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THE ENTANGLEMENT OF ATTITUDES TOWARD INEQUALITY: THE THEORETICAL BACKGROUND AND MEASUREMENT FOR THE EU COUNTRIES IN 2021

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ABSTRACT

This paper assumes two kinds of social planners who evaluate income distributions concerning social welfare, economic inequality and poverty. The first kind of social planner, SP_ε, comprises *averters to income inequality* as measured by the normative parameter ε. The second kind of social planner, SP_v, comprises *averters to rank inequality* as measured by the normative parameter v. As every member of society may play the role of a social planner, there could be as many levels of ε and v as society members. It raises the question of which ranges of v and ε values are ethically sensible when conducting empirical welfare studies. This paper proposes an answer to this question, introducing the concept of *inequality-entangled* SP_v and $SP\varepsilon$. If a randomly selected SP_v had v_i, one could *automatically* find ε_i of the inequality-entangled SP_ε, and vice versa. The inequality-entangled SP_v and $SP\varepsilon$ evaluate inequality, social welfare and poverty consistently. This paper offers a method of eliciting the pairs (v_i, ε_i), i=1, 2, …,n from empirical income distributions. Moreover, a single pair (v^*, ε^*) exists, representing all n pairs. This paper applies the inequality-entanglement methodological framework to assess social welfare, inequality and poverty for 27 European Union member countries in 2021.

Keywords: income distribution; social welfare; inequality; poverty; inequality aversion; European Union

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1. Introduction

Applied welfare economics delegates the measurement of social welfare embodied in income distributions to an abstractive *social planner* (*SP*) who uses individual *social evaluation functions* (*SEF*). Every member of society may play the role of the social planner with the same probability (Harsanyi, 1980).

This paper assumes two types of social planners: *averters to income inequality* (SP_ε) and *averters to rank inequality* (SP_v). An SP_ε uses Atkinson's (1970) index of income inequality $A(\varepsilon)$, where normative parameter $\varepsilon>0$ reflects *aversion to income inequality*. The greater the value of ε, the more sensitive SP_ε is to *income differences*. An SP_v uses the extended (generalised) Gini index $G(v)$ (Yitzhaki, 1983; Kakwani, 1980; Donaldson and Weymark, 1980). The normative parameter $v>1$ reflects *aversion to rank inequality*. The greater the value of v, the more sensitive SP_v is to *rank differences,* regardless of the exact value that income may take at that rank (Duclos, 2000).

As every member of society may be a social planner with the same probability, there could be as many values of ε and v as society members. It raises the question of which ranges of v and ε values are ethically sensible when conducting empirical welfare studies (Duclos, 2000).

This paper proposes an answer to this question by introducing the concept of the *entanglement of attitudes toward inequality* (the *inequality entanglement,* for short). Let V and $\mathcal{E}$ be the sets of admissible levels of v and ε, and let $\boldsymbol{V\mathcal{E}}$ be a cartesian product of V and $\mathcal{E}$. The economic theory allows for (resp. does not prohibit) the existence of pairs of SP_v and SP_ε (resp. v and ε) that consistently assess inequality in a given income distribution, namely that the following equity holds:

$$G(v)\text{-}A(\varepsilon)=0 \tag{1}$$

for all pairs $(v,\varepsilon) \in \boldsymbol{V\mathcal{E}}$.
We will refer to the pairs (SP_ε, SP_v), or (v, ε), satisfying Eq. (1) as *inequality-entangled social planners.* The sub-section 2.1 explains the use of such a quantum physics metaphor in more detail.

The concept of *inequality*-entangled *social planners* has various advantages. Such planners consistently assess income inequality. We will show that they also consistently assess social welfare and poverty in income distributions.

In applications, the concept of *inequality*-entangled *social planners* narrows the range of v and ε values remarkably. We will show that there is a unique pair $(SP_{v^*}, SP_{\varepsilon^*})$, resp. ($v^*$, ε^*), representing all inequality-entangled pairs of social planners. We propose a method of estimating the pairs (v,ε) and (v^*,ε^*) from income data.

What are the rationales for applying quantum physics concepts? Orrell (2024) notices that neoclassical economics had roots in classical mechanics. The influence of mechanics lives on through things like the assumption of a static equilibrium or the idea that people behave like independent rational utility maximisers. However, economics shaped by *uncertainty*, *dynamism* and *entanglement* might be more applicable to the real world (Facco & Fracas, 2022).

The rest of this paper has the following structure. Section 2 introduces basic concepts and formulae. This Section also offers a brief literature review. Section 3 describes the method of estimating pairs (v,ε). Section 4 comprises the first part of the empirical results. After describing the EU-SILC income data, this Section presents the estimates of pairs (v^*,ε^*), social welfare, and economic inequality for 27 EU countries in 2021. Section 5 offers estimates of poverty. Section 6. concludes.

2. Parametric utility functions and social evaluation functions

2.1. Inequality entanglement of social planners.

A phenomenon of some social planners satisfying Eq. (1) resembles *metaphorically* -rather than formally- the *quantum entanglement of particles*. Suppose two distinct quantum states, q_v or $q_{\varepsilon,}$ characterise some subatomic particles. The quantum state of a particle is unknown before measurement.

Quantum entanglement is the phenomenon of a group of particles such that the measurement of one particle's quantum state, say q_v, *automatically* provides the measurement of its companion's state, say q_ε, even when a vast distance separates the particles.

An example of entanglement is a subatomic particle that decays into an entangled pair of other particles. The decay events obey the various conservation laws. As a result, the measurement outcomes of one particle must be highly correlated with the measurement outcomes of its companion particle. So that the total momenta, angular momenta, energy, and so forth remain roughly the same before and after this process (Caltech Science Exchange, 2024). Many entangled particles may exist.

Anton Zeilinger demonstrated entanglement control methods that can apply to quantum computing, cryptography, and other quantum information technologies. Zeilinger shared the 2022 Nobel Prize in Physics with Alain Aspect and John Clauser.

Concerning social planners, note that if a randomly selected person is to play the role of a social planner, we do not know in advance whether he will be SP_ε or SP_v. In a pilot survey conducted among 71 students of Economics in February 2025, the participants answered the following questions:

"*When assessing inequality in a given income distribution, it matters:*

A) only differences in income levels;

B) only rank differences, regardless of the exact value that income may take at that rank;

C) both the differences in income levels and ranks".

Note that *A* defines SP_ε whereas *B* defines SP_v. *C* means to be either SP_ε or SP_v. In our survey, 19,72% of students declared themselves as SP_ε, 23.94% as SP_v and 56.34% as SP_ε or $SP_{v,}$

Inequality entanglement of the attitudes toward inequality (*inequality entanglement*, for short) is a metaphor for the phenomenon of a group of social planners so that just a measurement of v (resp. ε) *automatically* gives the measurement of ε (resp. v) due to Eq. (1).

.so that we may use the metaphor "entanglement" " in such a situation. i.e. "entangled".

If one of the "entangled" students became an actual social planner, he should provide an unambiguous assessment of the analysed income distribution. Suppose his inequality assessment is:" $G(v)$ equals 0.32". It reveals that he is an SP_v with an aversion to rank inequality as equal to $v=G^{-1}(0.32)$. For instance, if the mentioned "superpositioned" respondent SP_v were *inequality-entangled* with an SP_ε, the measurement of v would automatically provide the measurement of $\varepsilon=A^{-1}(0.32)$. There may exist a multitude of *inequality-entangled* SP_v and SP_ε.

2.2. Personal and moral preferences

According to Harsanyi (1980, pp. IX-X), each individual has two kinds of preferences. The first one comprises his *personal preferences*, defined as his actual preferences, which are based on his own interests. The second one consists of *moral* preferences defined as a person's "(…) *hypothetical* preferences that he *would* entertain if he forced himself to judge the world from a moral, i.e., from an impersonal and impartial point of view." More specifically, "(…) *moral* preferences are those preferences that he would entertain if he assumed to have the same probability 1/ *n* to be put in place of any one of the *n* individual members of society." (Harsanyi, 1980, pp. IX). Mathematically, an individual's personal preferences are represented by his *utility function,* whereas his *social evaluation function* represents his moral preferences.

Concerning moral preferences, a rational individual would try to maximise his expected utility, which would maximise the *average utility levels* of the individual members of society. It means that a rational individual will always use the average utility level in society as his social evaluation function.

Harsanyi (1980, p. X) noticed that this definition of social evaluation functions presupposes the possibility of *interpersonal comparisons* of utility. He argued that "(…) interpersonal utility comparisons are essentially the same kind of mental operation as intrapersonal utility comparisons are."

2.2. The social evaluation function of averters to income inequality.

In this paper, we will use the following terms and symbols. The positive valued random variable X, with the distribution function $F(x)=\mathrm{P}(X \leq x)$, will describe the distribution of personal incomes. We assume that the mean $\mu=\mathrm{E}_F[X]$ exists and is finite, where the operator $\mathrm{E}_F[\cdot]$ is the mathematical expectation of X with respect to $F(x)$.

We assume that an averter to income inequality uses the utility function of the form:

$$u(x) = \begin{cases} \frac{x^{1-\varepsilon}}{1-\varepsilon}, for\ \varepsilon \neq 1 \\ ln x, for\ \varepsilon = 1 \end{cases}, x>0 \tag{2}$$

(Atkinson, 1970). Eq. (2) defines the *constant relative inequality aversion function* (*CRIA*).

Averter's to income inequality social evaluation function is the expected value of $u(X)$ with respect to the distribution F, namely:

$$SEF_{\varepsilon} = E_F[u(X)] = \begin{cases} \frac{E_F[X^{1-\varepsilon}]}{1-\varepsilon}, for\ \varepsilon \neq 1 \\ E_F[ln X], for\ \varepsilon = 1 \end{cases} \tag{3}$$

(Atkinson, 1970).

The parameter ε measures *aversion to income inequality* of a social planer or a society. When $\varepsilon<0$, a social planner or society is *averse to equality*. Null inequality aversion, i.e. $\varepsilon=0$, characterises an *inequality-neutral* society. In this case, $SWF_0=\mu$ and value judgments on income distributions are based only on the mean incomes carrying nothing for income inequality. Thus, income distribution X with the mean μ_x is preferred over Y with the mean μ_y if and only if $\mu_x>\mu_y$. If $\varepsilon>0$, society is *inequality averse*. Hereafter, we will assume $\varepsilon \geq 0$.

Knowledge of ε is essential for various reasons. As ε ultimately determines the function (2), it enables a direct measurement of SEF_{ε}. Parameter ε expresses the rate at which a society solves the trade-off between efficiency and equality. As the (minus) elasticity of the marginal utility of income, ε also has a central role in public economics. The knowledge of ε is also essential in appraising social projects and policies impacting different socioeconomic groups (Evans, 2005; Layard et al., 2008; Aristei and Perugini, 2016).

Based on the interpretation of ε as inequality aversion, Atkinson (1970) proposed the normative index of inequality:

$$A(\varepsilon) = \frac{\mu-\mu_{\varepsilon}}{\mu} \tag{4}$$

where μ_{ε} is *the equally distributed equivalent income* (*EDEI*) that, if received by all persons, gives the value of social evaluation function $\mathrm{E}[u(X)]$ the same as the initial distribution (Kolm, 1969; Atkinson, 1970; Sen, 1973).

More specifically, for the utility function (2) and social welfare function (3), μ_{ε} is the solution to the equation: $u(\mu_{\varepsilon})=\mathrm{E}[u(X)]$, i.e.

$$\mu_\varepsilon = \begin{cases} \{\mathrm{E}[u(X)]\}^{1/(1-\varepsilon)}, & for\ \varepsilon \neq 1 \\ \exp\{E[lnX]\}, & for\ \varepsilon = 1 \end{cases} \tag{5}$$

For ε=1, μ_ε is the geometric mean, and for ε=2, μ_ε is the harmonic mean. For a given income distribution, μ_ε is a declining function of ε (Lambert, 2001, Chapter 4).

It follows from (4) and (5) that *EDEI* is a money metric of the social evaluation function *SEF,* namely:

$$\mu_\varepsilon=\mu[1-A(\varepsilon)] \tag{6}$$

(Atkinson, 1970). Eq. (5) specifies the family $\{SEF_\varepsilon\}_{\varepsilon>0}$ of social evaluation functions indexed by ε.

2.3. The social evaluation function of averters to rank inequality

Sen (1973, p. 41) argued that the social value of the welfare of individuals should depend crucially on the levels of welfare (or incomes) of others". The following social evaluation function satisfies this claim:

$$\mu_v=\mu[1-G(v)] \tag{7}$$

where *G(v)* is the extended Gini index of the form:

$$G(v) = 1 - v(v-1)\int_0^1 (1-p)^{v-2} L(p)dp\,, \qquad v>1,\, p \in [0,1] \tag{8}$$

(Yitzhaki, 1983; Donaldson and Weymark, 1980; Kakwani, 1980). In Eq. (8), *L(p)* is the Lorenz curve, 1-p=1-*F(x)* is the rank of a person with income *x,* and *v* is a normative parameter expressing *aversion to rank inequality*. The case 0≤v<1 reflects *rank equality aversion, v*=1 *rank equality neutral*, and v>1 *rank inequality aversion* (Yitzhaki, 1983; Duclos, 2000). For v=2, *G(v)* is the ordinary Gini index.

Eq. (7) defines the family $\{SWF_v\}_{v>1}$ of social welfare functions indexed by v>1. More specifically

$$\mu[1-G(v)] = v\int_0^\infty x[1-F(x)]^{v-1} f(x)dx \tag{9}$$

(Lambert, 2001, p. 125).

Yitzhaki (1983) noted that *G(v)* (8) has most of the properties of Atkinson's index (4). Indeed, at the extremes $v\to1$ and $v\to\infty$, the behaviour of *G(v)* resembles that of the *A(ε)* at the extremes $\varepsilon\to0$ and $\varepsilon\to\infty$ of inequality aversion (Lambert, 2001, p. 115). As $v\to1$, $G(v)\to0$. As $v\to\infty$, $G(v)\to1-L'(0)$. For a discrete distribution of *X,* $G(v)\to1-x_{min}/\mu$ as $v\to\infty$.

2.4. Some implications of inequality entanglement.

For an analysed income distribution with μ>0, Eq. (1) is equivalent to:

$$\mu[1-G(v)]=\mu[1-A(\varepsilon)] \tag{10}$$

In Eq. (10), $\mu[1-G(v)]$ and $\mu[1-A(\varepsilon)]$ are the abbreviated social evaluation functions, SEF_ε and SEF_v induced by *G(v)* and *A(ε),* respectively. Thus, *inequality-entangled* social planners consistently assess social welfare.

Moreover, Eq. (1) implies that *inequality*-entangled social planners also consistently assess poverty in income distributions. A person is deemed poor if his/her income is less than a normative *poverty line z* established by a social planner. Kot and Paradowski (2024a) argue that the *EDEI* is an upper limit of any socially acceptable poverty line z, namely,

$$z \leq EDEI \tag{11}$$

If a social planner proposed a poverty line z greater than *EDEI*, attaining an egalitarian income distribution would be possible at the cost of common poverty! Arguably, no reasonable society would accept such a poverty line. Kot and Paradowski (2024) refer to such a peculiar situation as the *Equity-Poverty Trap*.

Note that $\mu[1\text{-}G(v)]$ and $\mu[1\text{-}A(\varepsilon)]$ in Eq. (10) are the *EDEIs*. Thus, Eq. (10) defines the equality of poverty lines and the equality of poverty indices when they are monotonic functions of a poverty line. Thus, inequality-entangled social planners consistently assess poverty in a given income distribution.

In this paper, we will use the following family of poverty indices:

$$FGT_\alpha = \sum_{x_i<z}\left(\frac{z-x_i}{z}\right)^\alpha p_i \ , \tag{12}$$

where z is the poverty line, x_i is income below z, and a is a normative parameter (Foster, Greer, and Thorbecke, 1984).

Some Eq. (12) cases, namely FGT_0, FGT_1, and FGT_2 are widely used. FGT_0, called the head-count *ratio*, measures poverty incidence. FGT_1, called the *poverty depth*, measures the poverty of society as a whole (Foster and Shorrocks, 1991). FGT_2 measures *poverty severity.*

3. Estimating aversion to income inequality and rank inequality.

3.1. The previous methods of estimating ε and v

The literature offers various methods of recovering ε from empirical data. Inequality aversion ε has been elicited from Okun's "leaky bucket" experiment (Okun, 1975). In this experiment, participants subjectively assess a tolerable money 'leakage' due to administrative costs during income transfers among persons. The higher leakage the participants permit, the greater their aversion to income inequality.

One can elicit ε from *the equal sacrifice model* (Richter, 1983; Vitaliano, 1977; Young, 1987). Lambert et al. (2003) elicit ε by hypothesising *the natural rate of subjective inequality.* Kot (2020) proposes the estimator of $\hat{\varepsilon} = (ap + 1)/2$ when income obeys the Generalised Beta distribution of the second kind GB2(x;*a,b,p,q*) (McDonald, 1984).

Much less is known concerning the range of v that analysts may apply in empirical studies. Kot (2022) analyses the empirical relationship between the generalised Gini index $G(v)$ and three Italian indices of inequality, namely the Pietra (1915) index, the Bonferroni (193) index, and the Zenga (2007) index. The author finds these indices corresponding to $G(v)$ with v equal to 1.5, 3, and 11, respectively.

Duclos (2000) recommends the leaky bucket experiment for deriving v. The author argues that v should not exceed 4 in empirical analyses if not whole transfer licked.

The joint estimation of ε and v has not yet been analysed, with one exception. Recently, Kot and Paradowski (2024b) obtained the pairs (ε^*, v^*) for ten Latin American and Caribbean countries by solving the system of two nonlinear equations: $SWF_\varepsilon = SWF_v$ and $x_\varepsilon^* = x_v^*$, where x_ε^* and x_v^* are the *benchmark incomes* of SP_ε and SP_v, respectively. The authors admitted that their method needs further improvements.

3.2. The mean-value method.

We propose a three-stage method of estimating the pairs (v^*,ε*). In the first stage, we generate n random values of aversion to rank inequality $v_1, v_2,\ldots,v_n$ from the uniform distribution U[1,4] and estimate the sequence of n extended Gini indices, $G(v_1), \ldots, G(v_n)$ for an analysed income distribution.

To justify this stage, note that the state of complete ignorance concerning the value of v in the [1,4] interval means the state of *maximum entropy*. The uniform distribution has the maximum entropy among all probability distributions defined on finite intervals (Cover and Thomas, 1991), p. 269). Thus, one may expect v from the uniform distribution U[1,4].

In the second stage, we calculate n values of ε_i as the solutions to the Eq. (1) for $G(v_i)$. Thus, we get n pairs (v_i,ε_i) of inequality-entangled social planners. We call the graph of the pairs the *v-ε curve* or the $\varepsilon(v)$ function. Fig. 1 illustrates the v-ε curves for some European countries.

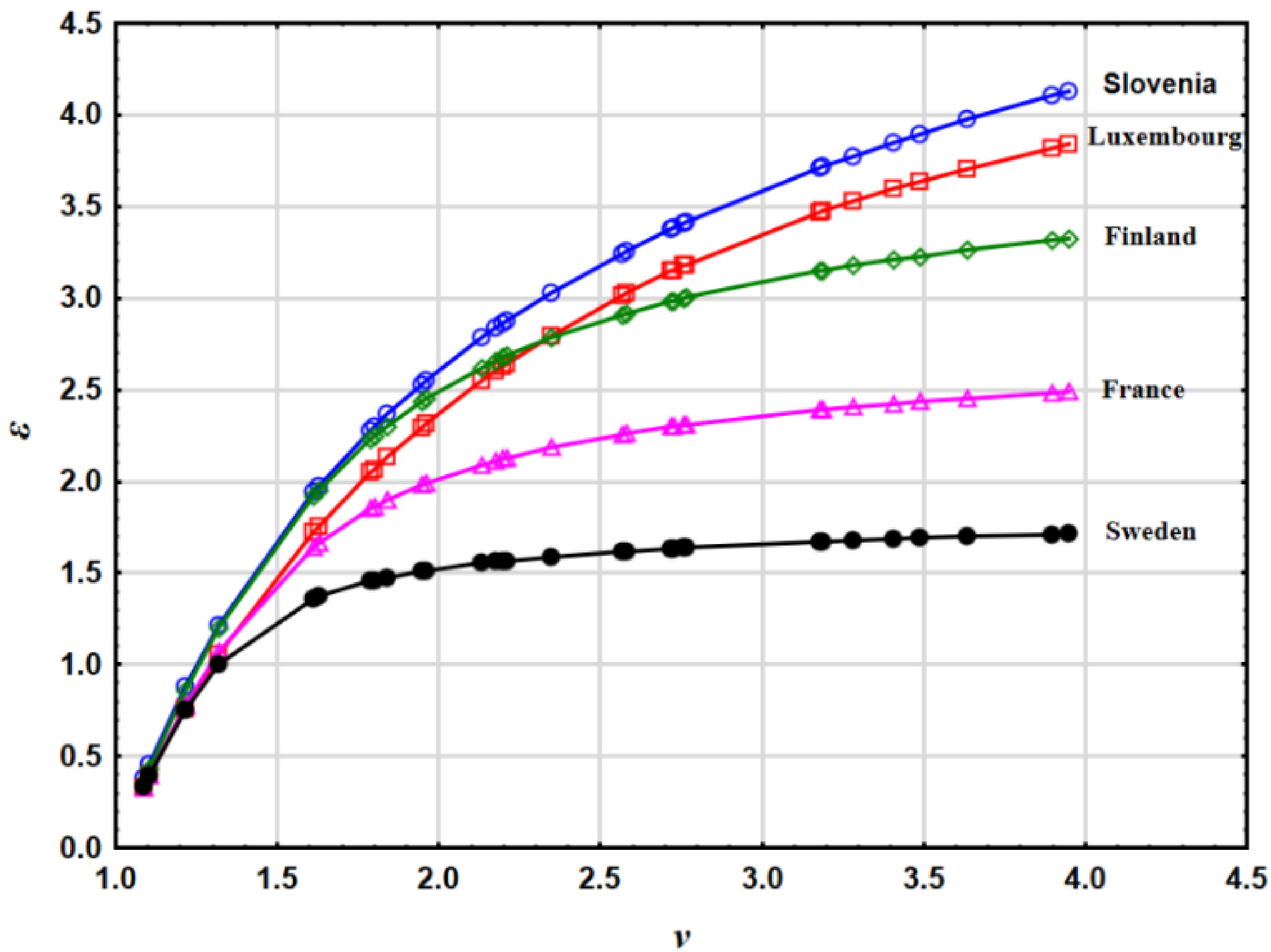

Figure 1. The *v-ε* curves for selected UE countries in 2021.
Source: own elaboration.

Every point in Fig. 1 represents a combination of exogenous v and corresponding ε, guaranteeing the same inequality assessment in a given income distribution by a pair of entangled social planners. At the upper limit of v=4, the curves in Fig.1 attain different levels which depend on the country's income distributions.

In the third stage, we search for a unique pair (v^*,ε^*) representing all inequality-entangled pairs (v_i,ε_i). The *v-ε* curve in Fig.2 illustrates the idea of this stage.

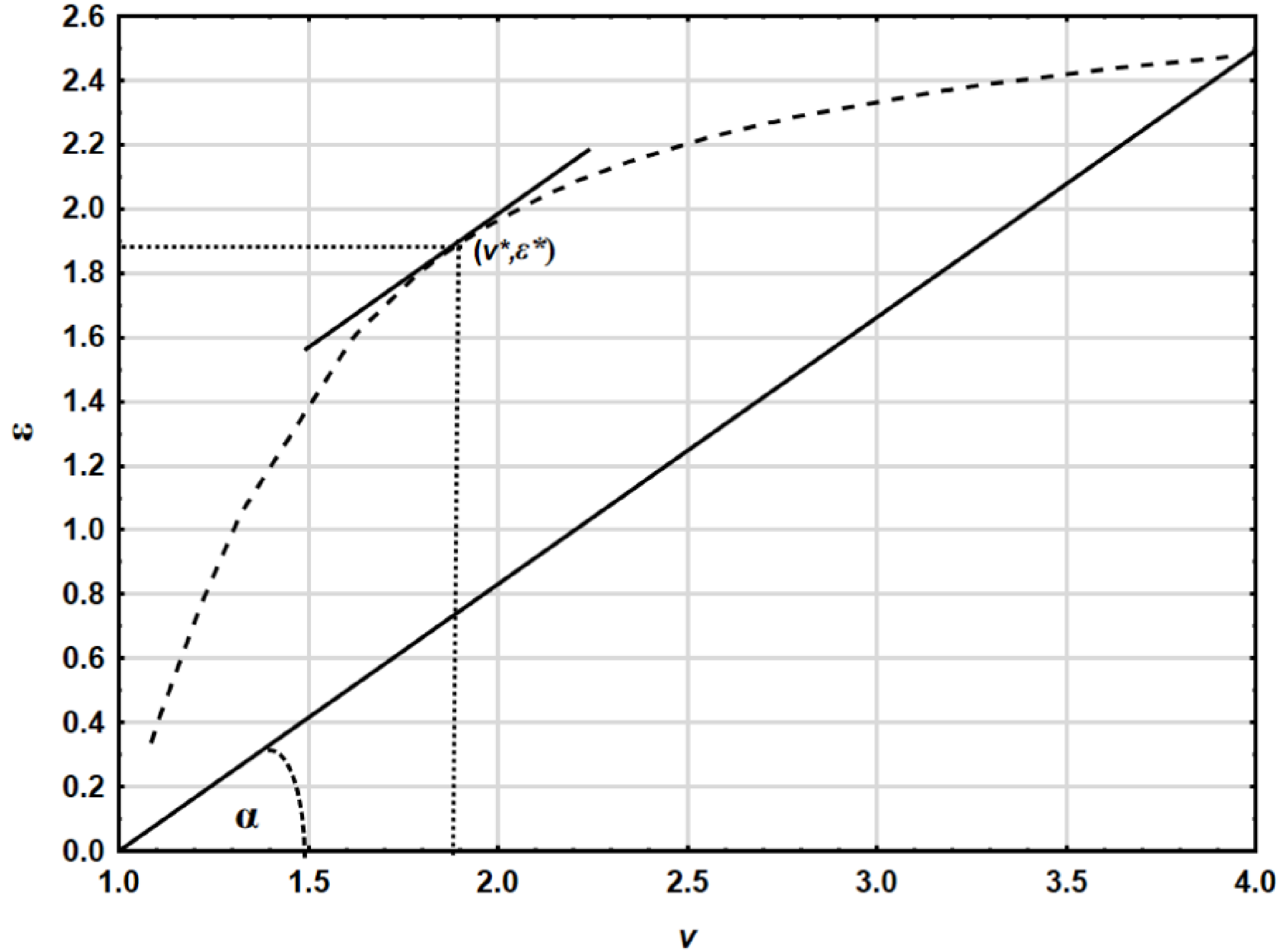

Figure 2. A single representation *(v*,ε*)* of the *v-ε* curve for Poland, 2021.
Source: *own elaboration*.

In Fig.2, the tangent of angle *a* reflects *the average proportion* of *ε* to *v* that gives the same inequality assessment. More specifically:

$$\tan(\alpha) = \frac{\varepsilon(v_{max})-\varepsilon(v_{min})}{v_{max}-v_{min}} \tag{13}$$

where the $v_{min} > 1$, and $v_{max}=4$. The corresponding $\varepsilon(v_{min})$ and $\varepsilon(v_{max})$ are calculated from Eq. (1).

If the function *ε(v)* is differentiable within the interval $[v_{min}, v_{max}]$, then Lagrange's mean value theorem implies the existence of a point *v** inside this interval at which the following equity holds:

$$tan(\alpha) = \varepsilon'(v*) \tag{14}$$

where *ε'(v*)* is the first derivative of *ε(v)* at *v**.

In Fig. 2, the point (*v*,ε**) reflects the average level of income inequality aversion for offsetting rank inequality aversion when attaining the same inequality assessment in a given income distribution. In this sense, the single point (*v*,ε**) represents all points on the *v-ε* curve.

Although one can calculate ε' (v_i) numerically, we propose a method based on analytical derivatives from a function fitted to the empirical *v-ε* curves. It has turned out that the following function approximates the *v-ε* curves "almost ideally":

$$\varepsilon(v) = \theta_1 + \theta_2 v - \exp\{\theta_3 - \theta_4 v\} \tag{15}$$

where the parameters $\theta_1, \theta_2, \theta_3$ and θ_4 can be estimated using the nonlinear least squares method.

Equating the derivative of (15) with *tan(a)* gives:

$$\tan(\alpha) = \theta_2 + \theta_4 \exp\{\theta_3 - \theta_4 v^*\} \tag{16}$$

After simple algebra, we get:

$$v^* = \left\{\theta_3 - \log[\frac{(tan(\alpha)-\theta_2)}{\theta_4}]\right\}/\theta_4 \tag{17}$$

Coresponding parameter ε^* can be calculated from Eq. (15).

Substituting the parameters θ_2, θ_3 and θ_4 by their estimates, we get the estimator of v^*. We shall refer to this way of obtaining (v^*,ε^*) as *the mean-value method* (MVM).

4. Empirical results for the EU-member countries 2021.

4.1. Statistical data.

We use statistical data on household disposable income [in Euros] from the EU-SILC database for 2021. To obtain a distribution of personal disposable incomes, we adjust household incomes by the square-root equivalence scale (Buhmann et al., 1988). Such an adjustment requires weighting the resulting equivalent incomes. We follow the common practice of weighting adjusted incomes by household size. The final weights applied in this paper are products of household size and cross-sectional survey weights.

We generate the sequence of 30 random values from the uniform distribution U(1,4). Then, we estimate the sequence of $G(v_i)$, i=1,…, 30, for every country and the corresponding sequence of ε_i, solving Eq.(1) numerically by the IMSL Fortran subroutine NEQNF. Next, we estimate the parameters θ_1, θ_2, θ_3, and θ_4 of the nonlinear function (15) for every country using the pairs (ε_i,v_i), i=1,…,30 and the IMSL Fortran subroutine RNLIN.

4.2. Estimates of v* and ε*.

Table 1 presents the results of applying the MVM to EU-SILC data. Besides estimates of ε^* and v^*, this Table contains the estimates of the generalised Gini index $G(v^*)$ (equalled to the Atkinson index $A(\varepsilon^*)$ and *EDEI*. The last row of this Table (labelled 'EU total') comprises results for all the EU-member countries' incomes and weights.

Examining Table 1 shows that normative parameters v and ε are country-specific. For instance, Spanish and Dutch social planners have a similar aversion to rank inequality, $v \approx 1.85$. However, Spanish inequality-entangled SP_ε should have $\varepsilon \approx 1.42$ to assess income inequality identically as his companion SP_v did. On the other hand, Duch inequality-entangled SP_ε must have $\varepsilon \approx 1.88$ for the same purpose.

The last row of the right panel in Table 1 shows that a European SP_v with $v = 1.90295$ assesses social welfare (*EDEI)* in the EU as €16153. His inequality-entangled companion SP_ε provides the same welfare assessment when having ε=1.52573.

Table 1. Estimates of income inequality $G(v^*) = A(v^*)$ and social welfare, *EDEI* [€] based on the inequality-entangled estimates of aversion to rank inequality v^* and income inequality ε^* for EU-member countries in 2021.

No.	Country	v^*	ε^*	$G(v^*) = A(\varepsilon^*)$	*EDEI*
1	Austria	1.71847	1.30212	0.22367	25637
2	Belgium	1.88000	2.05323	0.22847	23435
3	Bulgaria	2.06051	1.95660	0.40729	4463
4	Croatia	1.94088	1.76289	0.28500	7306
5	Cyprus	1.94303	2.21251	0.28839	15711
6	Czechia	1.99332	2.52619	0.25467	9854
7	Denmark	1.78069	1.68096	0.24039	29321
8	Estonia	1.90745	1.67218	0.29094	11044
9	Finland	1.97727	2.46902	0.26103	22752
10	France	1.87692	1.92728	0.27535	20694
11	Germany	1.87262	1.79843	0.28716	22548
12	Greece	1.89762	1.66411	0.29579	7975
13	Hungary	1.86140	1.75326	0.25622	6064
14	Ireland	1.75840	1.67332	0.23879	27216
15	Italy	1.79748	1.38777	0.28947	16030
16	Latvia	1.93202	1.60822	0.34519	8153
17	Lithuania	1.99808	1.84871	0.35679	8346
18	Luxembourg	2.11278	2.52324	0.30744	36250
19	Malta	1.66892	1.31318	0.24643	16123
20	Netherlands	1.84791	1.87964	0.25099	19377
21	Poland	1.89022	1.88695	0.24884	7944
22	Portugal	1.93503	1.72011	0.31758	9978
23	Romania	1.95258	1.53072	0.32642	4197
24	Slovakia	1.92978	2.10286	0.21011	8210
25	Slovenia	2.02849	2.64598	0.24319	14044
26	Spain	1.84606	1.41535	0.29774	14259
27	Sweden	1.70576	1.41729	0.22131	23228
1-27	**EU total**	**1.90295**	**1.52573**	**0.32298**	**16153**

Source: own calculations using EU-SILC data.

5. Economic poverty in the EU member countries in 2021.

As mentioned in Section 1, inequality-entangled social planners consistently assess poverty in an income distribution. When we set a country's EDEI as a national poverty line z, the FGT_a indices (12) enable assessments of various aspects of the country's impoverishment.

EDEI, as an upper limit of poverty lines, inherently implies an *international poverty line*. If there were rationales for comparisons of poverty across N selected countries, an international poverty line, $z_{all,}$ should satisfy the following condition:

$$z_{int} = \min_i\{z_1, z_2, \dots, z_N\}, i = 1,2, \dots, N \quad (18)$$

where $z_1,\ldots,z_N$ are the country's poverty lines equal to the countries' *EDEI*s. (Kot, Paradowski, 2024a). The international poverty line z_{int} satisfying (18) guarantees that no selected country falls into the *Equity-Poverty Trap*.

Table 2 presents the estimates of the FGT_a poverty indices (12) for a=0, 1, and 2.

Table 2. Poverty in the EU member countries in 2021.

No.	Country	*National poverty lines* z_i= *EDEI*$_i$ *in Table 1*			*International poverty line* z_{int}=4197 (Romania)		
		FGT_0	FGT_1	$FGT2_2$	FGT_0	FGT_1	$FGT2_2$
1	Austria	0.36581	0.10582	0.04873	0.01143	0.00787	0.00659
2	Belgium	0.34246	0.08842	0.03331	0.00386	0.00175	0.00105
3	Bulgaria	0.35380	0.11823	0.05542	0.31664	0.10431	0.04810
4	Croatia	0.33375	0.11037	0.05319	0.10984	0.03284	0.01533
5	Cyprus	0.36184	0.09453	0.03514	0.00255	0.00095	0.00058
6	Czechia	0.32988	0.07594	0.02769	0.01674	0.00413	0.00167
7	Denmark	0.36599	0.09620	0.03921	0.00443	0.00205	0.00142
8	Estonia	0.36033	0.11800	0.05462	0.03432	0.01215	0.00677
9	Finland	0.33782	0.08149	0.02879	0.00134	0.00045	0.00023
10	France	0.35090	0.09391	0.03790	0.00535	0.00244	0.00147
11	Germany	0.35968	0.10394	0.04514	0.00580	0.00197	0.00111
12	Greece	0.34707	0.11060	0.05256	0.08125	0.02651	0.01396
13	Hungary	0.34633	0.09805	0.04322	0.13057	0.03774	0.01787
14	Ireland	0.37738	0.10011	0.03874	0.00190	0.00145	0.00122
15	Italy	0.35964	0.12254	0.06170	0.02593	0.01086	0.00699
16	Latvia	0.35922	0.12914	0.06469	0.10611	0.03147	0.01564
17	Lithuania	0.35290	0.11525	0.05370	0.07271	0.02273	0.01138
18	Luxembourg	0.32825	0.09153	0.03611	0.00003	0.00002	0.00001
19	Malta	0.40029	0.12068	0.05332	0.01124	0.00647	0.00452
20	Netherlands	0.36097	0.09178	0.03624	0.00701	0.00283	0.00168
21	Poland	0.33929	0.09580	0.04091	0.06027	0.01658	0.00779
22	Portugal	0.34087	0.11130	0.05403	0.05156	0.01785	0.00974
23	Romania	0.33552	0.13102	0.07162	0.33552	0.13102	0.07162
24	Slovakia	0.31707	0.08255	0.03454	0.04662	0.01368	0.00636
25	Slovenia	0.31133	0.07859	0.02956	0.00386	0.00084	0.00029
26	Spain	0.35373	0.12800	0.06751	0.03944	0.01670	0.01030
27	Sweden	0.37262	0.10814	0.04663	0.00828	0.00425	0.00297
1-27	**EU**	**0.34471**	**0.12646**	**0.06723**			

Source: own calculations using data from the EU-SILC database.

On the left panel of Table 2, one can see high poverty levels in all countries. It should be remembered that *EDEI* as an *upper limit of poverty lines implies upper limits of poverty measures.* The differences between countries' FGT_0, FGT_1, and FGT_2 estimates are relatively small. Thus, according to national poverty standards, all analysed countries might expect similar poverty incidences, depths, and severity. However, these results are only for *internal use,* not for international comparisons.

When we apply Romanian's *EDEI* = 4197 [€] as the international poverty line, the right panel of Table 2 shows remarkably greater diversification of poverty assessments in the EU-member countries than the left panel.

6. Concluding Remarks

The inequality entanglement is a conceptual novelty of this paper. It enables eliciting normative parameters v and ε from empirical income distributions. Knowledge of these parameters makes consistent assessments of inequality by social planners SP_v and SP_ε, who respect different methodologies. The inequality entanglement also enables consistent assessments of social welfare and economic poverty.

The method of eliciting pairs (v,ε) from income data may start with generating random numbers of ε instead of v from U[1,4}. If incomes obey the generalised beta distribution of the second kind GB2(a,b,p,q), Kot (2020) demonstrates that ε belongs to (0, ap+1) interval. So, one may generate n random numbers from the U(0, ap+1) distribution and then calculate inequality-entangled v from Eq. (1).

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