z (see Table A.2). The variable *"# Answers consistent with headcount"* counts the number of answers to (Q1) that are consistent with the headcount view of poverty (Q1.a=1, Q1.b=1, Q1.c=2). The variable "Interaction" is an interaction term between these two variables. In all regressions, I include fixed effects identifying questions with similar underlying ϵ and I control for the leakage rate and a dummy identifying questions for which the respondent could not fully close the income gap by giving money to A. Standard errors in parentheses. Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.5: Robustness tests for questions 2, 3, and 4

	Question 2 =1 if answer is Individual A		Question 3 Inequality aversion (θ)		Question 4 =1 if answer is B is not poor	
	(1)	(2)	(3)	(4)	(5)	(6)
Age	-0.0000248	-0.0000219	0.000307	0.000323	0.0000140	-0.00000657
	(0.0000940)	(0.0000936)	(0.000273)	(0.000272)	(0.000114)	(0.000112)
Female	0.0321*	0.0312*	0.0339	0.0361	0.0157	0.0165
	(0.0175)	(0.0174)	(0.0516)	(0.0514)	(0.0212)	(0.0208)
Education years	-0.0112*	-0.0109*	-0.0410**	-0.0408**	0.00228	0.00203
	(0.00614)	(0.00611)	(0.0180)	(0.0179)	(0.00744)	(0.00730)
Household size	-0.00271	-0.00172	-0.00573	-0.00313	0.0109	0.00859
	(0.00554)	(0.00552)	(0.0163)	(0.0163)	(0.00671)	(0.00659)
Income (log+1)	0.00311	0.00260	-0.0194	-0.0196	0.00994	0.0102
	(0.00563)	(0.00560)	(0.0166)	(0.0165)	(0.00682)	(0.00669)
Survey duration (log)	0.0181	0.0203	0.00351	0.00772	0.0499**	0.0455**
	(0.0165)	(0.0165)	(0.0489)	(0.0487)	(0.0200)	(0.0197)
Random order answers (d1)		0.0168		-0.0683		-0.0138
		(0.0167)		(0.0494)		(0.0200)
No poverty line		0.0872***		0.265***		-0.217***
		(0.0196)		(0.0579)		(0.0234)
Cross poverty line		-0.0313*				
		(0.0168)				
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2262	2262	2193	2193	2262	2262
R^2	0.015	0.026	0.029	0.039	0.028	0.064

Data source: survey data. Questions 2, 3, and 4 are defined in Table A.1. In Columns (1) and (2), the dependent variable is a dummy equal to 1 if the participant selected the answer *"Individual A"*. Participants who were randomly assigned to the amount \$1 are identified using the dummy variable *" Cross poverty line"*. In Columns (3) and (4), the dependent variable is the measure of inequality aversion introduced in Section 4.4. In Columns (5) and (6), the dependent variable is a dummy equal to 1 if the participant reported that the individual above the poverty line, B, is not poor. In all questions, for a quarter of participants (randomly selected), the introductory sentence did not include information on the level of the poverty line: *"The World Bank has determined that it is impossible for a person to meet their basic needs if they have an income below a certain level."*. These respondents are identified using the dummy variable *"No poverty line"*. The order of answers was randomized, with two possible orderings for each question (identified by the binary variable "Random order answers (d1)"). Country fixed effects are included in all regressions. Standard errors in parentheses. Significance levels are indicated by * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.