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European Social Citizenship

Well-being convergence in the European Union

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Summary

In this study, a method is proposed to measure well-being inequality and to test for well-being convergence in the EU. The method considers well-being as a multidimensional concept and recognizes that individuals may have different preferences about the relative importance of the different dimensions of well-being. The focus is on interpersonal well-being convergence (i.e., a reduction in well-being inequality between all European citizens) and on intercountry well-being convergence (i.e., a reduction in the well-being inequality between the European countries). To illustrate the method, we use data from EU-SILC (2005-2019) about five dimensions of well-being: income, employment, crime, pollution and health. The relative importance of these dimensions is estimated with a life satisfaction regression. Results show interpersonal and intercountry well-being convergence over the study period, but increased well-being inequality during the Great Recession (2008-2015). Several decompositions are used to shed light on the drivers of well-being convergence in Europe.

Keywords: convergence, decomposition, equivalent income, well-being, preferences, life satisfaction

Well-being convergence in the European Union

Project name	The Future of European Social Citizenship
Project acronym	EuSocialCit
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Lead partner	University of Antwerp
Work package	EuSocialCit is an interdisciplinary research project aiming to support the EU in strengthening social rights and European social citizenship. It evaluates the current state of social rights in Europe and their relationship to social inequalities, gender inequalities, poverty and precariousness, and diagnoses the shortcomings of current policies and institutions at the level of individual countries and the EU. The EuSocialCit project focusses on three domains in which social rights are important: the empowerment of citizens (e.g. education and activation), fair working conditions and social inclusion. Each of these domains are respectively studied as part of WP3, WP4 and WP5. This report is produced as part of WP 5 which is entitled *Inclusion through social policy*. This WP analyses social rights in relation to the principles in the 'social protection and inclusion' cluster of the EPSR. Core diagnoses undergirding this WP are the long-lasting trend of poverty in many EU welfare states and for particular groups, and the increased disparities between member states and structural inadequacies of social protection for the most vulnerable. WP5's central questions are what the role of the EU has been in delivering social rights for social protection and inclusion to all EU citizens, and what improvements can and should be made.
Web address	For more information about the EuSocialCit project, please visit www.eusocialcit.eu. EuSocialCit's output can also be found in its community on Zenodo: https://zenodo.org/communities/eusocialcit.

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1. Introduction

> *"In order to promote its overall harmonious development, the Community shall develop and pursue its actions leading to the strengthening of its economic and social cohesion."*
> *(Single European Act, 1986, Article 130a)*

> *"A strong Social Europe is about people and their well-being. Europe is home to the most equal societies in the world, the highest standards in working conditions, and broad social protection. Competitive sustainability is at the heart of Europe's social market economy, striving for a sustainable and inclusive growth model that delivers the best for people and the planet. On this unique model rests Europe's social and economic resilience."*
> *(European Commission (2021), "The European Pillar of Social Rights Action Plan")*

Since the start, upward economic convergence has been at the heart of the EU project. Article 130a of the Single European Act, which was ratified in 1986, constituted the legal ground for several policy instruments to stimulate upward economic convergence, such as the creation of the European Structural and Investment Funds and the EU Cohesion Policy. The European Pillar of Social Rights, proclaimed at the Gothenburg Summit in 2017, complements the focus on economic convergence with 20 principles dealing with the social dimension. Recently, in 2021, the European Commission presented its "The European Pillar of Social Rights Action Plan" to turn these principles into concrete actions and headline targets for 2030. Markedly, the opening sentence of this action plan puts people and their well-being at the centre stage of a strong Social Europe (European Commission, 2021).

A consensus has emerged in academic and policy-circles that individual well-being is best seen as a multidimensional notion (Stiglitz, Sen, & Fitoussi, 2009). Besides purely monetary aspects such as income, consumption and wealth, people also care about other aspects of their life, such as their health, employment, safety and environmental quality, to name a few. The European statistical system has a long tradition in constructing dashboards with many social indicators about several dimensions of life. Consider, for instance, the 18 'Laeken indicators' on poverty and social exclusion (Atkinson, Cantillon, Marlier, & Nolan, 2002) and, more recently, the Social Scoreboard, which monitors the performance of EU member states along the various dimensions of the European Pillar of Social Rights (European Commission, 2018). Yet, each of the social indicators on these dashboards focusses on a single dimension in isolation from the other dimensions. Quantifying individual well-being in a way that takes the cumulative nature of disadvantages across the dimensions into account, however, requires a different approach that constructs a multidimensional measure of well-being for every individual (Decancq & Schokkaert, 2016).

Comparing individual well-being is a value-laden exercise (Robbins, 1932). Different persons may hold different preferences about the relative importance of the dimensions of life. While some individuals may care more about the monetary aspects of their life, others may give more weight to their health or employment situation. Some authors have argued that an appealing measure of individual well-

being should be able to take preferences into account (Decancq, Fleurbaey, & Schokkaert, 2015b; Fleurbaey & Blanchet, 2013). Given the apparent social and cultural differences between the EU member states and the central position of subsidiarity in the EU project, it would be odd indeed to impose a common, pan-European set of values about the relative importance of the different well-being dimensions when evaluating well-being convergence and the concrete actions that are taken to advance it.

Against this background, two broad sets of questions come to the fore. First, methodologically, questions arise on how well-being convergence in the EU can be measured in a way that respects preference heterogeneity between and within its member states. Second, more substantively, there is the empirical question on whether the EU project has been an engine for upward well-being convergence in the past (and whether it will be able to be one in the future).

There is a rich empirical literature on the measurement of intercountry income convergence, using three notions of convergence: (absolute) β-convergence, conditional β-convergence and σ-convergence (Barro & Sala-i-Martin, 1992; Sala-i-Martin, 1996). First, (absolute) β-convergence measures the extent to which poorer countries catch up with richer countries. Diminishing returns to capital lead to β-convergence, for instance, as they make investing in poorer countries more profitable. Empirically, β-convergence is tested in a cross-section regression with income growth as explained variable and the initial income level as explanatory variable. Second, to allow for different structural growth paths across the countries, tests of conditional β-convergence include additional control variables in the regression. Third, σ-convergence takes place when the dispersion of incomes between countries decreases over time. Empirically, σ-convergence is tested by checking the evolution of inequality measures such as the variance, Gini coefficient, or (members of) the Generalized Entropy class of inequality measures. β-convergence is a necessary condition for σ-convergence, but not a sufficient condition since poor countries may grow so much that dispersion increases (Sala-i-Martin, 1996). Very few studies investigate convergence using a multidimensional notion of well-being. Noorbakhsh (2007), Jordá and Sarabia (2015) and Paprotny (2021) offer notable exceptions in their studies of convergence of human development and the dimensions that constitute it (living standards, life expectancy, and education).

We propose a method to monitor multidimensional well-being σ-convergence between persons and between countries in a single measurement framework.[1] Interpersonal well-being convergence refers to a decrease in well-being inequality between individuals. Intercountry well-being convergence, on the other hand, takes place when well-being inequality between countries decreases over time. Some policies and events may primarily affect interpersonal well-being inequality, while others influence intercountry well-being inequality. The unification of the European labour market and the increase in labour mobility can be expected to lead to convergence of the employment rates between the EU countries, for instance, while a directive on minimum wages may reduce earnings inequality within the EU member states.

[1] Our research ties into research on global and EU-wide income inequality (Beblo & Knaus, 2001; Kranzinger, 2020; Milanovic, 2005, 2016).

To measure convergence in the space of multidimensional well-being, we proceed in three steps. First, we use so-called equivalent incomes to measure well-being at the individual level. Equivalent incomes have a long pedigree in micro-economics to measure well-being with respect for individual preferences (see, for instance, Deaton and Muellbauer (1980); King (1983)). Second, we use the class of Generalized Entropy inequality measures to measure well-being inequality in the equivalent incomes obtained in the first step. We interpret a reduction of well-being inequality as interpersonal well-being convergence. Third, we decompose total well-being inequality into a component that captures the inequalities within the European countries and one that captures inequalities between the countries. A reduction in the latter component is interpreted as intercountry well-being convergence. Finally, the between and within components can be further decomposed to highlight the role of the different countries, the dimensions, the preferences and the outcomes.

Our work is related to several contributions in the literature on the measurement of multidimensional well-being inequality. Equivalent incomes have been used to estimate well-being, both for single countries (for example, Decancq et al. (2015b); Decancq, Fleurbaey, and Schokkaert (2017); Jara and Schokkaert (2017)) as for multiple countries. The aims of existing cross-country analyses vary, from estimating the effect of the Great Recession (Decancq & Schokkaert, 2016), to studying the social welfare implications of using a multidimensional well-being measure (Ledić & Rubil, 2020; Petrillo, 2018) and decomposing inequality in multidimensional well-being (Ledić & Rubil, 2019). These studies make use of life satisfaction regressions to estimate preferences, which is an empirical strategy that we will also follow in this paper.[2] With the exception of Ledić & Rubil (2020), these studies focus on preference heterogeneity between socio-demographic groups, assuming that the relative importance of the life dimensions is the same across countries, as long as individuals belong to the same socio-demographic group. We contribute to this literature by taking preference heterogeneity between countries into account, and by taking an EU-wide perspective on well-being inequality.

We use data from the EU Statistics on Income and Living Conditions (EU-SILC) between 2005 and 2019 to implement the proposed well-being inequality measures and their decomposition for the EU. We use information about five dimensions of well-being: income, health, employment, crime and pollution. This permits us to investigate well-being convergence, or the lack thereof, before, during and after the turbulent years of the Great Recession in Europe.

We find that well-being inequality is high in Europe, much higher than income inequality alone. Over the entire considered period, there is some interpersonal and intercountry well-being convergence. Yet, this overall trend masks some fluctuations. Interpersonal well-being inequality is found to decrease sharply in the initial period before the Great Recession. During the Great Recession (between 2008 and 2015) interpersonal well-being inequality keeps on gradually increasing. There is a short

[2] Alternative methods to estimate preferences for well-being measurement are based on stated preference techniques such as contingent valuation (e.g., Fleurbaey, Luchini, Muller, and Schokkaert (2013) and Capéau et al. (2020)) or revealed preferences in labour market decision (e.g., Bargain et al. 2013; Decoster and Haan (2014)). Decancq and Nys (2021) present an adaptive bisectional dichotomous choice algorithm to elicit individual preferences.

period of interpersonal well-being convergence between 2015 and 2017, after which it plateaus. Intercountry well-being inequality is found to be more stable over time, with a similar short period of convergence between 2015 and 2017. Preference heterogeneity is found to play an important role in the level and evolution of both interpersonal and intercountry well-being inequality. We find that the health dimension is the most important driver of well-being inequality. Income and employment play also an important role, while the contribution of crime and pollution is found to be small. Finally, as can be expected, we find that large countries as Germany, France, Spain and Italy contribute a lot to the within component of well-being inequality. The contribution of Spain, Italy and Austria increases over the considered period, while the contribution of Germany, Poland and Greece decreases.

The paper is structured as follows. Section 2 discusses the methodology and zooms in on the definition of the equivalent income measure of individual well-being, the measurement of well-being inequality and the decomposition. Section 3 presents the data, the estimation of the preferences, and some summary statistics. Section 4 discusses the decomposition results. Section 5 concludes.

2. Methods

In this section, we present a framework for the measurement and decomposition of well-being inequality, building on the work of Decancq et al. (2017). We proceed in three steps. First, we discuss the measurement of individual well-being using equivalent incomes. Then, we discuss the measurement of well-being inequality and well-being convergence. Finally, we present a decomposition of well-being inequality that sheds light on convergence.

2.1 Measuring individual well-being

We assume that the relevant society in period t consists of n_t individuals and that this society can be partitioned geographically in several subsocieties. Amongst others, we are interested in studying whether the well-being of these subsocieties is converging over time. While we will focus in this paper on the well-being convergence between European countries, the proposed convergence analysis can be performed on other levels as well (country-groups or regions, for instance).

The outcome vector ℓ_{it} describes the life of individual i in the m well-being dimensions at period t. It will be convenient to write $\ell_{it} = (y_{it}, x_{it})$, where the first component y_{it} of the outcome vector can be interpreted as the "income" of individual i in period t. The second component x_{it} is an $(m-1)$ dimensional vector which contains the individual's "non-income" dimensions. In our empirical analysis that will be health, employment, crime and pollution.

We assume that each individual has a complete, transitive and continuous preference ordering R_i over the set of outcome vectors. We interpret $\ell_{it}\ R_i\ \ell'_{it}$ as individual's i well-considered judgement that the life described by outcome vector ℓ_{it} is at least as good as the life described by ℓ'_{it} according to her conception of the "good life".[3] We write $\ell_{it}\ I_i\ \ell'_{it}$ to denote that individual i considers both lives equivalent according to her conception of the "good life". The preferences of each individual $R_i = R(a_i)$ are modelled as a function of a k-dimensional vector of preference parameters $a_i = (a_i^1, a_i^2, \dots, a_i^k)$. The vector of preference parameters identifies the preferences of an individual uniquely. In the next section we discuss how these preference parameters can be estimated using a life satisfaction regression approach.

We are interested in a preference-based measure of individual well-being $WB(\ell_{it}, a_i)$. This measure depends on the multidimensional outcome vector ℓ_{it} of each individual as well as on her view on the good life (captured by the preference parameters a_i). We say that a measure is preference-consistent whenever it holds that:

[3] Because preferences are assumed to be stable in the main part of the paper, we do not index them with the period t.

$$WB(\ell_{it}, a_i) \geq WB(\ell'_{it}, a_i) \text{ if and only if } \ell_{it}\ R(a_i)\ \ell'_{it}.$$

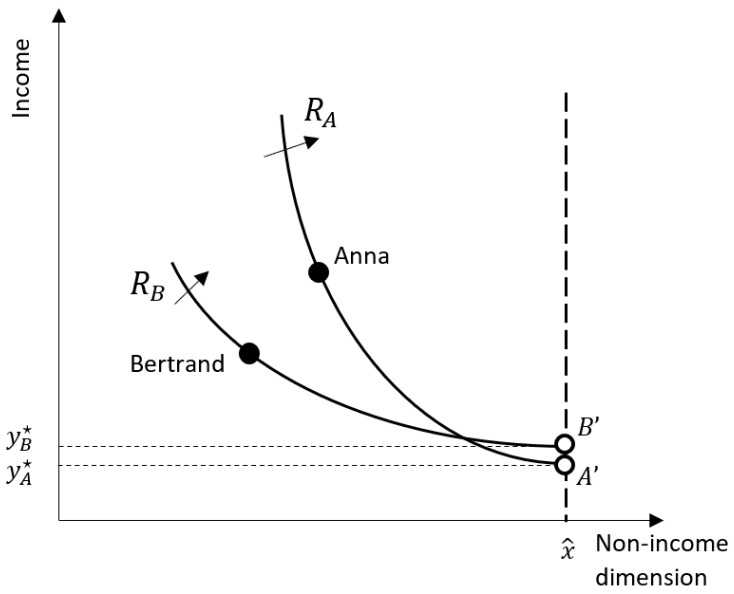
This means that when individual i considers the life described by outcome vector ℓ_{it} at least as good as the life described by ℓ'_{it}, her well-being level cannot be higher in the latter life. Indeed, assigning a higher well-being level to the life ℓ'_{it} would go against the preferences of individual i and can be considered paternalistic. As a consequence, the level of well-being of two individuals with the same outcome vectors, but a different view on the good life, can be different. This implies that researchers and policy makers who want to use a preference-consistent well-being measure need to know not only the multidimensional outcome vector of the concerned individuals, but also their preference parameters.

Recently, equivalent incomes have been proposed as a preference-based well-being measure (Decancq, Fleurbaey, & Schokkaert, 2015a; Fleurbaey et al., 2013). The equivalent income measure can be defined as follows: $WB(\ell_{it}, a_i) = y^{\star}_{it}$ where $y^{\star}_{it}$ is defined as the solution of the equation:

$$(y_{it}, x_{it})\ I(a_i)\ (y^{\star}_{it}, \hat{x}_{it}). \quad (1)$$

The equivalent income $y^{\star}_{it}$ is the hypothetical level of income that, combined with the reference value in the non-income dimensions, $\hat{x}_{it}$ keeps the individual on the indifference curve corresponding to her actual situation (Decancq et al., 2015b, 2017). The choice of the reference value is essentially a normative choice. Decancq et al. (2015a) propose to select the optimal outcome level in the non-income dimensions as a reference value. If preferences are monotonic, then the equivalent income $y^{\star}_{it}$ cannot be larger than the actual income level y_{it}. The difference between the equivalent income and the actual income level of an individual is her "willingness-to-pay" to be in the optimal outcome level in the non-income dimensions. The willingness-to-pay is larger for an individual who is further away from her optimal outcome level or who cares more about this shortfall according to her view of the good life.

Figure 1. Equivalent income as preference-consistent individual well-being measure



Source: Own elaboration

Figure 1 illustrates the equivalent income well-being measure graphically for two individuals: Anna and Bertrand. Income and only one non-income dimension are considered in the figure, but in our empirical analysis we will consider four non-income dimensions. As indicated by the black circles in the figure, Anna scores better in the income and non-income dimension than Bertrand. The vertical dashed line depicts the reference situation in which the non-income dimension reaches its optimal value. The figure also illustrates an indifference curve of each individual. The indifference curves indicate all well-being situations which are equally good to them using their personal conception of the good life. Since these indifference curves cross, Anna and Bertrand hold a different conception of the good life. The indifference curve of Anna is steeper, hence she cares more about the non-income dimension compared to Bertrand. Using these indifference curves, we see that Anna is indifferent between her own life situation and the life situation indicated by A' and Bertrand is indifferent between his own life situation and the life situation indicated by B'. The life situations A' and B' are situated on the dashed line and, hence, the non-income dimension is at its optimal level in these life situations. The equivalent income of both individuals, $y_A^\star$ and $y_B^\star$, can be read from the figure as the income level corresponding to A' and B'. Comparing both equivalent incomes, we see that Bertrand is considered better off than Anna according to the equivalent income well-being measure (even though Anna scores better on both well-being dimensions)[4]. This is because Anna, according to her conception of the good life, cares more about her shortfall in the non-income dimension than Bertrand.

A practical advantage of the equivalent income measure over other preference-based measures is that equivalent incomes are measured in monetary units (as are the actual incomes). Tools to measure inequality and convergence can consequently be used to measure well-being inequality and convergence without much adaptation.

2.2 Well-being inequality and convergence

To measure well-being inequality at the level of the society, we first define L_t as the $(n_t \times m)$ outcome matrix that consists of the outcome vectors ℓ_{it} of all n_t individuals in period t. Likewise, we use A to refer to the $(n_t \times k)$ preference matrix that consists of the preference parameters a_i of all n individuals. A measure of well-being inequality in period t takes both matrices as inputs.

In this paper, we use the Generalized Entropy class of inequality measures (Cowell, 2011) to measure inequality in the individual equivalent income well-being measures. As the individual well-being measures depend on the outcome vector and preference parameters, the measure of well-being inequality in period t depends on both the outcome matrix L_t and the preference matrix A:

$$GE_\alpha(L_t, A) = \frac{1}{\alpha(\alpha-1)n_t}\left[\sum_{i=1}^{n}\left(\frac{WB(\ell_{it}, a_i)}{\sum_{i=1}^{n} WB(\ell_{it}, a_i)/n_t}\right)^\alpha - 1\right] \qquad \text{for } \alpha \neq 0,1.$$

[4] See Fleurbaey and Trannoy (2013) and Brun and Tungodden (2004) on the incompatibility between respect for preferences and dominance.

In particular, we zoom in on the limit cases when $\alpha = 0$ (the mean logarithmic deviation) and $\alpha = 1$ (the Theil measure). These measures are given by following expressions:

$$GE_0(L_t, A) = \frac{1}{n_t}\sum_{i=1}^{n} \ln\left(\frac{\sum_{i=1}^{n} WB(\ell_{it}, a_i)/n_t}{WB(\ell_{it}, a_i)}\right) \qquad \text{for } \alpha = 0,$$

$$GE_1(L_t, A) = \frac{1}{n_t}\sum_{i=1}^{n} \frac{WB(\ell_{it}, a_i)}{\sum_{i=1}^{n} WB(\ell_{it}, a_i)/n_t} \ln\left(\frac{WB(\ell_{it}, a_i)}{\sum_{i=1}^{n} WB(\ell_{it}, a_i)/n_t}\right) \qquad \text{for } \alpha = 1.$$

All the members of the class of Generalized Entropy inequality measures satisfy the transfer principle in the well-being space, meaning that a distribution which could have been obtained from a (hypothetical) transfer from an individual who is worse-off (in the well-being distribution) to another individual who is better-off, has higher well-being inequality than the original distribution (see Decancq et al. (2017) for a comparison with multidimensional transfer principles). The lower the value of the inequality aversion parameter α, the more weight is given to transfers at the bottom of the well-being distribution compared relative to transfers at the top. Equipped with a measure of well-being inequality, we can propose a simple test of interpersonal well-being.[5]

Test 1 (Interpersonal well-being convergence). We say that there is interpersonal well-being convergence between period t_0 and t_1 for a given inequality aversion parameter α, whenever interpersonal well-being inequality decreases:

$$GE_\alpha(L_{t_0}, A) > GE_\alpha(L_{t_1}, A).$$

Likewise, we speak about well-being divergence when well-being inequality increases over time (i.e., when the inequality above is reversed). The difference between both inequality measures captures the size of the convergence or divergence between both periods.

Although we choose to work with the class of Generalized Entropy inequality indices, other measures of inequality, such as the Gini coefficient, Atkinson or Kolm inequality indices, could be used as well.

2.3 Decomposing well-being inequality

To decompose well-being inequality, it is useful to define some smoothed (counterfactual) outcome and preference matrices. The smoothed matrices are based on the actual observed outcome matrix L_t and the estimated preference matrix A and are obtained by averaging by country or across the EU as a whole. Table 1 provides an overview. The smoothed outcome matrix $\bar{L}_t^C$ replaces, for each individual, her actual outcomes by the average outcomes of the subsociety (country) in which the individual lives. The smoothed outcome matrix $\bar{L}_t^{EU}$ replaces the actual outcomes of each individual by the EU-wide average outcomes. Similarly, we define a preference matrix $\bar{A}^C$ in which each

[5] Note that the Generalized Entropy inequality measures are ordinally equivalent to the Atkinson inequality measures for $\gamma = 1 - \varepsilon < 1$.

individual in a given country obtains the same preference parameters (and, hence, holds the same view of the good life). The remaining preference heterogeneity across the countries is smoothed away in $\bar{A}^{EU}$, which captures a common, pan-European, view on the good life.

Table 1. Building blocks for the decomposition analysis

Outcomes	L_t	Outcome matrix in period t
	$\bar{L}_t^C$	Outcome matrix in period t smoothed by country
	$\bar{L}_t^{EU}$	Outcome matrix in period t smoothed across the EU
Preferences	A	Preference matrix
	$\bar{A}^C$	Preference matrix smoothed by country
	$\bar{A}^{EU}$	Preference matrix smoothed across the EU

Source: Own elaboration

Decomposition of well-being inequality in a within- and between-component

To decompose total well-being inequality in a within-component and a between-component, we compare the total well-being inequality with the counterfactual well-being inequality when the outcome and preference matrix would be smoothed at the pan-European level, i.e., $GE_\alpha(\bar{L}_t^{EU}, \bar{A}^{EU})$. In this case, all Europeans would obtain the same well-being level so that no well-being inequality remains and $GE_\alpha(\bar{L}_t^{EU}, \bar{A}^{EU}) = 0$.

To obtain the *between-component*, we compute well-being inequality in the counterfactual case when all individuals in the same country would have the same outcome vector and the same preference parameters, i.e., $GE_\alpha(\bar{L}_t^C, \bar{A}^C)$. We call it the intercountry well-being inequality. In this smoothed case all individuals in the same country have the same well-being level and, consequently, there is no within-country inequality in well-being. The *within-component* of the decomposition is then obtained as the residual by subtracting the country-level smoothed well-being inequality from total well-being inequality. The full decomposition of well-being inequality can be written as follows:

$$GE_\alpha(L_t, A) - \underbrace{GE_\alpha(\bar{L}_t^{EU}, \bar{A}^{EU})}_{=0} = \underbrace{GE_\alpha(L_t, A) - GE_\alpha(\bar{L}_t^C, \bar{A}^C)}_{within-component} + \underbrace{GE_\alpha(\bar{L}_t^C, \bar{A}^C) - GE_\alpha(\bar{L}_t^{EU}, \bar{A}^{EU})}_{between-component} \quad (2)$$

Based on the definition of the intercountry well-being inequality, we define a second test of well-being convergence that focusses on the convergence between countries.

Test 2 (Intercountry well-being convergence). We say that there is intercountry well-being convergence between period t_0 and t_1 for a given inequality aversion parameter α, whenever intercountry well-being inequality decreases:

$$GE_\alpha(\bar{L}_{t_0}^C, \bar{A}^C) > GE_\alpha(\bar{L}_{t_1}^C, \bar{A}^C).$$

The decomposition in equation (2) can be interpreted as a multidimensional extension of the standard (unidimensional) decomposition of the Generalized Entropy inequality measure in a between and

within component.[6] The within-component depends on the well-being inequality measured in each country.

To understand which countries contribute more to the within-component, we will provide a further decomposition that highlights the marginal contribution of each country to the within-component. We will do that by smoothing the outcomes and preference parameters of each country separately. As this decomposition isolates the marginal contribution of each country, there is no guarantee that the country contributions precisely sum to the within-component.[7]

$$\underbrace{GE_\alpha(L_t, A) - GE_\alpha(\bar{L}_t^C, \bar{A}^C)}_{within-component} = \underbrace{GE_\alpha(L_t, A) - GE_\alpha(\bar{L}_t^{C:r}, \bar{A}^{C:r})}_{Marginal\ contribution\ of\ country\ r} + \underbrace{GE_\alpha(\bar{L}_t^{C:r}, \bar{A}^{C:r}) - GE_\alpha(\bar{L}_t^C, \bar{A}^C)}_{residual}$$

In this decomposition, $\bar{L}_t^{C:r}$ denotes the outcome matrix where the outcomes of country r are smoothed at the country-level and $\bar{A}^{C:r}$ denotes the preference matrix where the preference parameters of country r are smoothed at the country-level. The residual contains the contribution of the other countries to the within component, as well as the interactions between the different countries.

Effect of preferences and outcomes on the between component

First, we zoom in on the between-component of the decomposition in equation (2). This component is obtained by subtracting $GE_\alpha(\bar{L}_t^{EU}, \bar{A}^{EU})$ from $GE_\alpha(\bar{L}_t^C, \bar{A}^C)$ and, hence, it involves a smoothing of the outcomes as well as a smoothing of the preference parameters. To understand whether the main driver of intercountry well-being inequality is the dispersion in outcomes or the dispersion in preferences, we present the following decomposition of the between-component, which we call the outcome-first decomposition of the between-component:

$$\underbrace{GE_\alpha(\bar{L}_t^C, \bar{A}^C) - GE_\alpha(\bar{L}_t^{EU}, \bar{A}^{EU})}_{between-component} = \underbrace{GE_\alpha(\bar{L}_t^C, \bar{A}^C) - GE_\alpha(\bar{L}_t^{EU}, \bar{A}^C)}_{between-outcomes} + \underbrace{GE_\alpha(\bar{L}_t^{EU}, \bar{A}^C) - GE_\alpha(\bar{L}_t^{EU}, \bar{A}^{EU})}_{between-preferences}$$

The first term of the outcome-first decomposition is obtained by smoothing the outcome matrix while keeping the preference matrix unaltered. In the second step the preference matrix is smoothed. As is well-known with this kind of (path-dependent) decompositions, the sequence of both smoothing

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[6] An alternative procedure would be to apply the standard (unidimensional) decomposition on the distribution of the individual well-being indices. Both decompositions define a different between-component (to be precise, $GE_\alpha(\bar{L}_t^C, \bar{A}^C) \neq GE_\alpha(\overline{WB}^C(L_t, A))$ where $\overline{WB}^C(L_t, A)$ refers to the vector of the individual well-being measures of all European citizens, smoothed by country). This alternative procedure has the advantage that the within component equals a weighted average of the well-being inequality measured in each country. In general, the weights depend on the well-being and the population shares of the countries. Yet, this alternative decomposition would not allow us to reveal the separate role played by the outcomes and preferences.

[7] The marginal contribution of countries could also be computed with decomposition techniques based on the Shapley value, as proposed by Chantreuil and Trannoy (2013); Shorrocks (2013). In the Shapley value decomposition, the marginal contribution of each country is the average of its contributions across all possible elimination sequences. The advantage to this method is that the marginal contributions add up to the within-component. The disadvantage, however, is that the averaged effect is hard to interpret. In addition, in the empirical analysis the number of sequences is extremely large.

operations can be altered, which leads to a related, but different decomposition of the between-component. We call this the preference-first decomposition of the between-component:

$$\underbrace{GE_\alpha(\bar{L}_t^C, \bar{A}^C) - GE_\alpha(\bar{L}_t^{EU}, \bar{A}^{EU})}_{between-component} = \underbrace{GE_\alpha(\bar{L}_t^C, \bar{A}^C) - GE_\alpha(\bar{L}_t^C, \bar{A}^{EU})}_{between-preferences} + \underbrace{GE_\alpha(\bar{L}_t^C, \bar{A}^{EU}) - GE_\alpha(\bar{L}_t^{EU}, \bar{A}^{EU})}_{between-outcomes}$$

As there seems no unambiguous reason to favour one decomposition over the other, we will report them both in the empirical analysis of this paper.

Effect of preferences and outcomes on the within component

Similarly, the within-component can be further decomposed to highlight the relative importance of the smoothing of outcomes and the smoothing of preferences at the country level. The outcome-first decomposition of the within-component can be written as:

$$\underbrace{GE_\alpha(L_t, A) - GE_\alpha(\bar{L}_t^C, \bar{A}^C)}_{within-component} = \underbrace{GE_\alpha(L_t, A) - GE_\alpha(\bar{L}_t^C, A)}_{within-outcomes} + \underbrace{GE_\alpha(\bar{L}_t^C, A) - GE_\alpha(\bar{L}_t^C, \bar{A}^C)}_{within-preferences}$$

The first term of this decomposition captures the smoothing of the outcomes within countries, whereas the second term captures the smoothing of the preference parameters. Also this decomposition is path-dependent and an alternative decomposition can be made, changing the sequence of the smoothing of preferences and outcomes. We call this the preference-first decomposition of the within-component.

$$\underbrace{GE_\alpha(L_t, A) - GE_\alpha(\bar{L}_t^C, \bar{A}^C)}_{within-component} = \underbrace{GE_\alpha(L_t, A) - GE_\alpha(L_t, \bar{A}^C)}_{within-preferences} + \underbrace{GE_\alpha(L_t, \bar{A}^C) - GE_\alpha(\bar{L}_t^C, \bar{A}^C)}_{within-outcomes} \quad (3)$$

Together, the outcome-first (or the preference-first) decompositions of the within and the between-component provide a full decomposition of total well-being inequality in four components.

To highlight the marginal contribution of the different well-being dimensions, we can provide a further decomposition of the second term in equation (3). In this decomposition, the smoothing of the outcomes in the second step at the country level is done for each dimension separately, while the other dimensions remain unaffected. This decomposition provides information on the marginal contribution of dimension j. Again, the marginal decomposition analysis does not guarantee that the sum of the contributions of all dimensions equals the joint contribution of all dimensions together. It can be written as follows:

$$\underbrace{GE_\alpha(L_t, \bar{A}^C) - GE_\alpha(\bar{L}_t^C, \bar{A}^C)}_{within-outcomes} = \underbrace{GE_\alpha(L_t, \bar{A}^C) - GE_\alpha(\bar{L}_t^{C:j}, \bar{A}^C)}_{marginal\ contribution\ of\ dimension\ j} + \underbrace{GE_\alpha(\bar{L}_t^{C:j}, \bar{A}^C) - GE_\alpha(\bar{L}_t^C, \bar{A}^C)}_{residual}$$

Where $\bar{L}_t^{C:j}$ is the outcome matrix were only the dimension j is smoothed (at the country level). The residual contains the contribution of the other dimensions to the within component, as well as the interactions between the dimensions.

3. Data

We use data from the EU Statistics on Income and Living Conditions (EU-SILC) between 2005 and 2019. The EU-SILC contains harmonized information on income and living standards for European countries. Moreover, in 2013 and 2018 the EU-SILC includes an ad-hoc module on well-being, containing a life satisfaction question and information about individual personality traits.

We restrict our sample to 23 countries for which data is available in all survey waves.[8] We restrict the sample to adult individuals (18+) with complete information on all variables included in the analysis. We reweight the sample to correct for item non-response so that the weighted sample size of each country equals the population size of the country in that year, based on Eurostat figures.

3.1 Outcomes

Aside from detailed information on income, the EU-SILC contains questions regarding four non-monetary dimensions of life: health, unemployment, crime and pollution. The choice for these dimensions is driven by pragmatic considerations about data availability, rather than a full-fledged theory on the relevant dimensions of well-being (see, e.g., Nussbaum (2000)). Table 2 summarizes the indicators used to measure each well-being dimension and the reference value selected to compute the equivalent income well-being measure.

Table 2. Dimensions of well-being

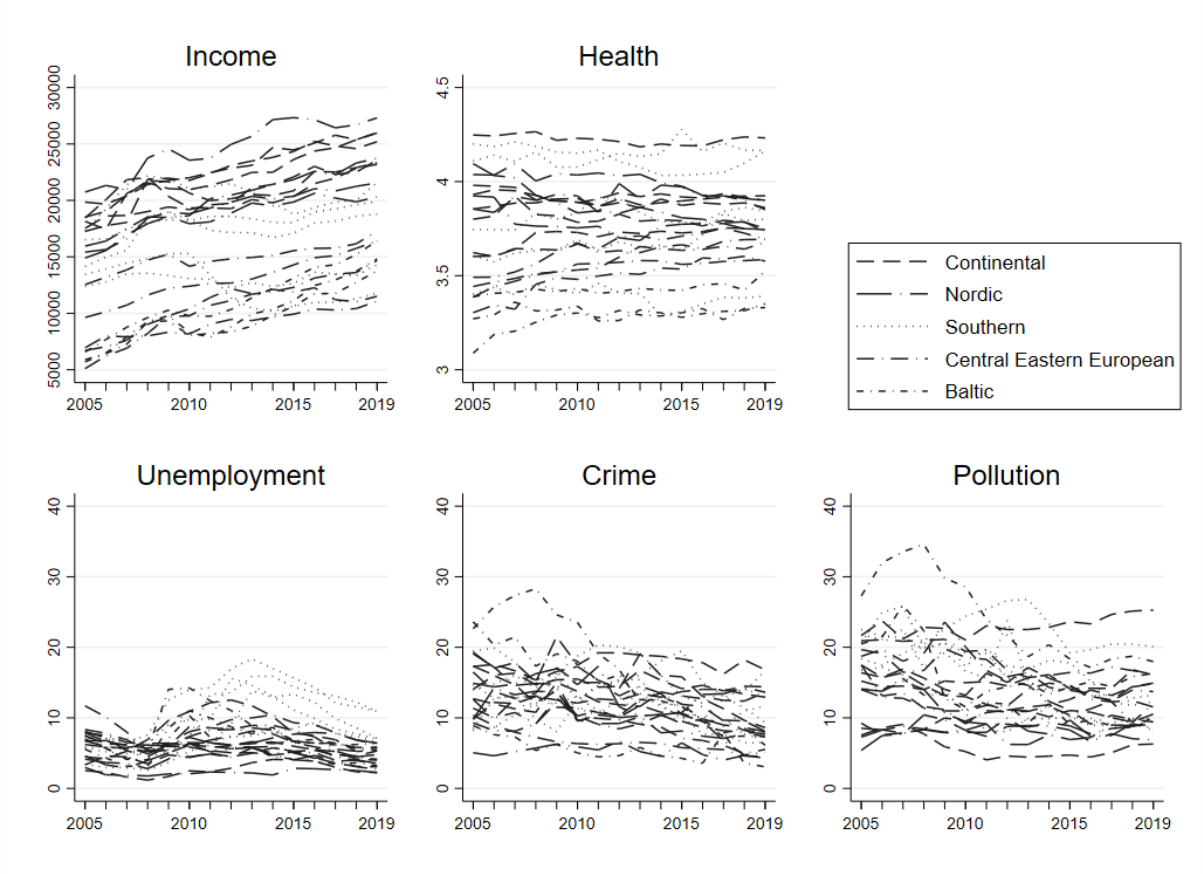
Dimension	Indicator	Reference value
Income (y)	Equivalized disposable income (in € PPP)	
Unemployment (u)	Unemployment status (binary)	Employment
Crime (c)	Self-assessed crime (binary)	No crime
Pollution (p)	Self-assessed pollution (binary)	No pollution
Health (h)	Self-assessed health (on 5-point scale)	Very good health

Source: Own elaboration

[8] These countries are Austria (AT), Belgium (BE), Cyprus (CY), Czech Republic (CZ), Germany (DE), Denmark (DK), Estonia (EE), Spain (ES), Finland (FI), France (FR), Greece (EL), Hungary (HU), Ireland (IE), Italy (IT), Latvia (LV), Lithuania (LT), Netherlands (NL), Norway (NO), Poland (PL), Portugal (PT), Sweden (SE), Slovenia (SI), Slovakia (SK).

Income is operationalized using disposable income. We correct for household composition and size by the modified OECD equivalence scale.[9] In addition, to correct for price level differences across countries, we convert incomes to € PPP using conversion factors provided by Eurostat. Health is operationalized with self-assessments of the respondents' general health status, measured on a 5-point scale from very bad health to very good health. In the analysis, we treat this variable as cardinal and interpersonally comparable. The unemployment variable is derived from a question on self-defined current economic status. The binary variable takes the value of 1 only for those individuals who classify themselves as unemployed. The indicator for crime refers to the respondent's assessment of issues of crime, violence or vandalism in the area. Similarly, pollution refers to the assessment of problems with pollution, grime or other environmental problems in the area. Our list of life dimensions includes a combination of positively formulated dimensions (e.g., health) and some negatively formulated ones (e.g., crime). The equivalent income approach is flexible enough to handle this. For all variables, we set the reference values to the 'best' value (see Fleurbaey and Blanchet (2013) for a discussion).

Figure 2. Well-being dimensions: trends



Source: Own calculations, based on EU-SILC data

[9] It is important to distinguish between the notions of "equivalent income", which we use as measure of multidimensional well-being, and "equivalized disposable income", which we use to refer to disposable income after correction for the household composition and size by an equivalence scale.

The dashboard in Figure 2 shows the trend of the five well-being dimensions. While the income dimension shows an overall increasing trend for most countries, for some (Southern) countries the effects of the Great Recession are clearly visible. The health dimension shows a more stable trend for most countries, with the bottom performers (Baltic countries) in 2005 gradually catching up. The unemployment rate for nearly all considered countries is below 10% in 2005, then it sharply increases during the Great Recession for some (Southern) countries after which it gradually returns to its initial level. The crime dimension shows overall a mildly decreasing trend, as does the pollution dimension. Based on this dashboard it is hard to judge whether there is well-being convergence between the European countries. Moreover, the dashboard remains blind for the trend of well-being inequality within the European countries.

3.2 Estimating preferences with the life satisfaction approach

While we observe the outcomes in the EU-SILC, the data set does not provide direct information about the preferences that capture the conception of the good life of the European citizens. We use a life satisfaction regression approach to estimate the preference parameters based on data from the ad-hoc module on well-being in 2013 and 2018.

The explained variable in the life satisfaction regression is the individual life satisfaction score of individual i in period t, denoted s_{it}. The explanatory variables consist of the outcome vector ℓ_{it} (where income and health are logarithmically transformed to capture non-linear effects and to improve the empirical fit of the model); a time dummy; a series of individual control variables z_{it} that includes age, gender, educational level, place of residence (rural or otherwise), marital, migration and economic status; a vector of individual personality traits and an error term ε_{it}:

$$s_{it} = \underbrace{\alpha^y \ln(y_{it}) + \alpha^h \ln(h_{it}) + \alpha^u u_{it} + \alpha^c c_{it} + \alpha^p p_{it}}_{well-being\ dimensions} + \underbrace{\beta_t + \gamma z_{it} + \varepsilon_{it}}_{scaling\ factors}$$

We retrieve the preference parameters from the coefficients of the well-being dimensions in the outcome vector in the regression. To do that, we assume that the individual life satisfaction scores are consistent with the preferences of the individual as discussed before: $s(\ell_{it}) \geq s(\ell'_{it})$ if and only if $\ell_{it}\ R(a_i)\ \ell'_{it}$. This consistency assumption requires that individuals assign life satisfaction scores to outcome vectors using their conception of the "good life". While the consistency assumption is hard to test empirically, it allows us to retrieve the individual preference parameters a_i from the life satisfaction regression as the estimated α-coefficients (see Decancq et al. (2015a); (2015b) and Decancq and Schokkaert (2016) for discussions). The time dummy β_t and control variables z_{it} are included in the regression to capture factors which may influence the aspiration level of the individual and consequently their life satisfaction. These variables are not considered as well-being dimensions (although they may be correlated with them) and are called scaling factors as they can be interpreted as variables that determine the way in which an individual uses the response scale of the life satisfaction question (Fleurbaey & Blanchet, 2013). Scaling factors are not used to compute the equivalent income well-being measures as will be illustrated below.

We run three life satisfaction regressions to obtain the necessary preference parameters to construct the preferences matrices A, $\bar{A}^C$, and $\bar{A}^{EU}$. The first regression is estimated with pooled data for all European citizens in the EU-SILC samples in 2013 and 2018. This estimation leads to a preference matrix $\bar{A}^{EU}$ in which the parameters are common for all citizens of the EU and stable over time. Second, we run the above regressions country-by-country, so that the estimated coefficients are country-specific (but common across all citizens of the same country). This provides us with the preference matrix $\bar{A}^C$. Finally we run the third, and most flexible, regression. This regression starts from the second country-specific models and includes in each model interactions between the coefficients of interest and five socio-demographic variables. Specifically, we include interactions between the life dimensions and age (continuous) and dummies indicating whether the respondent is female, has completed tertiary education, was born in the country of residence or not, and whether the place of residence is rural or urban. While this model is still far removed from estimating individual preferences, we allow for considerable preference heterogeneity between the European citizens in the resulting preference matrix A.

Table 3. Common European preference parameters

	Pooled coefficient	
Income (in logarithm)	0.288***	(0.003)
Health (in logarithm)	1.646***	(0.008)
Unemployment	-0.758***	(0.009)
Crime	-0.134***	(0.007)
Pollution	-0.099***	(0.007)
Time dummy 2018	✓	
Control variables	✓	
N	562843	
R^2	0.346	

Note: Standard errors between parentheses. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Own calculations based on EU-SILC data

The first column of Table 3 presents the relevant coefficients of the first regression model, with common preference parameters for all European citizens. The full model (including control variables) is shown in Appendix 1. All coefficients are significantly different from 0 at high significance levels ($p < 0.001$). In this model, all European countries are pooled as well as both waves (2013 and 2018) in which the life satisfaction variable is available. The latter is consistent with our assumption of preference stability over the rather short period considered.[10]

[10] As shown in Appendix 1, we test whether the preference parameters are stable between 2013 and 2018. An

In Appendix 1 we show the coefficients of the country-specific regressions, which are used to construct $\bar{A}^C$. These coefficients indicate considerable cross-country preference differences. We also show the coefficients for the interactions between life dimensions and the socio-demographic variables, which are used to construct A. Here too, there is considerable variation in the magnitude of the different interactions across countries.

There are several limitations to the life satisfaction approach to estimate preferences. A first issue relates to the potential endogeneity of income, which may lead to an underestimation of the effect of income on life satisfaction (e.g. Powdthavee (2010)). Moreover, the self-reported variables such as health may be highly (and spuriously) correlated because a similar subjective reporting scale is used. As noted by Ferrer-i-Carbonell and Frijters (2004), the use of an individual fixed effects regression would be preferred, in order to control for unobserved individual time-invariant characteristics that otherwise could bias estimations. Unfortunately, the SILC data set does not permit the inclusion of individual fixed effects. Finally, the life satisfaction approach assumes that a variable can be unambiguously classified as a dimension of life or a scaling factor. Yet, in reality such a clear-cut classification may not always be possible. Education, for instance, can be argued to be an important well-being dimension, but at the same time it may also influence the aspiration level of the respondents (see, e.g., Capéau et al. (2020)). We decide here to treat education as a factor that determines the aspiration level, so that it cannot be used as a well-being dimension.

Based on the estimated preference parameters, the equivalent incomes can be computed using its implicit definition in equation (1):

$$\begin{aligned} s_{it} &= \alpha^y \ln(y_{it}) + \alpha^h \ln(h_{it}) + \alpha^u u_{it} + \alpha^c c_{it} + \alpha^p p_{it} + \beta_t + \gamma z_{it} + \varepsilon_{it} \\ &= \alpha^y \ln(y^\star_{it}) + \alpha^h \ln(\hat{h}) + \alpha^u \hat{u} + \alpha^c \hat{c} + \alpha^p \hat{p} + \beta_t + \gamma z_{it} + \varepsilon_{it} \end{aligned}$$

Solving this equation for $y^\star_{it}$ yields the following expression for the equivalent incomes:

$$y^\star_{it} = y_{it} \times exp\left[\frac{\alpha^h}{\alpha^y}\left[\ln(h_{it}) - \ln(\hat{h})\right] + \frac{\alpha^u}{\alpha^y}[u_{it} - \hat{u}] + \frac{\alpha^c}{\alpha^y}[c_{it} - \hat{c}] + \frac{\alpha^p}{\alpha^y}[p_{it} - \hat{p}]\right] \quad (4)$$

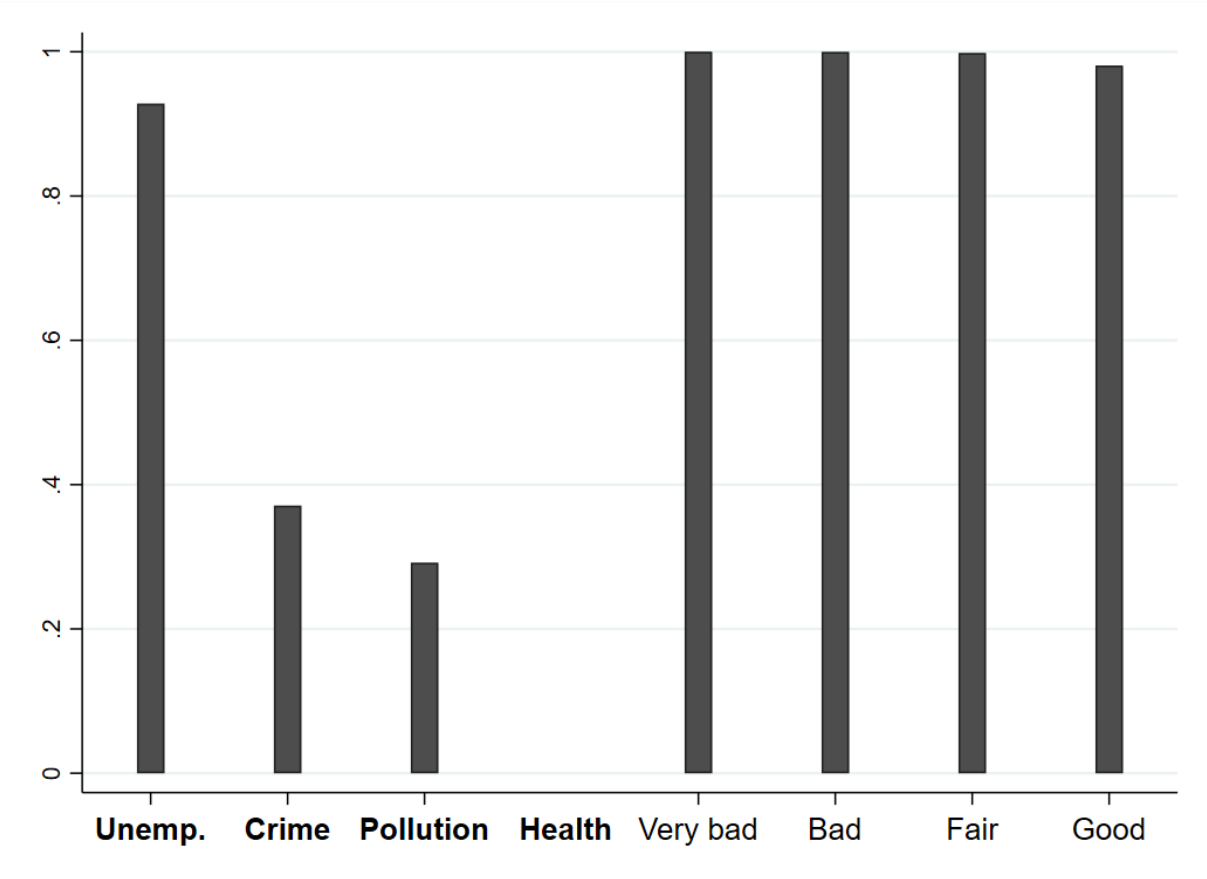
Inspecting this expression, we can notice indeed that the equivalent incomes depend on the outcomes of the individual, the reference values in the non-income dimensions and the α -coefficients, but not on any of the scaling factors.

With the estimated coefficients, we can compute individuals' willingness-to-pay (WTP) for the non-income life dimensions. The WTP of a non-income dimension indicates how much individuals would be willing to pay to achieve the reference value in that dimension. It is expressed as a percentage of income. Figure 3 shows the WTP for each life dimension based on the common European preference parameters. For health we compute the WTP to be in very good health at each of the four other health

F-test of the joint significance of interactions between a wave dummy and the five well-being dimensions ($F(6, 562797) = 129.1, p = 0.000$) indicates that the preference parameters have significantly changed over time. Studying how the results are affected by changing preferences over time, is left as an avenue for further research.

categories (very bad, bad, fair, and good). It becomes immediately clear that the WTP for health and unemployment is very high. Individuals would be willing to give up more than 85% of their income not to be unemployed or to be in very good health (rather than any other category). While these estimates are very large, they are in line with those obtained in other studies using the life satisfaction approach to estimate preferences (e.g., Decancq and Schokkaert (2016); Ledić and Rubil (2020)).

Figure 3. Willingness-to-pay to reach the reference level in each life dimension, based on common preference parameters



Source: Own calculations, based on EU-SILC data

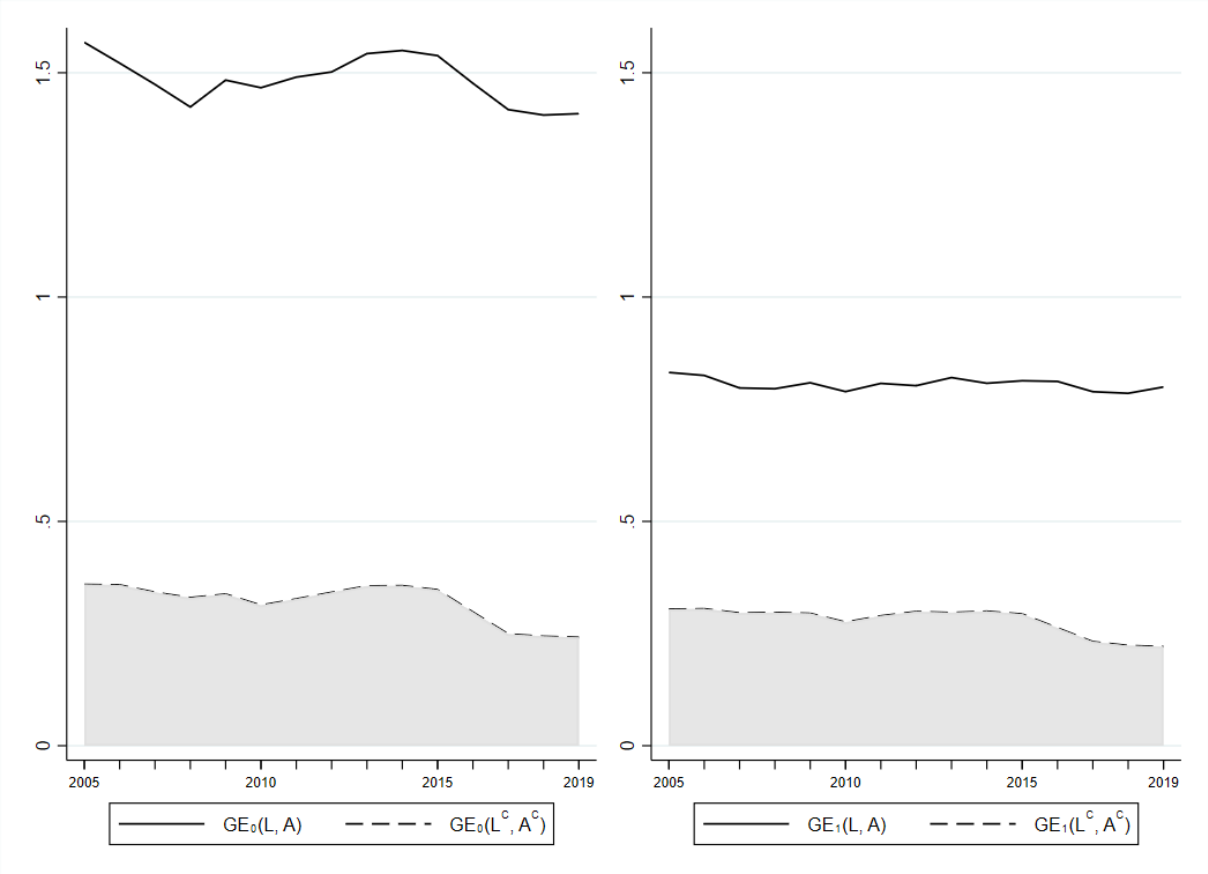
4. Results

In this section, we focus first on the evolution of interpersonal well-being inequality (Convergence Test 1) and intercountry well-being inequality (Convergence Test 2). Then, we analyze how these results are influenced by the different components using the decompositions discussed in Section 2.

4.1 Well-being inequality and convergence

As shown in the left-hand panel of Figure 4, there has been mild well-being convergence between 2005 and 2019 based on the mean logarithmic deviation (GE_0) inequality measure, both for interpersonal well-being inequality level (depicted in the left-hand panel by the full black line) as for intercountry well-being inequality level (depicted by the dashed line and shaded area below it).

Figure 4. Trend in interpersonal well-being inequality $GE_\alpha(L_t, A)$ and intercountry well-being inequality $GE_\alpha(\bar{L}_t^C, \bar{A}^C)$ for $\alpha = 0$ (left) and $\alpha = 1$ (right)



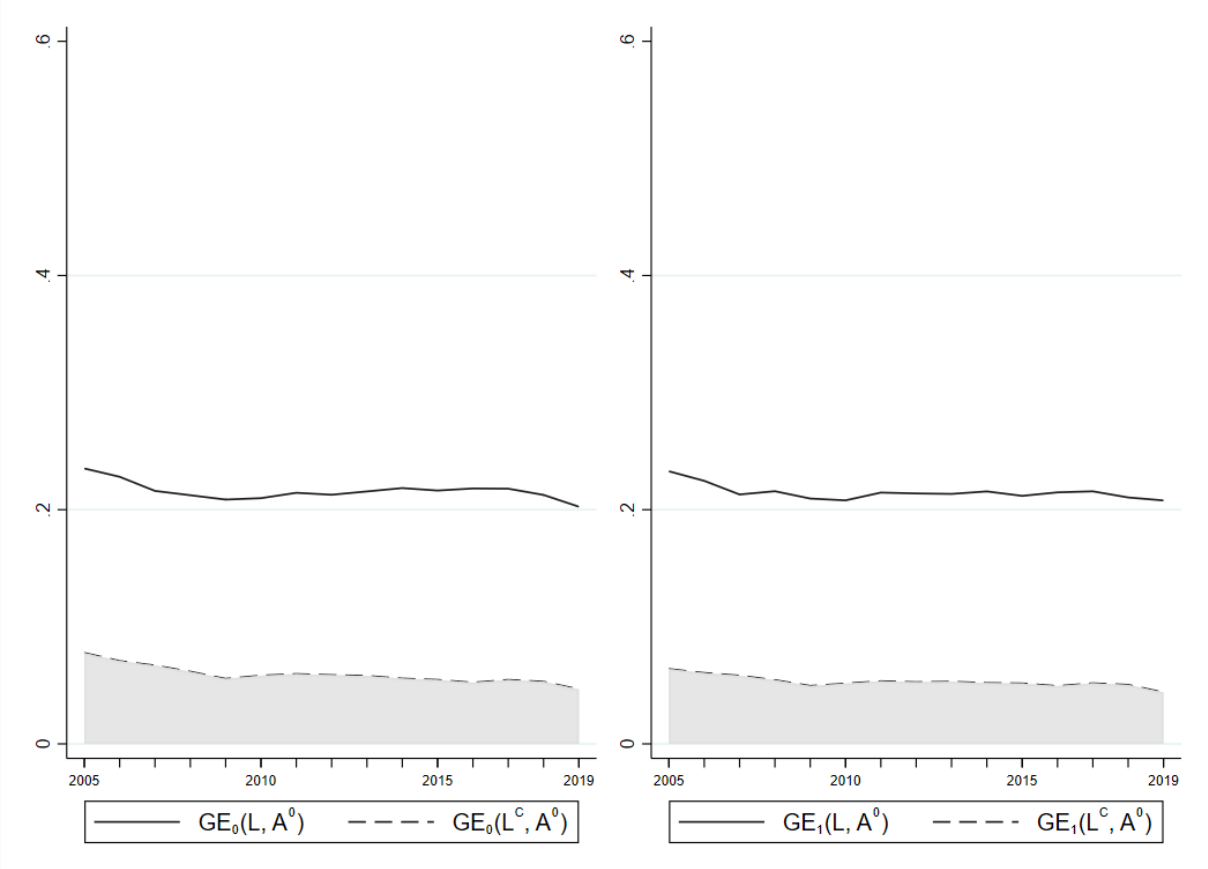
Source: Own calculations, based on EU-SILC data

With regards to interpersonal well-being inequality, we can distinguish three periods with varying trends in equality. Before the onset of the Great Recession (i.e., between 2005 and 2008), well-being inequality decreased sharply. During the Great Recession (i.e., between 2008 and 2015), inequality

between EU citizens increased. The highest level of interpersonal well-being inequality is reached in 2014-2015. After the Great Recession (i.e., between 2015 and 2019) inequality first decreased sharply. In 2018, interpersonal well-being inequality reaches its lowest point in the time period considered (see Table 4). Afterwards interpersonal inequality stabilized at its pre-Great Recession levels. Most of the interpersonal well-being inequality is due to well-being inequalities within countries, rather than inequalities between countries. Between 2005 and 2019, intercountry well-being inequality is found to be rather stable, with the exception of the period 2015-2017, when intercountry well-being inequality decreased.

We show the same decomposition using the Theil index (GE_1) in the right-hand panel. Compared to the mean logarithmic deviation (GE_0), this measure gives larger weights to well-being transfers at the top of the distribution. Comparing both panels, we see that the level and evolution of the intercountry well-being is similar. Yet, the level of the interpersonal well-being inequality is considerably smaller, and the trend of the interpersonal well-being inequality is more stable when measured with the Theil index (GE_1). This suggests that well-being inequality within countries (the unshaded area in Figure 4) is mostly situated at the bottom of the well-being distribution.

Figure 5. Trend in interpersonal income inequality $GE_\alpha(L_t, A^0)$ and intercountry income inequality $GE_\alpha(\bar{L}_t^C, A^0)$, for $\alpha = 0$ (left) and $\alpha = 1$ (right)



Source: Own calculations, based on EU-SILC data

To provide some background for the interpretation of these figures, we construct a counterfactual preference matrix A^0. In this preference matrix, we replace all the preference parameters of the non-

income dimensions (health, unemployment, crime and pollution) by 0. In this case, only income matters for well-being and, hence, equivalent income equals disposable income (see equation 4). In other words, in this case we follow the standard approach of measuring inequality and convergence by focusing on the income dimension only. In Figure 5, we show the interpersonal and intercountry income inequality, measured by GE_0 and GE_1. Disregarding the non-monetary life dimensions leads to considerably lower levels of interpersonal and intercountry inequality. The evolution of interpersonal income inequality using the GE_0 shows a period of convergence between 2005 and 2009, but is relatively stable in the following years. Similarly, intercountry inequality based on the GE_0 shows a decreasing trend over time. This suggests that the change in (multidimensional) well-being inequality following the Great Recession can be largely attributed to changes in non-monetary life dimensions.

Table 4. Interpersonal and Intercountry convergence test of year in the column over the year in the row

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
2005	-	1&2	1&2	1&2	1&2	1&2	1&2	1&2	1&2	1&2	1&2	1&2	1&2	1&2	1&2
2006		-	1&2	1&2	1&2	1&2	1&2	1&2	2	2	2	1&2	1&2	1&2	1&2
2007			-	1&2	2	1&2	2	2				2	1&2	1&2	1&2
2008				-		2	2					2	1&2	1&2	1&2
2009			1	1&2	-	1&2	2					1&2	1&2	1&2	1&2
2010				1		-						2	1&2	1&2	1&2
2011			1	1	1	1&2	-					1&2	1&2	1&2	1&2
2012			1	1&2	1&2	1&2	1&2	-				1&2	1&2	1&2	1&2
2013		1	1&2	1&2	1&2	1&2	1&2	1&2	-		1&2	1&2	1&2	1&2	1&2
2014		1	1&2	1&2	1&2	1&2	1&2	1&2	1&2	-	1&2	1&2	1&2	1&2	1&2
2015		1	1&2	1&2	1&2	1&2	1&2	1&2			-	1&2	1&2	1&2	1&2
2016			1	1		1						-	1&2	1&2	1&2
2017													-	1&2	1&2
2018														-	2
2019														1	-

Note: A '1' indicates that $GE_0(L_t, A)$ of the year in the column is strictly lower than the row year, whereas a '2' denotes the same for $GE_0(\bar{L}_t^C, \bar{A}^C)$.

Source: Own calculations, based on EU-SILC data

In Table 4, all pairwise comparisons between years are shown for the GE_0 inequality measure. A '1' in the table refers to the first convergence test and indicates that $GE_0(L_t, A)$ of the year in the column is strictly lower than the row year, whereas a '2' refers to the second convergence test and indicates that $GE_0(\bar{L}_t^C, \bar{A}^C)$ of the year in the column is strictly lower than the row year. In most cases both tests

lead to the same result, but not in all. Whereas interpersonal well-being inequality (Test 1) increases between 2018 and 2019, intercountry well-being inequality has decreased (Test 2) in the same period, for instance. This means that between 2018 and 2019, the within component of well-being inequality has increased more than the between component of well-being inequality has decreased.

4.2 Marginal contribution of countries to the within component

In this section, we compute the marginal contribution of each country to the within component of well-being inequality (i.e., the unshaded area in Figure 4). As discussed in Section 2, we measure this marginal contribution by constructing a counterfactual well-being distribution in which the outcome and preference matrix of one country are smoothed, keeping the outcome and preference matrices of the remaining countries unchanged. Inequality in this counterfactual distribution is denoted by $GE_\alpha(\bar{L}_t^{C:r}, \bar{A}^{C:r})$. For example, the difference between observed interpersonal inequality, $GE_\alpha(L, A)$, and the counterfactual well-being inequality $GE_\alpha(\bar{L}_t^{C:BE}, \bar{A}^{C:BE})$ indicates the marginal contribution of Belgium to well-being inequality across European citizens.

Table 5 provides the marginal contribution of each country to the within component in 2005, 2010, 2015 and 2019, expressed as a percentage (of the within component of well-being inequality). Countries are ranked in the table according to the marginal contribution in 2019. To interpret the magnitude of these marginal contributions, the population and well-being share of each country in 2019 is shown in the first two columns. Together, the marginal contributions of all 23 countries add up to about 75% of the within component of well-being inequality.

In 2019, the country with the largest contribution to the within component was Germany (DE) in line with its large population and well-being share. The contributions of France (FR), Poland (PL), and Spain (ES) are of comparable magnitude in 2019. The fifth largest contributor is Italy (IT). Interestingly, the evolution of the marginal contribution of these countries is quite different. The marginal contribution of Germany and France is rather stable over time, whereas the contribution of Poland is declining and the one of Spain and Italy is increasing over time (in particular during the Great Recession). In Poland, this decline in contribution is related to a decline in well-being inequality within the country (as shown in Appendix 2). Compared to its population and well-being share, the marginal contribution of Austria (AT), Ireland (IE) and, perhaps surprisingly, Sweden (SE) is rather large. Countries with a small marginal contribution to the within component are Latvia (LV), Cyprus (CY), Slovenia (SI) and Slovakia (SK). These four countries have relatively low levels of within-country inequality in well-being compared to the other countries.

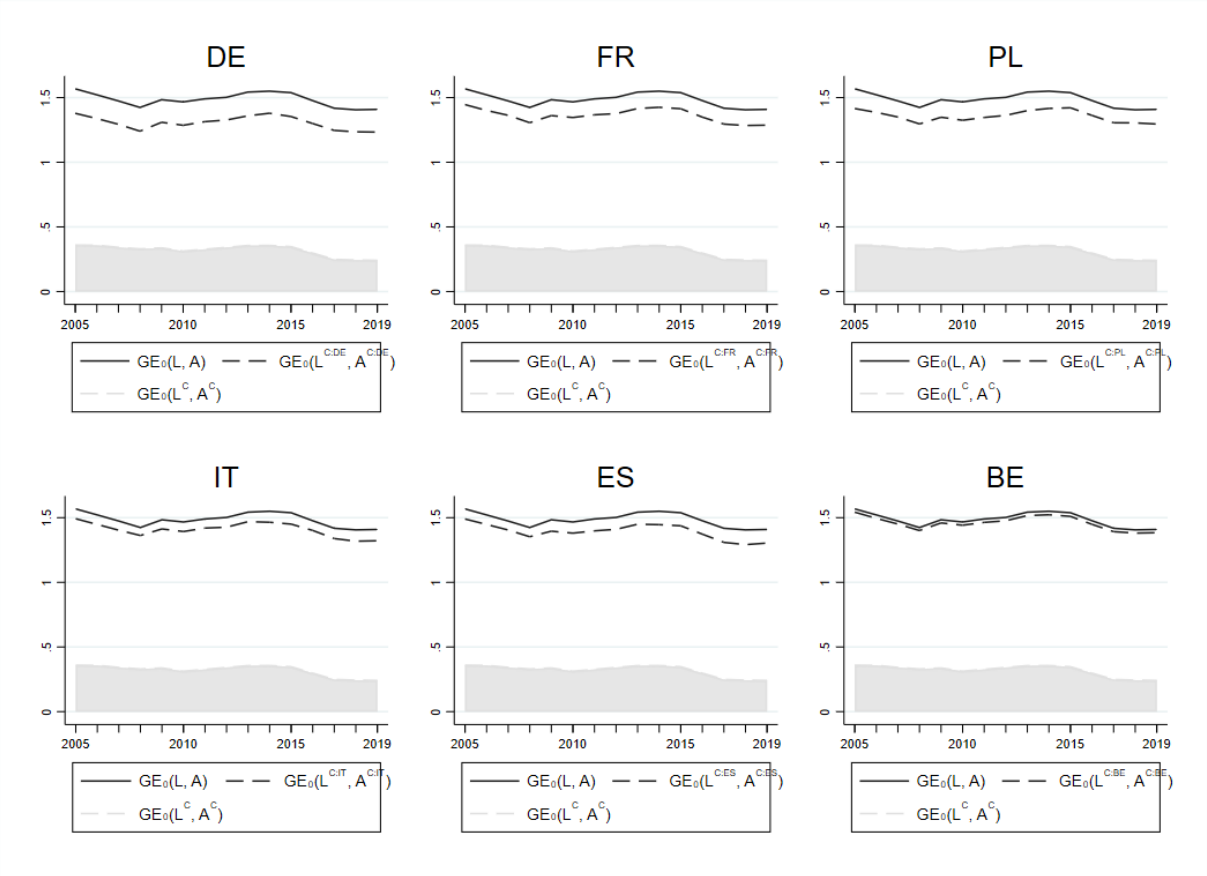
Table 5. Marginal contribution of each country to the within component of well-being inequality (as percentage)

	Pop. share	WB share	2005	2010	2015	2019
DE	19,8	23,1	15,6	15,7	15,5	15,1
FR	16,0	21,6	10,1	10,5	10,4	10,4
PL	9,0	8,1	12,6	12,3	9,8	9,7
ES	11,2	6,9	6,4	7,5	8,5	9,0
IT	14,2	9,6	6,3	6,4	7,4	7,5
SE	2,4	3,3	4,2	3,3	4,9	4,2
AT	2,1	2,6	2,7	2,6	3,2	3,5
NL	4,1	4,5	3,1	3,3	3,2	3,2
IE	1,2	1,8	2,0	1,9	2,0	2,2
DK	1,4	1,2	2,3	2,5	2,4	2,2
BE	2,7	3,6	2,1	2,2	2,3	2,1
CZ	2,5	2,8	1,2	1,3	1,3	1,4
NO	1,3	1,6	1,1	1,2	1,4	1,3
FI	1,3	1,0	1,8	1,2	1,2	1,2
EL	2,6	2,1	2,2	2,0	1,4	1,1
PT	2,4	2,0	0,9	0,8	0,9	0,8
HU	2,3	1,5	0,7	0,7	0,8	0,5
LT	0,7	0,3	0,5	0,5	0,3	0,4
EE	0,3	0,2	0,2	0,2	0,2	0,2
SI	0,5	0,6	0,2	0,2	0,2	0,2
SK	1,3	1,0	0,1	0,4	0,3	0,1
CY	0,2	0,4	0,1	0,2	0,1	0,1
LV	0,5	0,2	0,1	0,1	0,1	0,1
Total	*100*	*100*	*76,6*	*76,8*	*77,9*	*76,5*

Source: Own calculations, based on EU-SILC data

Figure 6 visualizes the marginal contribution of the five most populated countries (Germany, France, Poland, Italy, and Spain) and Belgium.

Figure 6. Marginal contribution of six selected countries to the within component of well-being inequality



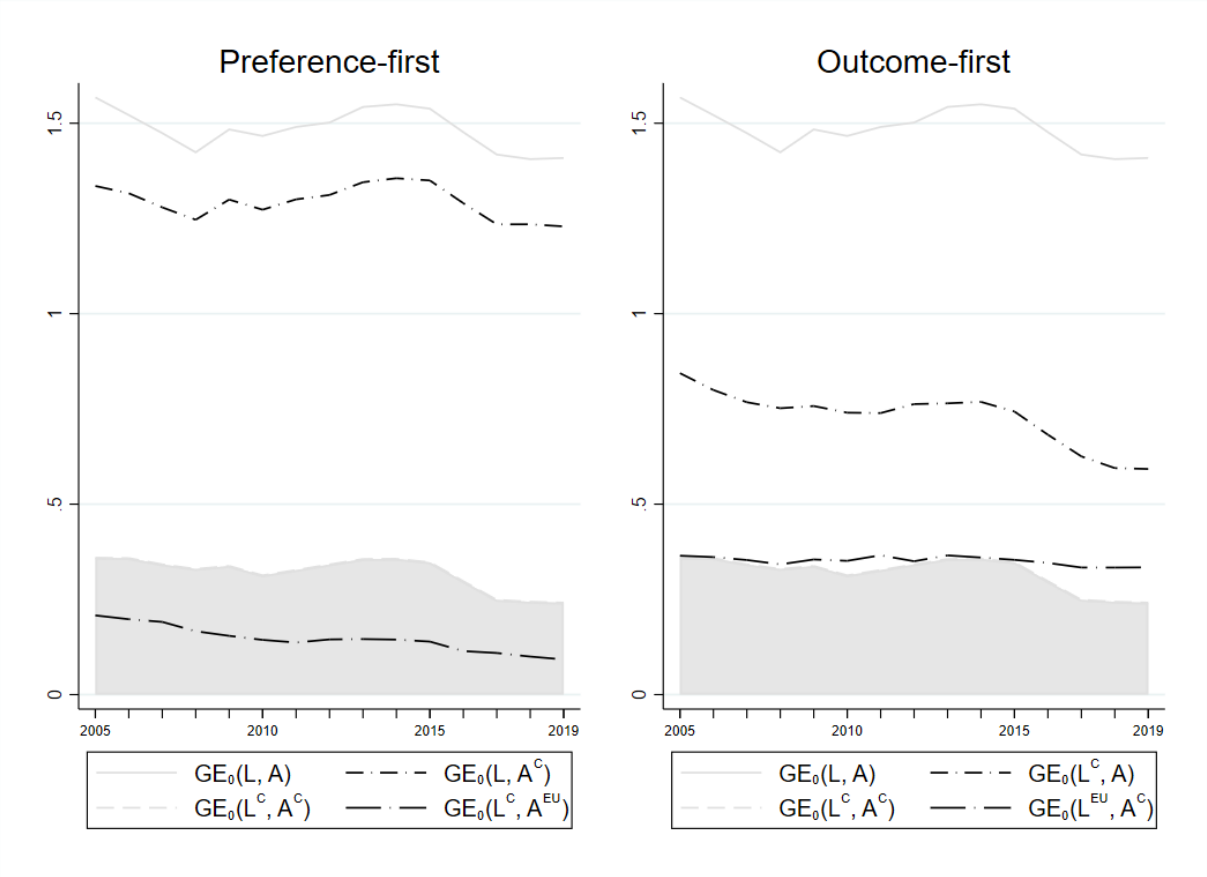
Source: Own calculations, based on EU-SILC data

4.3 Contribution of preferences and outcomes

We decompose the within and between component of well-being inequality to analyze to what extent interpersonal well-being inequality is influenced by preference heterogeneity and inequality in the different outcomes.

The left-hand panel of Figure 7 shows the results of the preference-first decomposition. The area between $GE_0(L, A)$ and $GE_0(L_t, \bar{A}^C)$ shows the contribution of preference heterogeneity within countries (across socio-demographic groups) to the within component of inequality. Smoothing preferences to common country parameters reduces wellbeing inequality considerably. The area between $GE_0(L_t, \bar{A}^C)$ and $GE_0(\bar{L}_t^C, \bar{A}^C)$ depicts the contribution of inequalities in outcomes within countries to interpersonal inequality. In the between-countries component (the shaded area), smoothing the preference parameters is relatively more important. Inequality in the counterfactual distribution where all countries are assigned EU preferences, $GE_0(\bar{L}_t^C, \bar{A}^{EU})$, amounts to a considerable share of the counterfactual where preferences differ across countries, i.e., $GE_0(\bar{L}_t^C, \bar{A}^C)$.

Figure 7. Contribution of preferences and outcomes to GE_0

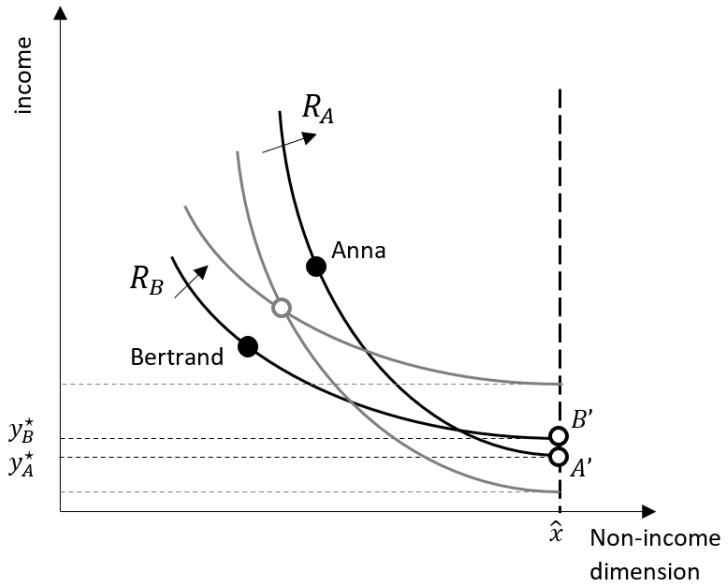


Source: Own calculations, based on EU-SILC data

The right-hand panel of Figure 7 shows the results of the outcome-first decomposition. The decomposition of the within component confirms the importance of inequalities in outcomes within countries for interpersonal inequality. Inequality in the counterfactual distribution where individuals are assigned the country average score for each life dimension is much lower, as indicated by $GE_0(\bar{L}_t^C, A)$. In this decomposition, the area between $GE_0(\bar{L}_t^C, A)$ and $GE_0(\bar{L}_t^C, \bar{A}^C)$ captures the effect of neutralizing preference heterogeneity within countries. Compared to the results of the preference-first decomposition, the effect of preference heterogeneity is more pronounced. Turning to the between-countries component, $GE_0(\bar{L}_t^{EU}, \bar{A}^C)$ measures the inequality in the counterfactual distribution where the outcome matrix is smoothed to the EU average. In this counterfactual distribution, all European citizens would achieve exactly the same outcomes, but preferences would differ across countries. Perhaps counterintuitively, we find that smoothing the outcomes between countries leads to higher levels of well-being inequality after 2015. This result can be explained by the interplay between country outcomes and preferences, see Figure 8 for a stylized example. As in Figure 1, the indifference curves depict the preferences of Anna and Bertrand. Anna's indifference curves are steeper and hence, she cares more about the non-income dimension than Bertrand. Their initial situations are depicted by the black points. In the scenario where outcomes are smoothed, both individuals move to the white point situated in the middle between them. For Bertrand, this is an improvement, both for income and the non-income dimension. Consequently, his equivalent income increases. For Anna, however, smoothing outcomes leads to a worse situation, and as a result her equivalent income is smaller than before. As Bertrand had a higher well-being level before the

smoothing, the difference in equivalent incomes between both individuals has increased by the smoothing.

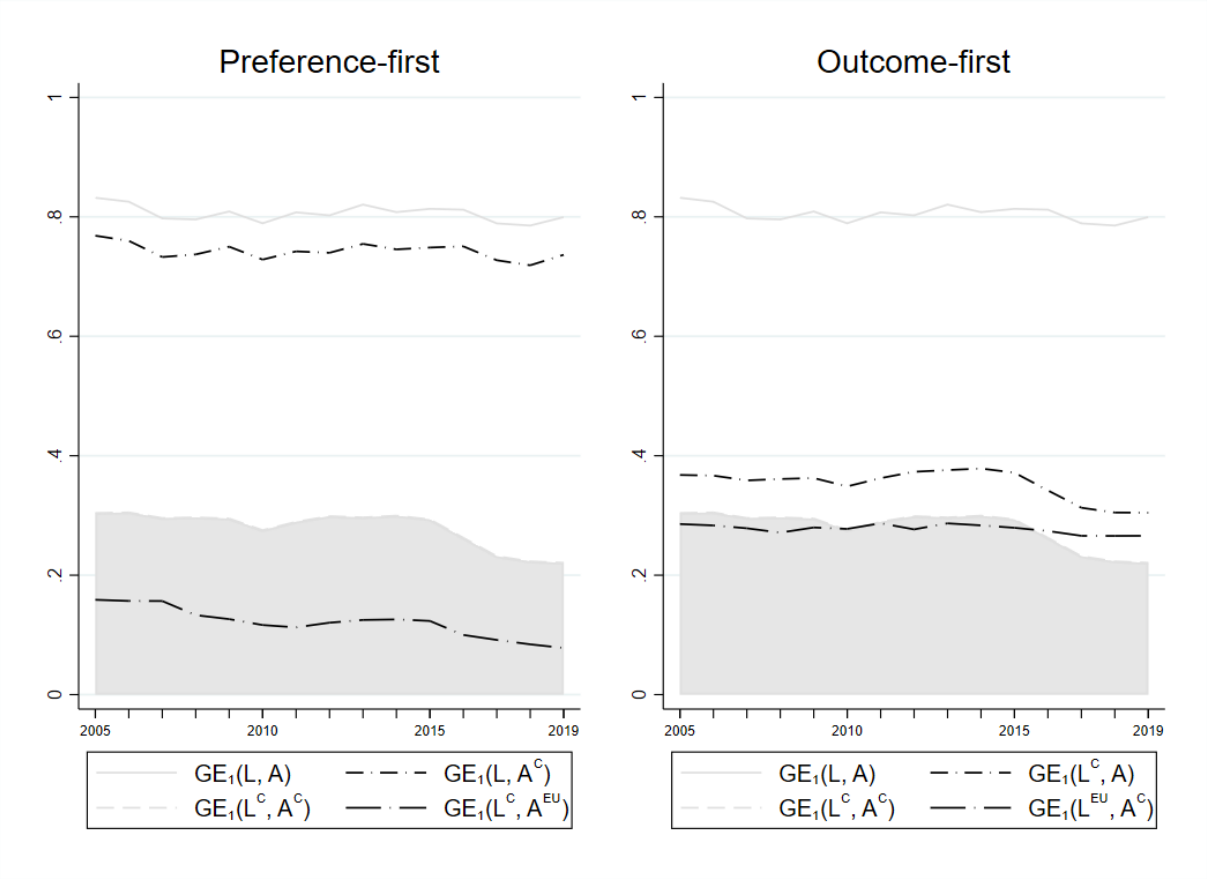
Figure 8. Smoothing outcomes can lead to well-being divergence



Source: Own elaboration

The results of the decompositions of the GE_1 measure are shown in Figure 9. In the preference-first decomposition, smoothing preferences within countries has a smaller effect on the within component of interpersonal inequality, as can be seen from comparing $GE_1(L, A)$ and $GE_1(L_t, \bar{A}^C)$. The large area between $GE_1(L_t, \bar{A}^C)$ and $GE_1(\bar{L}_t^C, \bar{A}^C)$ confirms the importance of inequalities in outcomes. In the outcome-first decomposition of GE_1, the effect of preference heterogeneity is again smaller (compared to the decomposition of the GE_0).

Figure 9. Contribution of preferences and outcomes to GE_1



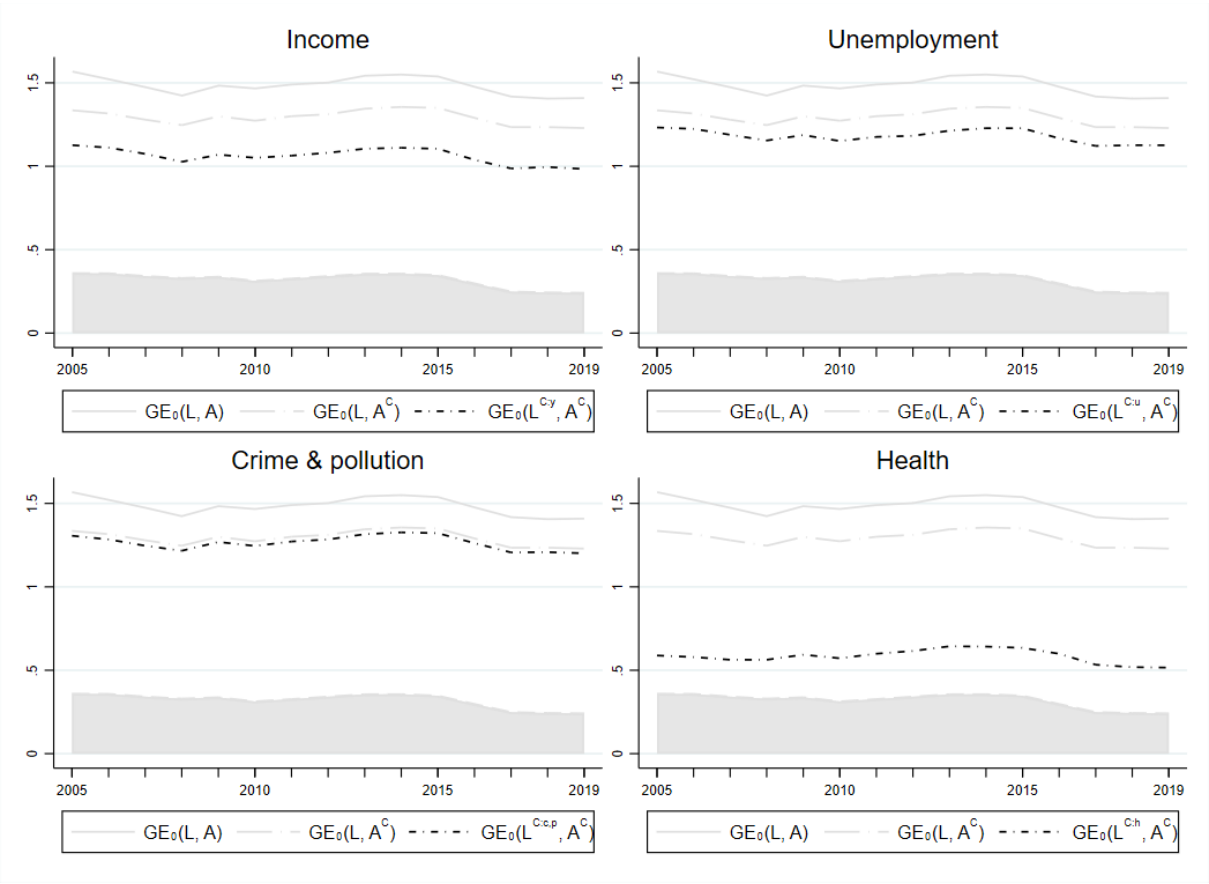
Source: Own calculations, based on EU-SILC data

4.4 Marginal contribution of the different life dimensions to the within component

As we have seen, a large part of the within component of interpersonal inequality in well-being is due to inequalities in outcomes within countries. In this section, we analyze the marginal contribution of each life dimension to this within component. We do this by comparing inequality across counterfactual distributions in which outcome inequality in one single life dimension is smoothed. For example, the difference between observed interpersonal inequality, $GE_0(L, \bar{A}^C)$, and $GE_0(\bar{L}_t^{C:y}, \bar{A}^C)$ indicates the marginal contribution of smoothing the income dimension to the total effect of smoothing all dimensions in the preference-first decomposition of the within component of well-being inequality (i.e. the difference between $GE_0(L, \bar{A}^C)$ and $GE_0(\bar{L}_t^C, \bar{A}^C)$).

Figure 10 shows the marginal contribution of each life dimension (given their small effect on inequality, we combine the smoothing of inequality in the crime and pollution dimensions). The health dimension has the largest marginal contribution to the within component: smoothing health inequalities within countries substantially lowers inequality. In part, this is due to the large relative importance attached to health and the prevalence of health problems. Inequalities in income and unemployment within countries also have a substantial marginal contribution to the within component of well-being inequality.

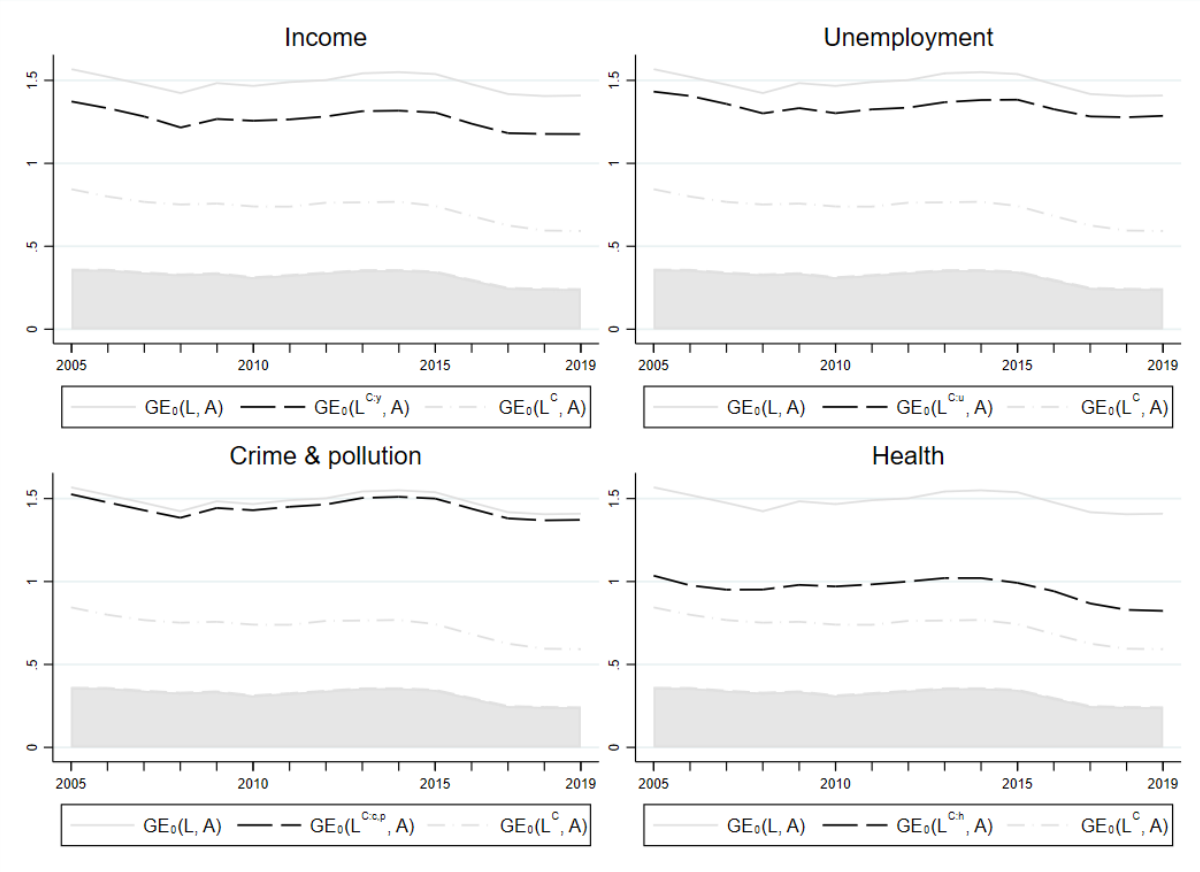
Figure 10. Marginal contribution of the dimensions to the within component of well-being inequality (in the preference-first decomposition)



Source: Own calculations, based on EU-SILC data

Figure 11 shows the contribution of dimensions in the outcome-first decomposition using the GE_0. The results are similar: smoothing inequalities in health has the largest impact on inequality, followed by income and unemployment.

Figure 11. Marginal contribution of the dimensions to within-country well-being inequality (in the outcome-first decomposition)



Source: Own calculations, based on EU-SILC data

5. Conclusion

This study proposed a new method for policymakers to monitor well-being convergence in the EU, which acknowledges the multiple dimensions of well-being and diverse preferences among Europeans. The first step of this method is to compute an equivalent income for each European citizen as a measure of their individual well-being. This measure considers the outcomes of the individuals in five dimensions of well-being as well as their preferences over the dimensions. In the empirical analysis, a life satisfaction regression is used to estimate these preferences. The method then computes well-being inequality using a Generalized Entropy inequality measure. Several decompositions are provided to disentangle the between- and within-country component of total well-being inequality, the marginal contribution of dimensions and countries, and the contribution of preferences and outcomes.

The method was illustrated using data from EU-SILC (2005-2019). We found that overall well-being inequality has slightly decreased indicating mild interpersonal well-being convergence over the considered period in the EU. Furthermore, we found that there has been intercountry well-being convergence. Differences between countries have become less important for EU-wide well-being inequality, however. In 2005, intercountry well-being inequality made up 25% of total well-being inequality, reducing to 20% in 2019. The overall trend of European well-being convergence masks several interesting observations. First, well-being inequality between individuals and countries has increased during the Great Recession (2008-2015), especially when measured with an inequality index that is more sensitive to the bottom part of the distribution. Second, there is considerable heterogeneity in terms of the size and the evolution of the marginal contributions of the countries. This heterogeneity is, in general, related to the country's size, but also to the within-country well-being inequality. Third, preference heterogeneity is an important contributor to well-being inequality between European citizens and countries. The contribution of preference heterogeneity is larger in decompositions that focus first on the contribution of outcomes and then on the contribution of preferences. Fourth, the health dimension is the largest contributor to well-being inequality, followed by the income and employment, with crime and pollution having a smaller impact.

The proposed method is still in its infancy and has several limitations that should be addressed in further research. First, the selection of the dimensions was based on data availability rather than by a comprehensive theory of human well-being, which could have resulted in some important dimensions being omitted. Second, while the EU-SILC contains detailed information on incomes, little (objective) information is available about the non-monetary life dimensions. The subjective nature of some of the non-income dimensions may lead to spurious correlations with the life satisfaction variable. Unfortunately, the life satisfaction variable is only available in two waves of EU-SILC, with five-year intervals. More frequent information on life satisfaction could provide important insights on the evolution of preferences over time. Third, the life satisfaction method to estimate the preferences can be argued to be susceptible to endogeneity issues and unobserved personal characteristics. Yet, currently it remains the only method that can be applied on a large-scale data set as EU-SILC. Further

research is needed to address these limitations, to test the underlying consistency assumption and to compare the estimated preferences with the results of other methods based on revealed and stated preferences.

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Appendix 1 Life satisfaction regressions

Table A1. Coefficients of the life satisfaction regression, with and without interactions with the year-variable

	Pooled coefficient		Preference stability	
Income (in logarithm)	0.288***	(0.003)	0.324***	(0.005)
Health (in logarithm)	1.646***	(0.008)	1.553***	(0.011)
Unemployment	-0.758***	(0.009)	-0.836***	(0.012)
Crime	-0.134***	(0.007)	-0.136***	(0.010)
Pollution	-0.099***	(0.007)	-0.105***	(0.010)
Education level				
(Pre-)Primary	-0.351***	(0.009)	-0.349***	(0.009)
Secondary	-0.184***	(0.005)	-0.183***	(0.005)
Female	0.161***	(0.004)	0.160***	(0.004)
Immigrant	-0.132***	(0.008)	-0.133***	(0.008)
Age	-0.052***	(0.001)	-0.053***	(0.001)
Age sq.	0.000***	(0.000)	0.000***	(0.000)
Marital status				
Never married	-0.401***	(0.007)	-0.403***	(0.007)
Separated/divorced	-0.454***	(0.008)	-0.453***	(0.008)
Widowed	-0.431***	(0.008)	-0.432***	(0.008)
Rural	0.025***	(0.005)	0.026***	(0.005)
Calm	0.398***	(0.003)	0.397***	(0.003)
Nervous	0.315***	(0.003)	0.314***	(0.003)
2018	0.088***	(0.004)	0.446***	(0.057)
2018#Income			-0.062***	(0.006)
2018 #Health			0.176***	(0.014)
2018 #Unemp			0.178***	(0.018)
2018#Crime			0.005	(0.015)
2018#Pollution			0.012	(0.013)
Constant	1.745***	(0.045)	1.548***	(0.055)
N	562843		562843	
adj. R^2	0.346		0.346	

Note: Standard errors in parentheses; $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: Own calculations, based on EU-SILC data

Table A2. Coefficients for the life dimensions of the country-specific regressions, used to construct $\overline{A}^C$

	AT	BE	CY	CZ	DE	DK	EE	ES	FI	FR	EL	HU
Income	0.181***	0.335***	0.476***	0.480***	0.402***	0.292***	0.389***	0.206***	0.206***	0.486***	0.228***	0.527***
(in logarithm)	(0.016)	(0.017)	(0.029)	(0.030)	(0.016)	(0.038)	(0.019)	(0.009)	(0.016)	(0.019)	(0.012)	(0.020)
Health	2.029***	1.530***	1.328***	1.410***	2.364***	2.159***	1.731***	1.954***	1.892***	1.680***	1.103***	1.701***
(in logarithm)	(0.042)	(0.034)	(0.060)	(0.044)	(0.034)	(0.056)	(0.046)	(0.029)	(0.037)	(0.036)	(0.027)	(0.035)
Unemployment	-0.726***	-0.317***	-0.777***	-0.793***	-0.900***	-1.126***	-1.097***	-0.758***	-0.402***	-0.712***	-0.537***	-1.052***
	(0.056)	(0.041)	(0.047)	(0.069)	(0.046)	(0.086)	(0.058)	(0.022)	(0.035)	(0.038)	(0.026)	(0.045)
Crime	-0.079*	-0.119***	-0.013	-0.194***	-0.194***	-0.117*	-0.169***	-0.095***	-0.136***	-0.100***	-0.136***	-0.258***
	(0.034)	(0.025)	(0.039)	(0.040)	(0.026)	(0.056)	(0.045)	(0.023)	(0.031)	(0.025)	(0.026)	(0.034)
Pollution	-0.104**	-0.141***	-0.111**	-0.061+	-0.068***	-0.141*	-0.063	-0.063*	-0.043	-0.208***	-0.085***	-0.118***
	(0.035)	(0.025)	(0.041)	(0.035)	(0.020)	(0.060)	(0.043)	(0.026)	(0.029)	(0.027)	(0.022)	(0.031)
Time dummy 2018	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Control variables	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Personality traits	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	19145	18922	17647	19969	36931	10214	18911	50835	18976	28293	57471	29125
adj. R^2	0.302	0.284	0.372	0.339	0.360	0.420	0.294	0.290	0.355	0.273	0.304	0.383

Table A2. Continued

	IE	IT	LT	LV	NL	NO	PL	PT	SE	SI	SK
Income	0.155***	0.158***	0.313***	0.446***	0.272***	0.176***	0.293***	0.589***	0.174***	0.638***	0.427***
(in logarithm)	(0.021)	(0.008)	(0.020)	(0.019)	(0.018)	(0.025)	(0.014)	(0.022)	(0.024)	(0.036)	(0.029)
Health	1.804***	1.278***	1.759***	1.591***	1.776***	1.801***	1.210***	1.508***	1.690***	1.494***	1.574***
(in logarithm)	(0.066)	(0.033)	(0.062)	(0.047)	(0.035)	(0.052)	(0.031)	(0.045)	(0.058)	(0.054)	(0.046)
Unemployment	-0.650***	-0.760***	-1.218***	-0.696***	-0.647***	-1.006***	-0.550***	-0.786***	-0.494***	-0.366***	-1.255***
	(0.060)	(0.034)	(0.068)	(0.052)	(0.052)	(0.097)	(0.036)	(0.042)	(0.072)	(0.054)	(0.056)
Crime	-0.148**	-0.077**	-0.203*	-0.298***	-0.078***	-0.141*	-0.206***	-0.223***	-0.126**	-0.012	-0.194***
	(0.049)	(0.024)	(0.084)	(0.045)	(0.021)	(0.064)	(0.038)	(0.046)	(0.043)	(0.052)	(0.050)
Pollution	-0.179**	-0.033	-0.140**	-0.234***	-0.115***	-0.098*	-0.054*	-0.038	-0.150**	-0.116**	0.057
	(0.068)	(0.024)	(0.046)	(0.033)	(0.022)	(0.048)	(0.026)	(0.036)	(0.051)	(0.039)	(0.040)
Time dummy 2018	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Control variables	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Personality traits	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	11167	50370	13097	16964	21453	11191	39889	27417	10783	13185	20888
adj. R^2	0.325	0.233	0.325	0.332	0.295	0.337	0.253	0.292	0.338	0.315	0.358

Note: Standard errors in parentheses; $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Source: Own calculations, based on EU-SILC data

Table A3. Coefficients of the life dimensions for the reference group and the different socio-demographic groups, used to construct A

		AT	BE	CY	CZ	DE	DK	EE	ES	FI	FR	EL	HU
Ref group	Income	0.192***	0.212***	0.487***	0.762***	0.231***	0.247*	0.134*	0.246***	0.196***	0.385***	0.113**	0.509***
		(0.049)	(0.057)	(0.101)	(0.106)	(0.057)	(0.124)	(0.053)	(0.028)	(0.047)	(0.064)	(0.040)	(0.063)
	Health	2.809***	1.658***	1.047***	1.184***	2.431***	1.778***	2.391***	1.761***	1.855***	1.754***	1.721***	1.399***
		(0.162)	(0.131)	(0.240)	(0.184)	(0.136)	(0.219)	(0.170)	(0.117)	(0.129)	(0.142)	(0.123)	(0.138)
	Unemp.	-1.141***	-0.622***	-0.821***	-1.543***	-1.747***	-0.657*	-1.387***	-1.111***	-0.817***	-1.069***	-0.516***	-1.255***
		(0.208)	(0.152)	(0.168)	(0.289)	(0.190)	(0.322)	(0.207)	(0.082)	(0.125)	(0.145)	(0.095)	(0.158)
	Crime	-0.344**	-0.077	-0.119	-0.420**	-0.208*	-0.047	0.019	-0.205**	-0.138	-0.210*	0.017	-0.587***
		(0.123)	(0.089)	(0.136)	(0.151)	(0.092)	(0.201)	(0.147)	(0.079)	(0.101)	(0.096)	(0.089)	(0.118)
	Pollution	-0.195	-0.186*	0.002	0.120	-0.017	-0.167	-0.015	-0.026	0.066	-0.283**	0.040	-0.180+
		(0.129)	(0.090)	(0.144)	(0.137)	(0.075)	(0.227)	(0.145)	(0.090)	(0.101)	(0.106)	(0.076)	(0.109)
Female	Income	-0.010	0.036	0.014	-0.015	-0.002	-0.043	0.070+	-0.002	-0.084**	-0.055	0.057*	0.007
		(0.031)	(0.033)	(0.053)	(0.056)	(0.031)	(0.068)	(0.037)	(0.017)	(0.029)	(0.035)	(0.022)	(0.038)
	Health	-0.178*	0.086	-0.006	0.057	0.114+	-0.145	-0.317***	-0.022	-0.174**	-0.119+	-0.096*	0.024
		(0.073)	(0.062)	(0.099)	(0.076)	(0.060)	(0.103)	(0.080)	(0.051)	(0.065)	(0.065)	(0.044)	(0.058)
	Unemp	0.261*	0.391***	0.194*	0.052	0.203*	0.149	0.167	0.383***	0.179*	0.221**	0.302***	0.257**
		(0.110)	(0.081)	(0.094)	(0.141)	(0.092)	(0.171)	(0.118)	(0.042)	(0.071)	(0.077)	(0.051)	(0.089)
	Crime	0.026	-0.007	0.029	0.129	0.038	0.202+	0.051	0.021	-0.071	-0.078	0.141**	-0.085
		(0.069)	(0.050)	(0.078)	(0.081)	(0.052)	(0.112)	(0.092)	(0.045)	(0.063)	(0.050)	(0.051)	(0.070)
	Pollution	-0.076	0.024	0.190*	-0.035	0.037	-0.168	-0.066	-0.029	0.094	-0.004	0.024	0.013
		(0.071)	(0.050)	(0.081)	(0.072)	(0.041)	(0.120)	(0.089)	(0.051)	(0.058)	(0.054)	(0.043)	(0.064)
High educ	Income	-0.150***	-0.013	0.058	-0.066	-0.133***	0.068	0.128**	0.027	-0.008	-0.121**	-0.028	-0.122*
		(0.034)	(0.036)	(0.061)	(0.069)	(0.032)	(0.074)	(0.044)	(0.021)	(0.033)	(0.038)	(0.029)	(0.049)
	Health	-0.167+	-0.019	0.084	0.003	-0.158*	0.091	0.116	-0.077	-0.347***	-0.002	-0.154*	0.305***
		(0.098)	(0.074)	(0.148)	(0.121)	(0.066)	(0.114)	(0.096)	(0.074)	(0.073)	(0.081)	(0.076)	(0.091)
	Unemp	0.017	-0.102	0.124	-0.191	-0.399***	-0.181	-0.260+	-0.186***	0.002	-0.066	-0.110+	-0.666***
		(0.149)	(0.098)	(0.104)	(0.292)	(0.115)	(0.194)	(0.156)	(0.051)	(0.080)	(0.089)	(0.061)	(0.162)
	Crime	-0.055	0.019	0.069	0.018	0.051	0.195+	0.200*	-0.066	0.105+	0.016	-0.042	-0.014
		(0.076)	(0.053)	(0.084)	(0.106)	(0.054)	(0.118)	(0.099)	(0.054)	(0.064)	(0.057)	(0.059)	(0.104)
	Pollution	0.052	0.054	-0.204*	-0.079	0.050	0.077	-0.138	-0.019	0.042	0.130*	0.017	-0.074
		(0.081)	(0.052)	(0.090)	(0.093)	(0.043)	(0.122)	(0.097)	(0.057)	(0.059)	(0.060)	(0.050)	(0.082)
Age	Income	0.001	0.001	0.000	-0.005**	0.004***	-0.000	0.003**	-0.001*	0.001	0.002*	0.002**	0.001

		(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	Health	-0.011***	-0.003	0.005	0.004	-0.000	0.009**	-0.006*	0.004*	0.004*	0.001	-0.008***	0.005*
		(0.003)	(0.002)	(0.004)	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
	Unemp	0.006	0.004	-0.003	0.016**	0.016***	-0.011+	0.004	0.004*	0.008**	0.006+	-0.003+	0.000
		(0.004)	(0.003)	(0.003)	(0.006)	(0.004)	(0.007)	(0.005)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)
	Crime	0.005*	-0.000	0.002	0.001	-0.000	-0.004	-0.008**	0.002	-0.000	0.003*	-0.003*	0.008***
		(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)
	Pollution	0.003	0.000	-0.001	-0.002	-0.002	0.002	0.001	0.001	-0.004*	0.001	-0.004**	0.003
		(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.004)	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)
Rural	Income	-0.026	0.052	-0.189**	0.020	0.134*	0.167*	0.070+	0.044*	-0.037	0.098**	0.017	0.066
		(0.033)	(0.052)	(0.065)	(0.059)	(0.055)	(0.073)	(0.037)	(0.020)	(0.032)	(0.038)	(0.023)	(0.041)
	Health	0.037	0.168*	-0.009	-0.132+	-0.391***	-0.136	-0.336***	0.024	-0.060	-0.126+	-0.034	-0.153**
		(0.076)	(0.080)	(0.111)	(0.077)	(0.097)	(0.104)	(0.080)	(0.054)	(0.069)	(0.066)	(0.045)	(0.057)
	Unemp	0.012	0.050	-0.029	0.172	0.278*	-0.156	0.195+	0.085+	-0.094	0.026	-0.129*	0.282**
		(0.125)	(0.114)	(0.111)	(0.138)	(0.132)	(0.180)	(0.119)	(0.045)	(0.074)	(0.082)	(0.053)	(0.090)
	Crime	0.187*	0.091	-0.264**	0.188*	-0.290*	-0.153	0.139	0.092	0.069	-0.021	-0.281***	-0.091
		(0.083)	(0.073)	(0.096)	(0.089)	(0.113)	(0.130)	(0.094)	(0.058)	(0.075)	(0.058)	(0.066)	(0.072)
	Pollution	-0.080	0.024	-0.226*	-0.155*	-0.064	-0.146	-0.011	-0.241***	0.076	0.058	0.213***	-0.234***
		(0.079)	(0.074)	(0.099)	(0.077)	(0.077)	(0.134)	(0.089)	(0.070)	(0.065)	(0.061)	(0.059)	(0.069)
Migr. Stat.	Income	0.041	0.136***	-0.021	-0.048	-0.055	0.004	-0.045	-0.051*	0.014	0.192***	-0.093**	-0.341***
		(0.038)	(0.037)	(0.068)	(0.130)	(0.050)	(0.125)	(0.061)	(0.024)	(0.116)	(0.054)	(0.033)	(0.089)
	Health	-0.205*	-0.245**	-0.057	0.064	-0.284**	-0.517*	0.007	-0.092	0.533*	-0.198+	-0.466***	0.610*
		(0.097)	(0.076)	(0.164)	(0.178)	(0.100)	(0.208)	(0.116)	(0.105)	(0.266)	(0.101)	(0.109)	(0.260)
	Unemp	0.157	-0.150+	0.160	-0.428	0.215	0.438	-0.351+	0.104+	0.066	-0.012	0.203*	-0.687
		(0.125)	(0.091)	(0.115)	(0.321)	(0.169)	(0.269)	(0.202)	(0.062)	(0.166)	(0.121)	(0.084)	(0.424)
	Crime	-0.116	-0.154*	0.285**	0.214	-0.013	-0.080	0.359**	-0.029	-0.077	-0.029	0.037	0.092
		(0.095)	(0.063)	(0.110)	(0.214)	(0.096)	(0.252)	(0.119)	(0.084)	(0.168)	(0.079)	(0.098)	(0.302)
	Pollution	0.064	-0.054	-0.214+	-0.220	0.020	-0.052	0.008	-0.134	0.002	-0.189*	-0.016	0.186
		(0.099)	(0.062)	(0.118)	(0.184)	(0.073)	(0.264)	(0.124)	(0.087)	(0.197)	(0.083)	(0.083)	(0.249)
N		19145	18922	17647	19969	36931	10214	18911	50835	18976	28293	57471	29125
adj. R^2		0.304	0.286	0.373	0.339	0.362	0.422	0.296	0.292	0.357	0.274	0.306	0.386

Table A3. Continued

		IE	IT	LT	LV	NL	NO	PL	PT	SE	SI	SK
Ref group	Income	0.302***	0.240***	0.256**	0.213**	0.215***	0.105+	0.017	0.426***	0.054	0.515***	0.291**
		(0.086)	(0.027)	(0.081)	(0.066)	(0.054)	(0.055)	(0.043)	(0.078)	(0.068)	(0.122)	(0.092)
	Health	1.167***	1.696***	2.315***	2.050***	2.457***	1.680***	2.349***	1.245***	2.325***	2.175***	1.472***
		(0.286)	(0.140)	(0.269)	(0.184)	(0.135)	(0.184)	(0.129)	(0.190)	(0.198)	(0.214)	(0.172)
	Unemp.	-1.012***	-0.712***	-1.619***	-1.375***	-0.533*	-0.386	-0.994***	-1.450***	-0.853***	-0.652**	-2.348***
		(0.242)	(0.128)	(0.295)	(0.208)	(0.215)	(0.316)	(0.142)	(0.175)	(0.232)	(0.219)	(0.189)
	Crime	-0.516**	-0.104	-0.268	-0.161	-0.189*	0.054	0.139	-0.118	-0.131	0.012	-0.191
		(0.196)	(0.095)	(0.316)	(0.162)	(0.080)	(0.202)	(0.137)	(0.180)	(0.139)	(0.192)	(0.160)
	Pollution	-0.626*	-0.100	0.083	-0.205+	-0.029	-0.033	-0.142	-0.115	-0.394*	0.243	0.092
		(0.278)	(0.093)	(0.186)	(0.122)	(0.086)	(0.169)	(0.101)	(0.143)	(0.178)	(0.156)	(0.129)
Female	Income	0.048	0.026+	0.021	0.025	0.002	-0.036	0.003	0.080*	-0.025	-0.078	0.089
		(0.041)	(0.015)	(0.039)	(0.036)	(0.033)	(0.046)	(0.027)	(0.039)	(0.046)	(0.066)	(0.056)
	Health	-0.028	0.034	-0.011	-0.053	-0.136*	-0.212*	-0.093+	-0.060	-0.271*	-0.117	-0.099
		(0.123)	(0.056)	(0.106)	(0.084)	(0.066)	(0.097)	(0.052)	(0.075)	(0.106)	(0.094)	(0.075)
	Unemp	0.578***	0.309***	0.276*	0.388***	0.144	0.130	0.458***	0.467***	-0.251+	0.146	0.335**
		(0.120)	(0.067)	(0.136)	(0.104)	(0.103)	(0.199)	(0.074)	(0.085)	(0.142)	(0.108)	(0.111)
	Crime	0.054	0.050	0.055	-0.058	0.042	-0.097	-0.005	0.066	0.021	-0.130	-0.051
		(0.099)	(0.048)	(0.177)	(0.095)	(0.043)	(0.127)	(0.079)	(0.093)	(0.085)	(0.105)	(0.101)
	Pollution	0.069	0.071	0.003	0.174*	-0.021	-0.014	0.029	0.082	0.102	0.053	0.043
		(0.139)	(0.048)	(0.096)	(0.070)	(0.045)	(0.096)	(0.055)	(0.074)	(0.103)	(0.080)	(0.080)
High educ	Income	0.010	-0.050*	0.155**	0.007	-0.002	-0.061	-0.135***	-0.197***	-0.084+	-0.047	-0.081
		(0.044)	(0.024)	(0.050)	(0.044)	(0.035)	(0.049)	(0.034)	(0.058)	(0.049)	(0.078)	(0.074)
	Health	0.003	0.014	0.299*	0.265*	0.090	0.160	0.013	0.070	0.165	-0.088	0.264*
		(0.139)	(0.112)	(0.133)	(0.107)	(0.074)	(0.107)	(0.078)	(0.144)	(0.121)	(0.132)	(0.121)
	Unemp	-0.300*	-0.109	-0.154	0.311*	-0.262*	-0.084	0.011	-0.187	-0.310+	-0.049	-0.039
		(0.125)	(0.103)	(0.194)	(0.150)	(0.109)	(0.234)	(0.112)	(0.140)	(0.177)	(0.138)	(0.172)
	Crime	0.093	0.016	-0.192	-0.038	0.074+	-0.089	0.003	0.200	0.071	-0.311**	0.146
		(0.102)	(0.068)	(0.184)	(0.103)	(0.044)	(0.129)	(0.093)	(0.122)	(0.090)	(0.112)	(0.127)
	Pollution	0.366**	0.013	-0.068	0.138+	-0.010	0.240*	-0.016	0.003	0.259*	-0.102	-0.299**
		(0.140)	(0.064)	(0.101)	(0.078)	(0.047)	(0.099)	(0.064)	(0.101)	(0.105)	(0.088)	(0.102)
Age	Income	-0.003*	-0.001*	-0.000	0.005***	0.001	0.003*	0.007***	0.003*	0.004**	0.003	0.004*

		(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
	Health	0.011*	-0.006**	-0.011**	-0.008**	-0.011***	0.004	-0.018***	0.005+	-0.007*	-0.010**	0.001
		(0.004)	(0.002)	(0.004)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
	Unemp	0.005	-0.004	0.006	0.011*	-0.002	-0.015*	0.004	0.009**	0.011*	0.004	0.025***
		(0.005)	(0.003)	(0.006)	(0.004)	(0.004)	(0.007)	(0.003)	(0.003)	(0.005)	(0.004)	(0.004)
	Crime	0.005	-0.000	0.002	0.000	0.001	-0.003	-0.007**	-0.004	-0.000	0.003	-0.000
		(0.003)	(0.002)	(0.005)	(0.003)	(0.001)	(0.004)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)
	Pollution	0.005	0.000	-0.003	-0.003	-0.001	-0.003	0.002	-0.001	0.002	-0.007**	-0.000
		(0.004)	(0.001)	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)
Rural	Income	-0.003	-0.065***	0.017	-0.009	0.000	-0.015	-0.012	-0.085*	-0.070	0.000	-0.107+
		(0.042)	(0.018)	(0.042)	(0.037)	(.)	(0.060)	(0.029)	(0.042)	(0.058)	(.)	(0.056)
	Health	0.063	-0.050	0.092	0.041	0.000	0.120	-0.117*	-0.029	-0.020	0.000	0.137+
		(0.124)	(0.062)	(0.104)	(0.081)	(.)	(0.105)	(0.051)	(0.076)	(0.125)	(.)	(0.074)
	Unemp	-0.070	-0.071	-0.030	-0.081	0.000	-0.023	-0.016	-0.060	-0.065	0.000	-0.057
		(0.119)	(0.076)	(0.142)	(0.104)	(.)	(0.215)	(0.071)	(0.087)	(0.176)	(.)	(0.112)
	Crime	0.260*	-0.027	0.096	-0.146	0.000	0.083	0.037	0.075	0.046	0.000	0.023
		(0.105)	(0.069)	(0.188)	(0.105)	(.)	(0.178)	(0.098)	(0.117)	(0.112)	(.)	(0.109)
	Pollution	0.044	0.129+	-0.028	-0.023	0.000	0.010	0.000	0.219**	0.120	0.000	0.042
		(0.152)	(0.071)	(0.097)	(0.069)	(.)	(0.112)	(0.057)	(0.081)	(0.143)	(.)	(0.082)
Migr. Stat.	Income	0.030	-0.099***	0.062	-0.104+	0.092	0.021	-0.136	0.099	-0.025	0.184+	0.191
		(0.050)	(0.021)	(0.072)	(0.056)	(0.067)	(0.063)	(0.126)	(0.073)	(0.052)	(0.107)	(0.251)
	Health	0.112	-0.354**	0.097	0.124	0.087	-0.610***	0.041	-0.016	-0.832***	-0.107	0.287
		(0.172)	(0.133)	(0.190)	(0.109)	(0.124)	(0.162)	(0.192)	(0.183)	(0.138)	(0.143)	(0.310)
	Unemp	0.091	0.083	0.577*	-0.054	0.181	-0.382	0.161	0.106	0.459**	0.240	0.024
		(0.139)	(0.096)	(0.274)	(0.171)	(0.171)	(0.236)	(0.559)	(0.145)	(0.162)	(0.149)	(0.640)
	Crime	-0.116	0.120	-0.095	-0.313**	-0.087	-0.036	0.612*	0.087	-0.158	-0.294	0.493
		(0.135)	(0.102)	(0.320)	(0.121)	(0.089)	(0.195)	(0.299)	(0.172)	(0.111)	(0.185)	(0.407)
	Pollution	-0.028	-0.067	-0.036	0.065	-0.232*	-0.159	-0.714**	0.045	-0.232	0.054	-0.206
		(0.180)	(0.097)	(0.191)	(0.101)	(0.095)	(0.164)	(0.234)	(0.144)	(0.153)	(0.129)	(0.333)
N		11167	50370	13097	16964	21453	11191	39889	27417	10783	13185	20888
adj. R^2		0.234	0.326	0.335	0.297	0.338	0.257	0.293	0.343	0.317	0.360	0.327

Note: Standard errors in parentheses; $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Regressions also include time dummy, control variables and personality traits.

Source: Own calculations, based on EU-SILC data

Appendix 2 Detailed results

Table A4. Decomposition results for GE_0

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$GE_0(L, A)$	1.568	1.521	1.474	1.424	1.484	1.467	1.490	1.502	1.543	1.550	1.538	1.477	1.418	1.406	1.409
$GE_0(\bar{L}_t^C, \bar{A}^C)$	0.359	0.358	0.342	0.330	0.338	0.313	0.327	0.342	0.356	0.356	0.347	0.298	0.249	0.244	0.242
$GE_0(\bar{L}_t^C, \bar{A}^{EU})$	0.208	0.198	0.191	0.166	0.154	0.144	0.137	0.145	0.146	0.144	0.139	0.114	0.109	0.100	0.092
$GE_0(L_t, \bar{A}^C)$	1.335	1.316	1.279	1.247	1.300	1.273	1.300	1.312	1.345	1.356	1.350	1.290	1.235	1.235	1.229
$GE_0(\bar{L}_t^{EU}, \bar{A}^C)$	0.365	0.361	0.353	0.342	0.355	0.351	0.366	0.350	0.366	0.360	0.354	0.346	0.334	0.334	0.334
$GE_0(\bar{L}_t^C, A)$	0.844	0.800	0.768	0.752	0.758	0.740	0.739	0.763	0.765	0.768	0.743	0.682	0.625	0.595	0.592
$GE_0(\bar{L}_t^{C:y}, \bar{A}^C)$	1.126	1.112	1.074	1.027	1.070	1.051	1.064	1.081	1.105	1.111	1.105	1.038	0.987	0.995	0.984
$GE_0(\bar{L}_t^{C:u}, \bar{A}^C)$	1.233	1.224	1.189	1.154	1.187	1.151	1.176	1.182	1.214	1.228	1.228	1.167	1.122	1.126	1.126
$GE_0(\bar{L}_t^{C:c,p}, \bar{A}^C)$	1.306	1.284	1.246	1.216	1.269	1.245	1.272	1.284	1.316	1.326	1.321	1.262	1.206	1.208	1.201
$GE_0(\bar{L}_t^{C:h}, \bar{A}^C)$	0.588	0.579	0.563	0.563	0.593	0.572	0.599	0.616	0.643	0.642	0.634	0.599	0.533	0.519	0.516
$GE_0(\bar{L}_t^{C:y}, A)$	1.373	1.332	1.282	1.216	1.267	1.257	1.265	1.283	1.315	1.317	1.306	1.239	1.182	1.177	1.177
$GE_0(\bar{L}_t^{C:u}, A)$	1.432	1.406	1.358	1.301	1.333	1.302	1.325	1.336	1.369	1.382	1.384	1.326	1.283	1.278	1.286
$GE_0(\bar{L}_t^{C:c,p}, A)$	1.526	1.477	1.430	1.384	1.443	1.430	1.451	1.465	1.504	1.510	1.500	1.439	1.380	1.369	1.372
$GE_0(\bar{L}_t^{C:h}, A)$	1.035	0.977	0.951	0.951	0.980	0.970	0.983	1.000	1.021	1.021	0.992	0.942	0.868	0.829	0.823

Source: Own calculations, based on EU-SILC data

Table A5. Decomposition results for GE_1

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
$GE_1(L, A)$	0.832	0.825	0.797	0.796	0.809	0.789	0.808	0.803	0.821	0.808	0.813	0.812	0.789	0.786	0.800
$GE_1(\bar{L}_t^C, \bar{A}^C)$	0.304	0.305	0.296	0.297	0.295	0.275	0.289	0.299	0.297	0.300	0.293	0.263	0.232	0.223	0.221
$GE_1(\bar{L}_t^C, \bar{A}^{EU})$	0.159	0.157	0.157	0.133	0.126	0.117	0.113	0.120	0.125	0.126	0.123	0.100	0.092	0.084	0.078
$GE_1(L_t, \bar{A}^C)$	0.768	0.760	0.733	0.737	0.750	0.729	0.742	0.740	0.755	0.746	0.749	0.751	0.727	0.719	0.736
$GE_1(\bar{L}_t^{EU}, \bar{A}^C)$	0.286	0.283	0.279	0.271	0.280	0.278	0.287	0.277	0.287	0.283	0.279	0.274	0.266	0.266	0.266
$GE_1(\bar{L}_t^C, A)$	0.368	0.367	0.359	0.361	0.363	0.349	0.362	0.373	0.376	0.379	0.372	0.342	0.313	0.305	0.305
$GE_1(\bar{L}_t^{C:y}, \bar{A}^C)$	0.605	0.599	0.578	0.560	0.568	0.562	0.559	0.562	0.571	0.570	0.572	0.558	0.539	0.531	0.530
$GE_1(\bar{L}_t^{C:u}, \bar{A}^C)$	0.733	0.733	0.706	0.712	0.717	0.696	0.708	0.709	0.728	0.721	0.726	0.730	0.704	0.695	0.714
$GE_1(\bar{L}_t^{C:c,p}, \bar{A}^C)$	0.747	0.736	0.709	0.716	0.728	0.709	0.723	0.720	0.736	0.727	0.728	0.729	0.707	0.708	0.716
$GE_1(\bar{L}_t^{C:h}, \bar{A}^C)$	0.457	0.462	0.441	0.464	0.467	0.434	0.460	0.468	0.473	0.466	0.463	0.449	0.408	0.398	0.421
$GE_1(\bar{L}_t^{C:y}, A)$	0.661	0.655	0.635	0.613	0.621	0.617	0.615	0.618	0.631	0.628	0.632	0.618	0.597	0.590	0.590
$GE_1(\bar{L}_t^{C:u}, A)$	0.788	0.791	0.760	0.759	0.761	0.743	0.760	0.759	0.780	0.768	0.774	0.777	0.752	0.750	0.765
$GE_1(\bar{L}_t^{C:c,p}, A)$	0.805	0.794	0.768	0.770	0.782	0.766	0.781	0.777	0.796	0.784	0.788	0.786	0.764	0.769	0.776
$GE_1(\bar{L}_t^{C:h}, A)$	0.513	0.516	0.499	0.518	0.523	0.495	0.520	0.530	0.533	0.531	0.527	0.510	0.470	0.461	0.478

Source: Own calculations, based on EU-SILC data

Table A6. Well-being inequality within countries over time, GE_0

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
AT	2.416	2.402	2.457	2.592	2.660	2.665	2.720	2.680	2.770	3.111	3.089	3.078	3.037	3.053	3.129
BE	0.912	0.914	0.860	0.906	0.937	0.962	0.984	0.956	0.945	0.959	0.966	0.962	0.919	0.916	0.899
CY	0.482	0.467	0.501	0.447	0.478	0.494	0.487	0.498	0.540	0.561	0.541	0.510	0.476	0.453	0.462
CZ	0.724	0.715	0.695	0.710	0.713	0.709	0.719	0.717	0.728	0.723	0.703	0.723	0.703	0.679	0.675
DE	1.212	1.183	1.225	1.182	1.148	1.170	1.173	1.152	1.166	1.125	1.176	1.147	1.142	1.114	1.127
DK	2.052	2.229	2.315	2.209	2.355	2.544	2.472	2.394	2.349	2.329	2.422	2.450	2.493	2.404	2.419
EE	1.441	1.389	1.417	1.238	1.313	1.397	1.356	1.349	1.354	1.358	1.277	1.195	1.168	1.215	1.175
EL	0.922	0.960	0.946	0.937	0.983	1.011	1.136	1.117	1.237	1.244	1.172	1.157	1.115	1.041	0.925
ES	2.488	2.348	2.312	2.000	2.343	2.295	2.234	2.379	2.509	2.626	2.468	2.378	2.362	2.417	2.267
FI	2.221	2.272	2.045	1.993	1.935	1.906	1.885	1.860	1.877	1.830	1.759	1.777	1.743	1.747	1.751
FR	0.690	0.668	0.613	0.653	0.684	0.686	0.683	0.683	0.689	0.671	0.668	0.692	0.679	0.682	0.701
HU	0.813	0.849	0.809	0.768	0.721	0.715	0.774	0.784	0.797	0.794	0.781	0.722	0.696	0.674	0.663
IE	2.840	2.935	2.809	2.729	2.835	2.929	2.993	2.990	3.152	3.063	3.002	3.052	2.953	2.816	2.828
IT	1.657	1.661	1.580	1.563	1.628	1.542	1.701	1.694	1.726	1.759	1.802	1.495	1.317	1.451	1.451
LT	1.959	1.787	1.593	1.639	1.861	1.925	1.906	1.872	1.872	1.857	1.848	1.808	1.887	1.846	1.747
LV	0.859	0.946	0.813	0.891	0.962	0.915	0.856	0.819	0.805	0.795	0.777	0.746	0.722	0.792	0.693
NL	1.058	1.072	1.064	1.051	1.049	1.035	1.062	1.089	1.085	1.068	1.085	1.090	1.108	1.110	1.168
NO	1.893	1.793	1.659	1.656	1.659	1.726	1.774	1.669	1.706	1.685	1.702	1.773	1.765	1.838	1.890
PL	2.493	2.267	2.127	2.103	2.155	2.179	2.141	2.101	2.090	1.998	1.806	1.748	1.742	1.591	1.690
PT	0.572	0.552	0.545	0.548	0.601	0.575	0.571	0.591	0.641	0.664	0.644	0.594	0.578	0.544	0.530
SE	2.812	2.324	2.182	2.104	2.234	2.078	2.225	2.361	2.594	2.641	2.946	3.146	2.903	2.624	2.778
SI	0.480	0.472	0.452	0.438	0.430	0.445	0.448	0.437	0.420	0.423	0.410	0.399	0.383	0.388	0.386
SK	0.743	0.756	0.665	0.581	0.607	0.660	0.640	0.625	0.599	0.629	0.590	0.584	0.525	0.516	0.555

Source: Own calculations, based on EU-SILC data