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HOW DO EUROPEANS EVALUATE INCOME DISTRIBUTIONS? AN ASSESSMENT BASED ON HAPPINESS SURVEYS

BY UDO EBERT* AND HEINZ WELSCH

University of Oldenburg, Germany

The purpose of this paper is to measure the evaluation of income inequality by European citizens. Starting from the concept of a social welfare function defined on income distributions the paper estimates the degree and nature of inequality aversion of Europeans. It uses subjective well-being (SWB) as an empirical measure of welfare and estimates how SWB is related to average income and measures of income inequality (from an appropriate class). The estimated relationship is used to determine those inequality measures which qualify as proper representations of people's inequality aversion.

1. INTRODUCTION

Starting with Gini (1914), the literature on economic inequality has proposed a variety of inequality measures and characterized these measures in terms of their normative properties (see Foster, 1985; Kolm, 1999; Chakravarty, 1999; and Cowell, 2000 for surveys). In practice, measures like the Gini or Atkinson indices are widely used in studies comparing income inequality across countries and over time (see, e.g. OECD, 1995). Such studies often employ several measures at a time, which differ in terms of their implied degree of inequality aversion. This pluralistic approach reflects a prevailing uncertainty as to the proper evaluation of income distributions.

The present paper aims to shed some light on this issue. Our maintained hypothesis is that an inequality measure should reflect the evaluation of income inequality by the citizens. The purpose of the paper is to identify this evaluation. Specifically, we seek to estimate the degree and nature of inequality aversion of Europeans. By considering a representative sample of about 60,000 citizens in 10 European countries, 1978–97, the paper identifies those inequality measures (from a given class of measures) which reflect people's evaluation of the distribution of income most accurately. This may inform the selection of inequality measures to be employed in cross-section or time series studies of European income inequality.

Our approach is based on insights from the theoretical and empirical literature on the measurement of social welfare. Using data on reported subjective well-being (SWB) and relating them to income data we estimate a typical European citizen's welfare function over income distributions. In order to make its estimation operational we have to put some structure on the problem: we utilize the fact that social welfare can be decomposed into an efficiency aspect (level of incomes) and a distributional aspect (inequality of incomes). From this (theoreti-

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*Correspondence to: Udo Ebert, Department of Economics, University of Oldenburg, D-26111 Oldenburg, Germany (ebert@uni-oldenburg.de).

cal) perspective, social welfare can be represented as a function of average income and the inequality of the distribution considered. By using the decomposability of welfare and by choosing an inequality measure (from a given class) and some functional form, we are able to establish an (empirical) social welfare function.

This exercise can in principle be done for any inequality measure. Since alternative measures represent different degrees of inequality aversion, the above procedure does not *per se* allow us to identify citizens' inequality aversion. In order to achieve this, we postulate that a proper inequality measure must be representative for the underlying social welfare function. Therefore, it has to be identical with the measure implicitly implied by the estimated social welfare function. Such a measure is called self-consistent with respect to the welfare function to be determined. Self-consistency permits discrimination between various inequality measures. In the empirical welfare function considered, it manifests itself as a relationship between the coefficients on average income and the respective inequality measure. Coefficient estimates therefore allow us to identify those measures that are consistent with people's view of inequality. In addition to self-consistency, as a theoretical requirement, we will request that admissible inequality measures be statistically significant. Having identified these measures, people's inherent inequality aversion can be investigated.

In our analysis we consider the needs-adjusted income distribution and examine its average and inequality. In order to adjust the income distribution for different needs each household is assigned its equivalent income (the living standard of a representative household member) and a weight representing its size. The equivalent income is household income divided by an equivalence scale. As weight we use the number of household members.

Employing SWB as a standard for evaluating income distribution is based on a "neo-utilitarian" view of social welfare (see Kahneman *et al.*, 1997). In this view, SWB is taken as a proxy of individual utility, and the average relationship between SWB and different economic conditions—e.g. inequality—is interpreted as a welfare function on which to base the social evaluation of those conditions (see Kahneman and Sugden, 2005). This approach to applied welfare analysis is increasingly adopted in the economics literature (see Frey and Stutzer, 2002; Bruni and Porta, 2005) and is underlying our empirical investigation. The role of the SWB indicator in this approach is entirely instrumental.

Our paper adds to recent empirical literature using data on SWB to explore the evaluation of income distributions. Alesina *et al.* (2004) provide an econometric study of the relationship between SWB of a large set of survey respondents and the Gini coefficient in several European countries and U.S. states. They find larger regression coefficients in their European than in their U.S. sample, which they take to suggest pronounced differences in the respective degree of inequality aversion.

Unlike that paper we address the efficiency and distributional aspects of welfare *jointly* within a unified theoretical and empirical framework. Furthermore, we systematically examine an entire class of inequality measures (being a generalization of Atkinson and Gini measures). Our framework allows us to identify those measures from the Atkinson and Gini class that are proper representations of an underlying welfare function and to investigate European people's view of inequality and their inequality aversion.

In our empirical analysis we find that the self-consistent inequality measures incorporate strong inequality aversion. The Gini measures which we find to be self-consistent indicate that people's evaluation of income distributions focuses more on lower than on higher incomes. Moreover, we find that, in addition to the level of income, their ranking is an indispensable factor in people's evaluation of income distributions. At a more general level, our findings suggest that European citizens dislike inequality more strongly than is implied by the Gini coefficient (used by Alesina *et al.*, 2004) and other frequently employed measures of inequality. Studies of inequality which use common measures may thus inadequately reflect European citizens' inequality aversion.

The paper is structured as follows. In Section 2 we set up our theoretical framework. In Section 3 we discuss our empirical data and approach, and in Section 4 we present our results. Section 5 concludes.

2. Theoretical Foundation

In this section we introduce the basic concepts and lay the theoretical foundation for the empirical investigation. In particular we define the property of self-consistency of an inequality measure which will below allow us to identify the set of measures which are proper representations of the individuals' view of inequality. For simplicity we will refer to these measures as proper inequality measures.

Proper Inequality Measures

Since self-consistency is fundamental for the analysis we already now briefly describe its function more precisely. We assume that a typical individual possesses a social welfare function W for an evaluation of income vectors X. It is well known (cf. e.g. Ebert, 1987) that—given some regularity conditions—social welfare $W(X)$ can be represented equivalently by an abbreviated welfare function $V(\mu(X), E(X))$, where μ denotes the average income and E an (implied) ethical equality[1] measure which—given V—is representative for W. This representation highlights two components of welfare: efficiency and distribution. The first reflects the level (average income) and the second the inequality of income (equality measure). V describes the trade-off between the two components inherent in X. Therefore the original income distribution X can be replaced by $\mu(X)$ and $E(X)$: these indicators give—in connection with V—the same information as W and X.

This equivalence is helpful and can be exploited when the empirical estimation is considered: we suppose that an individual's social welfare is represented by $V(\mu(X), \hat{E}(X))$, where V belongs to a class of functions V and $\hat{E}$ is an element from a class E of equality measures. For estimating V some specific $\hat{E} \in$ E is chosen a priori, without knowing whether it reflects the individuals' view on inequality, i.e. whether it is representative for the underlying social welfare function W. Some measure $\hat{E}$ is representative for a welfare function W *only* if $\hat{E}$ and the equality

[1]It is obvious that it does not matter whether one uses an inequality measure I or a corresponding equality measure E. Then the inequality aversion incorporated in I corresponds to the equality preference inherent in E.

measure E implied by W (see above) are identical. If this is the case, $\hat{E}$ is called self-consistent with respect to V. The property of self-consistency defines a subclass Ê of E given V. The individuals' view on inequality can then be identified by investigating the proper (in)equality measures belonging to Ê.

Welfare and Inequality

Now we consider the details: we consider a population consisting of $n \geq 3$ individuals. They are indexed arbitrarily by a number i ($1 \leq i \leq n$). Individual i has income $X_i > 0$. Therefore the set of feasible income distributions $X = (X_1, \ldots, X_n)$ is given by $\mathbb{R}^n_{++}$. Let $X\downarrow = (X_{[1]}, \ldots, X_{[n]})$ be the ordered vector X, i.e. $X\downarrow$ is a permutation of X and we have $X_{[i]} \geq X_{[i+1]}$ for $i = 1, \ldots, n-1$. The vector consisting of n ones is abbreviated by $\mathbf{1}$, and $\mu(X) = \Sigma_i X_i / n$ denotes the average income.

We want to compare income distributions $X, Y \in \mathbb{R}^n_{++}$ in terms of social welfare. Therefore we introduce a social welfare ordering $\succsim_W$ defined on $\mathbb{R}^n_{++}$ which satisfies the property (RW), i.e. it is continuous, increasing along rays, anonymous, equity-preferring, and homothetic.[2] Any function $W: \mathbb{R}^n_{++} \to \mathbb{R}$ representing the welfare ordering is called a welfare function, which is an ordinal concept. A particular welfare function is the equally-distributed-equivalent income (EDEI) $\xi(X)$. It denotes the level of income which—if enjoyed by each individual—yields the same level of welfare as X. Given the property (RW) the EDEI is continuous, increasing along rays, anonymous, equity-preferring, and linearly homogeneous.

Every welfare ordering allows us to define an ethical inequality (AKS) measure[3] I_{AKS} by $I_{AKS}(X) := (\mu(X) - \xi(X))/\mu(X)$. It represents the welfare loss due to inequality and is equal to the share of total income which is not necessary to attain the level of welfare implied by X. It is a cardinal concept. In the paper we will use the corresponding equality measure E_{AKS} defined by $E_{AKS}(X) := 1 - I_{AKS}(X) = \xi(X)/\mu(X)$ with $0 \leq E_{AKS}(X) \leq 1$.

Any welfare function $W(X)$ representing $\succsim_W$ is an ordinal transform of $\xi(X)$. Therefore there exists a strictly increasing function f such that

$$(1) \qquad W(X) = f(\xi(X)) = f\left(\mu(X)\left(\frac{\xi(X)}{\mu(X)}\right)\right) =: V(\mu(X), E_{AKS}(X)).$$

We call $V(\mu, E)$ an abbreviated welfare function which expresses welfare as a function of average income and the degree of equality. The function V is increasing in both arguments.

This proceeding can always be reversed: for a given equality measure E and an arbitrary function $V(\mu, E)$ a corresponding welfare function (ordering $\succsim_W$) can be derived. Using V and E, a representation of $\succsim_W$ is defined by the welfare function $V(\mu(X), E(X))$. If E is continuous, anonymous, equity-preferring and a relative measure ($E(\lambda X) = E(X)$) and if V is increasing in both arguments, the resulting

[2]Homotheticity is necessary in order to obtain relative inequality measures and to make the evaluation independent of the choice of currency.

[3]This definition goes back to Atkinson (1970), Kolm (1969) and Sen (1973).

welfare ordering possesses the properties (RW). But in general the equality measure E will not be the AKS measure derived from the ordering $\succsim_W$. Therefore we introduce the following concept:

Definition: *An equality measure E is self-consistent for $V(\mu(X), E(X))$ if it coincides with the AKS measure implied by V.*

A self-consistent measure is a measure which is equal to the E_{AKS} measure implied by the social welfare function it generates (by means of the function V). Self-consistency ensures that the equality preference implicit in a given equality measure is identical with the equality preference of the associated welfare ordering. This property restricts the set of admissible abbreviated welfare functions:

Lemma: *E with $E(\mathbf{1}) = 1$ is self-consistent for $V(\mu(X), E(X))$ if and only if $V(\mu, E) = f(\mu E)$ where f is strictly increasing.*

Proof: Let E be self-consistent. Then:

$$V(\mu(X), E(X)) = f(\mu(X) E_{AKS}(X)) = f(\mu(X) E(X))$$

for a strictly increasing function f (see the discussion above).

Conversely $V(\mu, E) = f(\mu E)$ implies that $f(\mu(X)E(X)) = g(\mu(X)E_{AKS}(X))$ for an increasing function g. Therefore

$$f(\mu(X)) = g\left(\mu(X)\frac{E_{AKS}(X)}{E(X)}\right)$$

which yields that $E_{AKS} = E$ since E_{AKS} / E = constant and $E_{AKS}(\mathbf{1}) = E(\mathbf{1}) = 1$. □

Class of (In)Equality Measures

Next we have to define the class of feasible equality measures which will be used below in the empirical investigation. We will employ ethical measures. In order to obtain relative inequality measures we introduce a class of welfare functions comprising the Atkinson and Gini family as special subclasses (Ebert, 1988; see also Araar and Duclos, 2003). The underlying welfare orderings can be represented by a welfare function (EDEI)

$$(2) \qquad \xi_{\delta,\varepsilon}(X) = \begin{cases} \left(\sum_{i=1}^{n} w_i(\delta) X_{[i]}^{1-\varepsilon}\right)^{1/(1-\varepsilon)} & \text{for } \varepsilon \geq 0, \quad \varepsilon \neq 1 \\ \prod_{i=1}^{n} X_{[i]}^{w_i(\delta)} & \text{for } \varepsilon = 1 \end{cases}$$

where

$$(3) \qquad w_i(\delta) = (i/n)^{\delta} - ((i-1)/n)^{\delta} \quad \text{and} \quad \delta \geq 1, \quad \varepsilon \geq 0, \quad \delta + \varepsilon > 1.$$

We obtain the Atkinson family for $\delta = 1$ and $\varepsilon > 0$, the Gini family[4] for $\delta > 1$ and $\varepsilon = 0$ (see also Donaldson and Weymark, 1980; Kakwani, 1980) and hybrid functions for $\delta > 1$ and $\varepsilon > 0$. The (conventional) Gini coefficient is implied by $\xi_{\delta,\varepsilon}(X)$ for $\delta = 2$ and $\varepsilon = 0$.

Equality preference (or inequality aversion) is increasing with δ and ε. For the Atkinson family only the levels of income are relevant. For the Gini family and for hybrid welfare functions both the levels and rankings of incomes are taken into account. The welfare functions with $\delta = 2$ provide an interesting reference case: The difference between two neighbored weights is always the same. If $1 < \delta < 2$ the differences are decreasing, if $\delta > 2$ they are increasing in the rank i. Thus, compared to the case $\delta = 2$, more emphasis is placed on higher incomes if $1 < \delta < 2$ and on lower incomes if $\delta > 2$: an increase in δ increases the weights attached to the lower end and decreases the weight put on the higher end of the income distribution in the social welfare function and the equality measure.[5]

Households

Finally—in view of the empirical application—we have to discuss that the individuals may form households of different size. Let h be the number of individuals belonging to a household and N be the number of households. Then a household i can be described by its income X_i and its size h_i. Thus X_i is no longer an individual's, but household i's income. Therefore the size of households and the differing needs have to be taken into account when evaluating the income distribution. This is achieved by employing equivalence scales $m(h_i)$ and type-specific weights $w(h_i)$ with $m(1) = w(1) = 1$. The equivalence scale $m(h_i)$ represents the needs of a household with h_i individuals. It allows us to define the equivalent income $X_i^* = X_i/m(h_i)$ which is equal to the income a one-person household needs in order to be as well off as each person living in a household with h_i individuals and household income X_i. Equivalent income is an indicator of living standard. Therefore the equivalence scale can be interpreted as the number of equivalent adults. The type-specific weights $w(h_i)$ are set equal to the number of household members h_i. We will use the needs-adjusted income distribution described by $X^* = (X_1^*, \ldots, X_N^*)$ and the vector of weights.[6]

Then the form of the EDEI $\xi_{\delta,\varepsilon}(X^*)$ has to be changed[7] accordingly. For a derivation of the equality measures $E_{\delta,\varepsilon}(X^*) = \xi_{\delta,\varepsilon}(X^*)/\mu(X^*)$ for $\delta \geq 1$, $\varepsilon \geq 0$, $\delta + \varepsilon > 1$ we have to employ the corresponding weighted average of equivalent income $\mu(X^*)$. The class E of feasible equality measures comprises the measures $E_{\delta,\varepsilon}$ defined on X^*.

[4]Donaldson and Weymark called them S-Ginis (S = single-parameter generalization of the Gini indices).

[5]This aspect is also discussed by Yitzhaki (1983). He considers the corresponding inequality measures (Gini family) in a continuous framework and proves that they can be interpreted as a weighted integral of the area below the Lorenz curve.

[6]It turns out that the choice of the weights $w(h)$ is relevant for the properties of the corresponding welfare functions and equality measures. For alternative weights and a discussion of this topic, see e.g. Ebert (1997) and Ebert and Moyes (2003).

[7]A characterization of an (even) more general class of welfare orderings with different household types is presented in Ebert (2004).

3. Empirical Framework

The General Approach

Our aim is to determine a welfare ordering over needs-adjusted income distributions X^*, as represented by a welfare function $W(X^*)$. To this end we will use the decomposability of $W(X^*)$ discussed in Section 2 and will estimate the welfare function by means of the associated abbreviated welfare function $V(\mu(X^*), E(X^*))$. This function has to be a member of a class V and will be estimated using several members of the class E which consists of the Atkinson–Gini equality measures characterized by the corresponding parameter configurations (δ, ε). The criterion of self-consistency will be employed as an identifying restriction for selecting those equality measures E and functions $V(\mu, E)$ which together qualify as proper representations of an underlying welfare ordering over income distributions. In addition, we will request that *admissible* equality measures be statistically significant. Though we will not be able to identify one uniquely admissible equality measure, this procedure allows us to rule out measures which do not reflect people's evaluation of income distribution.

As discussed in the introduction, implementation of this approach will use data on subjective well-being (SWB) as an empirical approximation of utility. Utility, however, depends not just on the income distribution, but on a variety of conditions at the individual level and the macroeconomic level. To capture this circumstance, we extend the abbreviated welfare function to include a vector of control variables Z, which comprises sociodemographic characteristics and macroeconomic conditions.

The extended function is stated as follows:

$$U_{ict} = V(\mu_{ct}, E_{ct})G(Z_{ict}), \tag{4}$$

where the subscript ct refers to country c and year t and the subscript ict to individual i in country c and year t. The dependent variable, U_{ict}, is unobserved (latent) utility, taken to be a continuous variable (without cardinal significance). It will be proxied by SWB or life satisfactions, LS_{ict}. The latter is an ordered categorical variable (see below). The association between LS_{ict} and U_{ict} will be established jointly with the functions[8] V and G by using the ordered probit technique (see the discussion of the empirical strategy below). In (4) we separate out heterogeneity of individuals (as captured by Z_{ict}). Therefore, V represents the evaluation of the income distribution by a typical individual, which is our notion of a welfare function over income distributions.

Data

The required variables are derived from data on subjective well-being, income distribution, sociodemographic characteristics, and macroeconomic conditions in 10 European countries, 1978–97. Our choice of countries and years is based on

[8]The multiplicative form is chosen in view of the empirical estimation.

data availability. For each country, between 2 and 5 observations of income distributions are available within this time frame, totaling 35 country-year combinations.[9]

The dependent variable is life satisfaction. The data come from the Eurobarometer Survey Series[10] (2008) in which the following type of question is asked: "On the whole, are you very satisfied, fairly satisfied, not very satisfied or not at all satisfied with the life you lead." The qualitative responses are rated as follows: "very satisfied" = 4, "fairly satisfied" = 3, "not very satisfied" = 2, "not at all satisfied" = 1. Data on life satisfaction or happiness are successfully used in a growing literature in economics.[11]

The explanatory variables are average equivalent income and a corresponding measure of equality. They are based on the distribution of needs-adjusted income X^*. The distribution X^* is derived from the *Luxembourg Income Study* (LIS, 2008). This database contains micro-data on distributions of household income and household size in selected countries and years, taken from national surveys and harmonized by LIS.[12] The basic income concept we use is disposable household income as defined in the LIS dataset. In principle all households surveyed are included. The LIS database is the only appropriate data source for our purposes since it contains micro-data and thus permits computation of any desired equality measure. "Secondary" datasets on income inequality that are frequently used (such as Deininger and Squire, 1996) contain only pre-fabricated observations on Gini coefficients and do not allow computation of other inequality measures.[13]

[9]The countries are Belgium, Denmark, France, (West) Germany, Ireland, Italy, Luxembourg, the Netherlands, Spain, and the U.K. With respect to Germany we deliberately confine ourselves to years prior to the unification to avoid the risk of structural break. Within the overall time frame, 1982 and 1993 have no observations.

[10]The Eurobarometer public opinion surveys are conducted on behalf of the European Commission, DG Press and Communication. Each consists of approximately 1000 face-to-face interviews per Member State of persons aged 15 and over.

[11]Some of the arguments made in the previous literature in favor of using happiness data in economics are as follows (see Frey and Stutzer, 2002). A basic requirement is that the original qualitative response data satisfy conventional quality standards. Whether happiness measures meet this condition has been widely assessed in decades of validation research. In these studies measures of happiness are generally found to have a high scientific standard in terms of internal consistency, reliability and validity, and a high degree of stability over time (Diener *et al.*, 1999). Different happiness measures correlate well with each other and, according to factor analyses, represent a single unitary construct. Happiness responses are correlated with physical reactions that can be thought of as describing true, internal happiness: people reporting to be happy tend to smile more and show lower levels of stress responses (heart rate, blood pressure). They are more frequently described by others as being happy and they are less likely to commit suicide. As concerns the comparability across nations, no indication has been found that cultural or linguistic bias may prevent a comparison of happiness across nations (Veenhoven, 1993; Bolle and Kemp, 2009).

[12]Conclusions on equality rely heavily on the underlying quality and comparability of income data. With respect to general quality, the LIS data satisfy at least the following minimum standards: they are based on household surveys, the population covered is representative of the entire country (or can be adjusted appropriately), and the measure of household income is comprehensive including income from self-employment, property income, and transfers (net of direct taxes and social security contributions). The LIS database allows a comparison of cross-national income distributions in a unified household income database environment created explicitly for this purpose and has been successfully used for comparisons of income distributions in OECD countries (see Buhmann *et al.*, 1988; OECD, 1995). Any remaining differences in the bases used to compute our equality measures are at least partially controlled for by including country dummies in our regressions.

[13]Inequality databases are discussed by Atkinson and Brandolini (2001).

Using the LIS database, we can construct the income distribution X^* which is based on equivalent incomes X_i^* and weights w_i, for $i = 1, \ldots, N$. Firstly, equivalence scale values $m(h)$ have to be chosen ($h = 1, \ldots, n_H$). Following common practice we use the square root of the number of household members (see OECD, 1995, p. 21). Secondly, the weights have to be determined. Here the number of household members is chosen. Furthermore, according to the LIS standard all households with income less than 1 percent of average equivalent income or with income higher than 10 times the median of household income are ignored (top and bottom coding[14]). We then obtain the needs-adjusted income distribution X^* which allows us to compute the average equivalent income $\mu(X^*)$ and any equality measure. The average equivalent incomes derived from the LIS data are nominal figures in national currency. For inclusion in the empirical abbreviated welfare function V we converted them to a common currency (US$ at 1990 price levels) using purchasing power parities from OECD (1998, 2003).

For completeness the class E of equality measures E has to be mentioned again. We suppose that $E_{\delta,\varepsilon}$ is defined by $\mathrm{E} = \{E_{\delta,\varepsilon} | \delta \geq 1, \varepsilon \geq 0, \delta + \varepsilon > 1\}$. Thus the parameters (δ, ε) determine the equality measure precisely, given the functional form of measures belonging to E (the Atkinson–Gini family). For given (δ, ε) the measure $E_{\delta,\varepsilon}(X^*)$ is then calculated. As discussed in Section 2, higher values of δ or ε, respectively, reflect higher equality preference.

In addition to measures of well-being and of income distribution, an array of control variables is used. We employ those variables that are common in the international literature on the correlates of SWB (see, e.g. Frey and Stutzer, 2002). The first category of control variables comprises sociodemographic characteristics of the individual (age, sex, education level, marital status, employment status, size of town). The data come from the Eurobarometer Surveys. The second category comprises indicators of macroeconomic conditions by country and year, namely the unemployment rate and the inflation rate.[15] The data come from *AMECO*, the macroeconomic database of the European Commission (see AMECO, 2009).

Empirical Strategy

In order to estimate the welfare function stated in (4), we must specify the function $V(\mu, E)$. We know from Section 2 that self-consistency requires $V(\mu, E) = f(\mu \cdot E)$ where $f' > 0$. A simple specification which satisfies this requirement is $V(\mu, E) = A \cdot (\mu E)^a$ for $A > 0$ and $a > 0$. In order to be able to *check* for self-consistency, we generalize this formulation to $V(\mu, E) = A \cdot \mu^\alpha E^\beta$ and normalize A to unity. Self-consistency is then equivalent to $\alpha = \beta > 0$, which is easy to check empirically.

We thus specify the function stated in equation (4) as follows:

$$U_{ict} = V(\mu_{ct}, E_{ct})G(Z_{ict}) = \mu_{ct}^{\alpha} E_{ct}^{\beta} \cdot G(Z_{ict}) \tag{5}$$

requiring $G > 0$.

[14]Top and bottom coding is common practice since otherwise results may be disproportionally affected by outliers (cf. e.g. Gottschalk and Smeeding, 1997; Atkinson *et al.*, 2002).

[15]These are the main macroeconomic variables usually included in studies of life satisfaction (e.g. Di Tella *et al.*, 2001; Welsch, 2007).

Taking logarithms, with $u_{ict} = \ln U_{ict}$, $g = \ln G$, we obtain

$$u_{ict} = \alpha \ln \mu_{ct} + \beta \ln E_{ct} + g(Z_{ict}).$$

Finally, we specify

$$g(Z_{ict}) = \sigma_c + \sum_{k=1}^{K} \gamma_k Z_{kict} + \eta_{ict},$$

where σ_c denotes country-fixed effects, Z_{kict} the k-th control variable, and η_{ict} an error term.[16] The country-fixed effects capture, especially, differences in the welfare states and the degree of redistribution.

As discussed above, we use self-reported life satisfaction, LS_{ict}, as an empirical approximation of unobserved (latent) utility U_{ict}. We treat LS_{ict} (not at all satisfied = 1, . . . , very satisfied = 4) as an ordinal variable and estimate the following ordered probit model (with $ls_{ict} = \ln LS_{ict}$):

$$u_{ict} = \alpha \ln \mu_{ct} + \beta \ln E_{ct} + \sigma_c + \sum_{k=1}^{K} \gamma_k Z_{kict} + \eta_{ict} \tag{6a}$$

$$ls_{ict} = l \Leftrightarrow \theta_l \le u_{ict} < \theta_{l+1}, \tag{6b}$$

where l represents the four discrete life satisfaction categories ($l = 1, \ldots, 4$), $\theta_1 = -\infty$, $\theta_5 = +\infty$, and θ_2, θ_3, θ_4 are three estimated threshold values that differentiate the categories from each other. The maximum likelihood method is used to estimate the parameter vector (α, β, $\sigma_1, \ldots, \sigma_{10}$, $\gamma_1, \ldots, \gamma_K$, θ_2, θ_3, θ_4). The number of observations is 59,706.

4. Empirical Results

Some Basic Results

Table 1 presents the estimation results of the ordered probit model (6) for some standard (in)equality measures which are widely used in empirical assessments of income inequality, namely the Gini coefficient and the Atkinson 0.5 and Atkinson 1.0 measures. The goodness of fit is as familiar from microeconomic life satisfaction regressions and practically invariant across all regressions considered (pseudo $R^2 = 0.154$). Therefore, we do not present the goodness of fit in the result tables. Also not shown are the results for the country dummies. They are consistent with the usual findings that the unexplained life satisfaction level is high in Denmark, low in France, Italy, Germany, and Belgium, whereas the other countries take an intermediate position. Except for the country dummies, the table presents the detailed results, including those for the control variables. Comparing these latter results with results from the previous literature provides a general

[16]Note that regardless of the sign of g, the function G in equation (5) will always be positive.

TABLE 1

Results for Selected Inequality Measures

	Gini ($\delta = 2.0$, $\varepsilon = 0.0$)		Atkinson 0.5 ($\delta = 1.0$, $\varepsilon = 0.5$)		Atkinson 1.0 ($\delta = 1.0$, $\varepsilon = 1.0$)	
	Coefficient	Significance	Coefficient	Significance	Coefficient	Significance
Age	–0.023	0.000	–0.023	0.000	–0.023	0.000
Age-squared	0.000	0.000	0.000	0.000	0.000	0.000
Male	Reference group		Reference group		Reference group	
Female	0.068	0.000	0.068	0.000	0.068	0.000
Education 15 years	Reference group		Reference group		Reference group	
Education >15 years	0.131	0.000	0.132	0.000	0.132	0.000
Education >19 years	0.270	0.000	0.273	0.000	0.273	0.000
Still in education	0.239	0.000	0.238	0.000	0.238	0.000
Single	Reference group		Reference group		Reference group	
Married	0.187	0.000	0.186	0.000	0.186	0.000
Living together	0.070	0.006	0.069	0.006	0.068	0.007
Divorced	–0.308	0.000	–0.308	0.000	–0.308	0.000
Separated	–0.399	0.000	–0.399	0.000	–0.401	0.000
Widowed	–0.171	0.000	–0.172	0.000	–0.172	0.000
Employed	Reference group		Reference group		Reference group	
Unemployed	–0.522	0.000	–0.524	0.000	–0.523	0.000
Retired	–0.018	0.346	–0.018	0.345	–0.018	0.335
Housewife	–0.003	0.850	–0.003	0.843	–0.003	0.850
Other occupation	0.071	0.047	0.073	0.042	0.073	0.042
Rural	Reference group		Reference group		Reference group	
Small town	–0.057	0.000	–0.059	0.000	–0.059	0.000
Big town	–0.151	0.000	–0.152	0.000	–0.153	0.000
Unemployment rate	–0.018	0.000	–0.021	0.000	–0.025	0.000
Inflation rate	–0.023	0.000	–0.025	0.000	–0.031	0.000
Average income	0.669	0.000	0.530	0.000	0.389	0.000
Equality measure	3.072	0.000	6.030	0.000	2.782	0.000
Country dummies	Yes		Yes		Yes	

validation check of our approach. Therefore, we start by discussing these results, before addressing the distribution-related variables (average income and equality measures).

With regard to the sociodemographic variables, we find a U-shaped relationship between age and life satisfaction. Females report higher life satisfaction than males. A higher education level is positively associated with life satisfaction, as are marriage or living together. Being divorced, separated or widowed, as well as being unemployed are negatively associated with life satisfaction, as is the size of the town. All of these relationships are highly significant at levels well above 99 percent.[17]

Though the absolute coefficient values have no meaningful interpretation in the ordered probit model, comparing coefficient sizes across variables is meaningful and yields interesting insights. It can be seen that being unemployed is the most important individual-level correlate of life satisfaction (relative to being employed). Other important factors relate to the family status. Especially, the difference in life satisfaction between being married and being divorced is substantial. All of these qualitative and quantitative results are in agreement with the

[17]The columns labeled "significance" show the probability of a coefficient being equal to zero.

pertinent literature (see Frey and Stutzer, 2002 for a survey). In addition, these coefficient estimates are remarkably robust across the regressions considered.

Turning to the macroeconomic variables, we find that the unemployment rate and the inflation rate are negatively and significantly associated with life satisfaction. The coefficient sizes differ across the three regressions. This is consistent with earlier findings according to which the coefficients on these variables are sensitive to which other macroeconomic variables are included or omitted (Welsch, 2007).[18]

Overall, the results concerning our control variables are consistent with earlier literature. They are valid not just for the three regressions shown in Table 1, but for all of our regressions (to be discussed below). This gives us some confidence in the reliability of our approach.

Against this background, we now address the distribution-related variables, that is, the average income and the Gini coefficient, Atkinson 0.5 and Atkinson 1.0 measures. The average income and the respective equality measures have positive and highly significant estimation coefficients. This holds while controlling for unobserved country characteristics. It can be seen that the coefficient on average income varies considerably according to which equality measure is included. It is largest when the Gini coefficient is included, much smaller in the case of the Atkinson 1.0 measure, and in between these values in the case of the Atkinson 0.5 measure.

It can thus be stated that our choice concerning how to measure inequality interferes with the conclusion to be drawn with respect to the evaluation of average income. This finding highlights the importance of exploring the evaluation of income distributions from a comprehensive perspective that integrates the level and the inequality aspects. Turning to the equality measures, the coefficients on the three standard measures differ considerably. Especially, the coefficients on Atkinson 0.5 and Atkinson 1.0 show a tremendous difference. The coefficient on the measure which incorporates less inequality aversion (Atkinson 0.5) is substantially larger than that on the measure which incorporates more inequality aversion (Atkinson 1.0). When we jointly consider average income and equality, we see that the respective coefficients differ to a great extent. The coefficient on equality is always much larger than the coefficient on average income. This finding suggests that the three standard measures—Gini, Atkinson 0.5 and Atkinson 1.0—are not self-consistent, that is, they are not proper representations of an underlying welfare function over income distributions.

In the following, we will investigate which members of the Atkinson–Gini class of (in)equality measures qualify as proper representations of a welfare function and what this implies with respect to European citizens' attitude towards income inequality.

Identifying Proper Inequality Measures

Inequality measures that are proper representations of an underlying welfare function over income distributions have to satisfy the property of self-consistency.

[18]While life satisfaction regressions which exclusively focus on the unemployment–inflation trade-off yield larger coefficients on unemployment than on inflation (Di Tella *et al.*, 2001), controlling for additional macroeconomic variables tends to raise the relative weight on inflation (Welsch, 2007).

TABLE 2
RESULTS FOR GINI INEQUALITY MEASURES ($\varepsilon = 0$)

	δ	2	4	6	8
Unemployment rate	Coefficient	–0.018	–0.019	–0.022	–0.023
	Significance	0.000	0.000	0.000	0.000
Inflation rate	Coefficient	–0.023	–0.021	–0.022	–0.022
	Significance	0.000	0.000	0.000	0.000
Average income (log)	Coefficient	0.669	0.565	0.405	0.376
	Significance	0.000	0.000	0.000	0.000
Equality measure (log)	Coefficient	3.072	1.487	0.529	0.329
	Significance	0.000	0.000	0.001	0.011
Demographic variables		Yes	Yes	Yes	Yes
Country dummies		Yes	Yes	Yes	Yes

Given the specification from equation (6a), self-consistency prevails if the coefficients on the log of average income (α) and on the log of the equality measure (β) are equal. In the preceding paragraphs it was found that the conventionally used inequality measures (from the Atkinson–Gini class) fail to satisfy this requirement.

We now check the self-consistency condition for other Atkinson–Gini measures. We start by considering "pure" Gini measures, i.e. those for which $\varepsilon = 0$ and which differ by the parameter δ. Table 2 presents the results for several choices of δ. For comparison purposes, the table reproduces the result for $\delta = 2$ discussed above.[19] When δ is increased, both coefficients α and β decrease, but α decreases much more slowly than does β. As a result, the relationship $\alpha < \beta$ observed for $\delta = 2$ is preserved for $\delta = 4$ and $\delta = 6$, but is reversed for $\delta = 8$. Given the apparent monotonicity of the α/β ratio, it can be expected that self-consistency arises for δ between 6 and 8.

These latter values for δ represent a fairly large degree of inequality aversion. It may also be noted that, though the equality measure is significant for all considered values of δ, the level of significance slightly deteriorates as δ increases. Furthermore, the choice of the equality measure affects the coefficients for the unemployment and inflation rates. An increase in δ implies that the estimated importance of unemployment relative to inflation rises. An under-rating of people's inequality aversion—as represented especially by the case $\delta = 2$—thus seems to imply an under-rating of the effect of unemployment on life satisfaction.

In a similar way, Table 3 presents results for "pure" Atkinson measures (for which $\delta = 1$ and which differ by the parameter ε). Similar to the increase of δ in the case of the pure Gini measures, an increase of ε implies that both coefficients α and β decrease, where α, again, decreases more slowly than β. As a result, we find the relationship $\alpha < \beta$ for $\varepsilon = 0.5$ and $\varepsilon = 1.0$, but it is reversed in the case $\varepsilon = 1.5$. It can, therefore, be expected that self-consistency arises for ε between 1.0 and 1.5.

Similar to the case of the pure Gini measures, self-consistent pure Atkinson measures seem to incorporate a fairly large degree of inequality aversion. In addition, the Atkinson 1.5 measure is insignificant by all standards. Finally, an

[19]The following tables omit the results for the demographic variables as they are almost unaffected by the choice of the inequality measure.

TABLE 3

Results for Atkinson Inequality Measures ($\delta = 1$)

	ε	0.5	1.0	1.5
Unemployment rate	Coefficient	–0.021	–0.025	–0.024
	Significance	0.000	0.000	0.000
Inflation rate	Coefficient	–0.025	–0.031	–0.022
	Significance	0.000	0.000	0.000
Average income (log)	Coefficient	0.530	0.389	0.326
	Significance	0.000	0.000	0.000
Equality measure (log)	Coefficient	6.030	2.782	0.096
	Significance	0.000	0.000	0.563
Demographic variables		Yes	Yes	Yes
Country dummies		Yes	Yes	Yes

TABLE 4

Characterization of Parameters Implying Self-Consistency

	δ	1	2	3	4	5	6	7
	$\underline{\varepsilon}$	1.3	1.1	0.9	0.7	0.5	0.3	0.0
Average income (log)	Coefficient	0.320	0.329	0.345	0.357	0.366	0.374	0.389
	Significance	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Equality measure (log)	Coefficient	0.358	0.457	0.419	0.397	0.380	0.374	0.414
	Significance	0.165	0.014	0.011	0.009	0.009	0.008	0.003
	$\overline{\varepsilon}$	1.4	1.2	1.0	0.8	0.6	0.4	0.1
Average income (log)	Coefficient	0.321	0.320	0.333	0.345	0.355	0.364	0.379
	Significance	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Equality measure (log)	Coefficient	0.202	0.310	0.312	0.313	0.313	0.318	0.368
	Significance	0.331	0.057	0.036	0.027	0.023	0.018	0.007

increase in ε raises the estimated importance of unemployment relative to inflation, similar to an increase in δ.

Up to this point, we have established a systematic monotonically increasing relationship between the α/β ratio and the degree of inequality aversion, for both the pure Gini and pure Atkinson measures. Moreover, we found that inequality measures which qualify as proper representations of an underlying welfare function of European citizens imply a larger degree of inequality aversion than the usually employed standard measures. We now want to identify proper inequality measures more accurately. In doing so, we do not confine ourselves to pure Gini or Atkinson measures, but consider hybrid measures ($\delta > 1$ and $\varepsilon > 0$) in addition. Table 4 presents several (δ,ε)-configurations which imply self-consistency. The first column shows that for $\delta = 1$ (i.e. in the case of pure Atkinson measures), self-consistency can be expected to arise for ε between $\underline{\varepsilon} = 1.3$ and $\overline{\varepsilon} = 1.4$. However, the inequality measures are insignificant in these cases. When $\delta = 2$, self-consistency occurs for ε between $\underline{\varepsilon} = 1.1$ and $\overline{\varepsilon} = 1.2$, and the respective inequality measures are (at least weakly) significant. For $\delta = 3$, we find $\underline{\varepsilon} = 0.9$ and $\overline{\varepsilon} = 1.0$, with inequality measures being significant. When δ is increased further, the values of ε that are required for self-consistency fall. For $\delta = 7$, the required value of ε is close to zero. The coefficients are always significant whenever $\delta > 3$.

Inequality Aversion of European Citizens

We can conclude that, with increasing values of δ, lower values of ε are required to assure self-consistency. Inequality aversion with respect to the ranking of incomes (δ) and with respect to the level of incomes (ε) thus seem to act as "substitutes" in the evaluation of income distribution.

Our criteria for admissibility (self-consistency and significance) do not allow us to identify uniquely which configuration of these two "types" of inequality aversion characterizes European citizens' evaluation most adequately. However, measures incorporating low aversion towards "rank inequality" are self-consistent only when the implied aversion towards "level inequality" is large. These measures were found to be insignificant, probably because they reflect the prevailing aversion towards "rank inequality" in an insufficient way. Our results, therefore, suggest that pure Atkinson measures ($\delta = 1$) fail to represent the evaluation of income distributions prevailing in Europe. On the other hand, measures which entirely neglect aversion towards "level inequality" ($\varepsilon = 0$) must incorporate a very high degree of aversion towards "rank inequality" ($\delta \approx 7$) to qualify as self-consistent. Such measures focus more on lower than on higher incomes. Our results suggest that *both* types of inequality aversion seem to play a role in European people's evaluation of income distributions. With regard to the overall degree of inequality aversion, it seems to be larger than implied by any of the usually employed inequality measures.

5. Conclusions

Comparisons of income distributions across countries and over time have used ethical inequality measures, i.e. measures which are supposed to represent an underlying welfare function over income distributions. Particularly popular in applied work are measures from the Atkinson–Gini class of inequality measures. While pure Atkinson measures focus on the inequality of income levels, Gini measures focus on the ranking of incomes. Both kinds of measures are widely used, but it is unclear which measure is a proper representation of people's evaluation of income distributions.

This paper has used data on life satisfaction for about 60,000 persons in 10 European countries, 1978–97, to characterize the prevailing inequality aversion among European citizens. The paper has introduced the concept of self-consistency of an inequality measure, a property which ensures that a given measure is a proper representation of an underlying welfare function. Self-consistency has been applied as a criterion for identifying inequality measures from the Atkinson–Gini class which qualify as being such representations.

We found that the conventional inequality measures (the Gini coefficient, Atkinson 0.5 and Atkinson 1.0 measures) do not properly reflect European citizens' evaluation of income distributions. Proper inequality measures are more inequality averse than these standard measures. Both the ranks and levels of income play a role in evaluating distributions. Measures that focus on either ranks or levels are inadequate, and the pure Atkinson measures are definitely inadequate, as they fail to reflect the rank aspect.

Our investigation refers to a considerable period of time. Though we cannot rule out the possibility that equality preferences may have changed over the 20 years considered, we believe that this is being controlled for to some extent by our demographic and macroeconomic control variables. In addition, we have no specific hypothesis concerning such changes, which we might be able to check empirically.

In assessing our results, it should be emphasized that our conclusions concerning inequality aversion refer only to those countries actually included in our sample. The issue of inequality aversion in other (groups of) countries remains to be studied, but such an investigation requires, of course, an appropriate database for income distributions. Should such a study show that inequality aversion is different in different country groups, inequality comparisons across different groups might be problematic.

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