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Beyond GDP and Life Expectancy: Welfare Comparisons across the Atlantic

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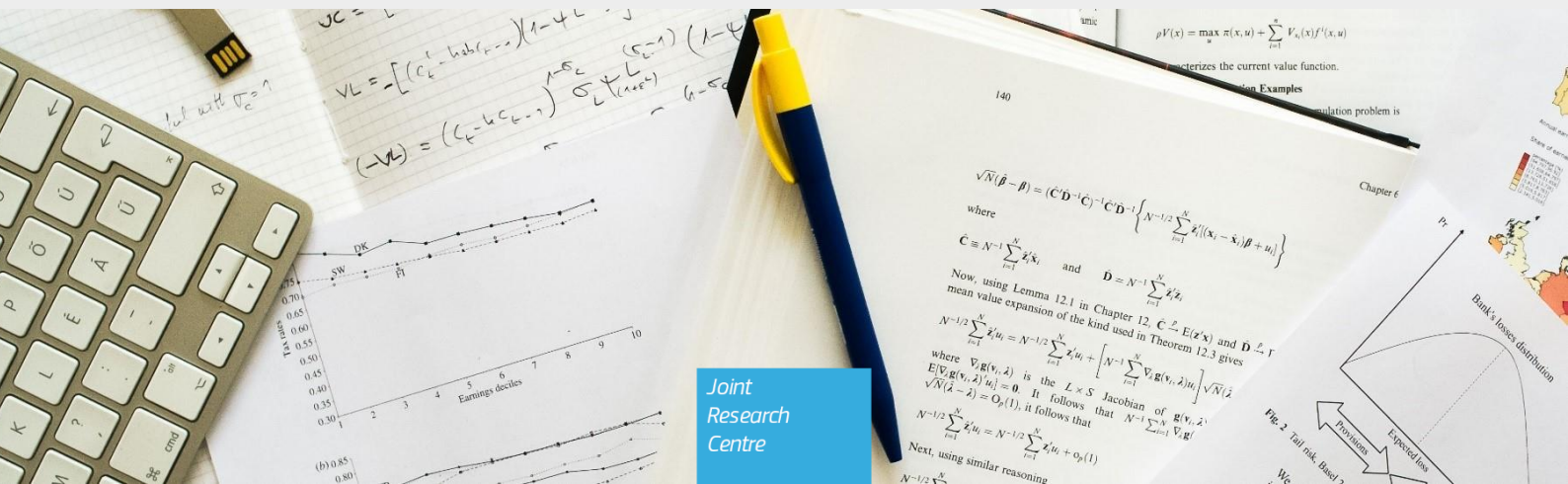

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Executive summary

This paper introduces a new framework for cross-country welfare comparisons that incorporates not only average outcomes in income and life expectancy, but also within-country disparities in these dimensions. More specifically, it derives a preference-based measure, the equivalent income, that is sensitive to within-country disparities in lifespan and income.

To construct the measure, I simulate lifetime utilities for individuals using data on national mortality rates and income. The former are taken from the UN World Population Prospects, which provides life tables that can be used to construct lifespan distributions for hypothetical cohorts. The latter are sourced from the World Inequality Database (WID), which provides post-tax national income by percentile for adults aged 20 and over. These distributions are then fed into a social welfare function to derive the equivalent income - the hypothetical income level that, if combined with a reference distribution of lifespan and income, would yield the same level of social welfare as the actual situation. In the reference distribution, there is no income inequality and the distribution of lifespan is derived from the lowest global age-specific mortality rates.

Applying this measure to the EU and US reveals that despite the US's higher average income, welfare comparisons change significantly when inequality and health outcomes are considered. When adjusting for income and lifespan disparities, the EU often surpasses the US in welfare terms due to its lower income inequality and better overall population health. The analysis also demonstrates that welfare growth rates in the EU become comparatively stronger as greater importance is given to improvements experienced by society's worst-off individuals, i.e., those with the shortest lifespans and lowest incomes. In contrast, incorporating a concern for such aspects tends to reduce US welfare growth rates, reflecting its poorer health outcomes and greater disparities in lifespan and income.

The findings underline the importance of adopting broader welfare measures in policy analysis and international comparisons, highlighting the impact that distributional concerns and health outcomes have on social welfare assessments. The paper acknowledges a key simplifying assumption that income and lifespan are independent, while recognising that low-income individuals often face higher mortality risks. Accounting for such correlations would likely strengthen the results as a prioritarian framework penalises joint disadvantages more heavily. The paper also suggests future research directions, such as extending the approach to capture preference heterogeneity and correlated outcomes.

Beyond GDP and life expectancy: welfare comparisons across the Atlantic *

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Abstract

Prior studies assessing welfare across countries have utilised measures that combine country-level outcomes in income and life expectancy (or average lifespan). However, this perspective remains blind to the fact that two countries may have the same life expectancy or average income but very different underlying distributions from which they are derived. In this paper, I introduce a new preference-based measure of social welfare that is sensitive to within-country disparities in lifespan and income. To illustrate the measure, I compare welfare levels/trends between the EU and the USA. The results reveal that while the EU lags behind the USA in terms of average income, the gap is reduced or eliminated when welfare is measured more broadly. Moreover, EU welfare growth rates tend to increase, relative to the income-only case, as more importance is placed on the improvements accruing to the worst-off in society. In contrast, US growth rates are generally lower when its poorer health outcomes and higher levels of inequality are taken into account.

Keywords: inequality, welfare, lifespan, life expectancy

JEL classification: I31, J17, O57

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1 Introduction

It is increasingly accepted that social welfare is a multidimensional concept that cannot be equated with narrow indicators of economic performance, such as GDP or income per capita (Stiglitz et al., 2009). Several scholars have therefore advocated for a broader concept of income, which integrates the value of non-monetary dimensions of well-being, such as life expectancy at birth. Usher (1973, 1980) was the first to introduce an adjusted consumption measure that incorporates a monetary imputation for changes in age-specific mortality rates over time. Becker et al. (2005) extended this approach using empirical estimates of the value of statistical life (VSL) and income-related risk aversion. Their findings highlight that longevity improvements, particularly in the world's poorest countries, have driven significant global welfare convergence over time. Utilising a similar framework, Jones and Klenow (2016) incorporate additional aspects, such as leisure time and consumption inequality. Their results also reveal a greater degree of global welfare convergence after longevity gains are accounted for. However, such studies and others like them (e.g., Decancq et al., 2009; d'Albis and Bonnet, 2018) do not explicitly account for within-country inequalities in both income *and* lifespan.

Although welfare losses due to income inequality have been extensively addressed in the literature, inequalities in lifespan have received much less attention.[1] To illustrate the issue, consider the case of life expectancy at birth. This is the average lifespan within a hypothetical cohort of individuals facing the age-specific mortality rates of a country at a given point in time. Since it is an average, it remains blind to the underlying disparities in the distribution of lifespan from which it is derived (Silber, 1983). To observe this, imagine two hypothetical societies. In the first society, all individuals live until 50 years of age. In the second, one half lives until 10 years of age, while the other half lives until 90 years. Both societies have the same average lifespan (life expectancy), but the distribution of lifespan in the second society is inherently more unequal. Yet, many individuals tend to be averse to such inequalities when asked in surveys or experimental settings (Costa-Font and Cowell, 2019; Robson et al., 2017, 2024). These issues extend to other measures based on the arithmetic mean, such as average income. At the same time, such inequalities may be important for comparisons between countries with different distributions of income and lifespan. For instance, Fleurbaey and Gaulier (2009) and Jones and Klenow (2016) demonstrate that income/consumption inequalities are important components of their respective adjusted GDP measures. Using a similar measure, Da Costa (2025) finds that between country inequality trends depend on the degree of aversion to within-country

[1] A small but growing empirical literature has addressed the issue of between- and within-country inequalities in lifespan Aburto and van Raalte (2018); Permanyer and Scholl (2019); Vigezzi et al. (2022)

lifespan inequalities.[2] Consequently, there is an impetus to go beyond GDP and beyond averages when measuring social welfare.

This paper proposes a novel measure of social welfare that captures changes in average income and lifespan, as well as inequalities associated with both dimensions. To do this, I build on the approach of Da Costa (2025) by simulating lifetime utilities for a cohort of hypothetical individuals and deriving an equivalent income measure.[3] This captures a social planner's hypothetical willingness to pay to achieve a reference distribution of income and lifespan. In this hypothetical reference distribution there is no income inequality and the distribution of lifespan is derived from the lowest age-specific mortality rates observed globally in a given year. The indicator relies on the same underlying data as traditional yardsticks of social welfare (e.g., income per capita, life expectancy) and aggregates dimensions using empirical evidence on preferences. In contrast, similar existing measures, such as the inequality-adjusted Human Development Index, often rely on arbitrary assumptions regarding the relative contribution of each dimension to social welfare.

I demonstrate the use of the measure by comparing welfare levels in the EU and the United States of America (USA). Such comparisons are of particular relevance in light of recent debates in the European context. Draghi (2024), for example, highlights that the EU is falling behind the USA in terms of competitiveness, defined narrowly as income per unit of labour. This paper demonstrates while the EU ranks worse off in terms of income, it performs strongly with respect to social welfare, as measured by the equivalent income. That is, differences in welfare levels are reduced, or even reversed, when a concern for the underlying distribution of income or lifespan is incorporated. These differences are largely due to the EU's better population health outcomes (longer mean lifespan and lower health inequality) and lower levels of income inequality. Moreover, EU welfare growth rates over the last two decades tends to increase when changes in population health and inequality are considered. Our results therefore highlight the need to consider a broader concept of welfare when making cross-country comparisons.

The paper is structured as follows. In the next section, I introduce the equivalent income and explain how it introduces sensitivity to the underlying distributions of income/lifespan. Section 3 discusses the data required for the measure, which are the same as those underpinning GDP per capita and life expectancy. Section 4 presents the results in terms of welfare levels and growth rates. Section 5 carries out some robustness checks using different parameterisations while section 6 compares the results to those based on

[2]Similar results have been estimated within the context of aversion to lifespan risk. See Edwards (2013); Córdoba and Ripoll (2017).

[3]In this paper I refer to a specific application of the equivalent income approach. The equivalent income measure has been applied in various contexts e.g., health, social interactions (see Fleurbaey and Blanchet, 2013; Decancq et al., 2015).

other measures of welfare, namely the UNDP's inequality-adjusted HDI. The final section discusses some of the limitations of the measure and future avenues for research.

2 Measuring social welfare

2.1 Adjusting for health

The starting point for the measure is a prioritarian social welfare function defined over a vector of income levels y_i and a distribution of lifespans d_i for country i (e.g. Atkinson, 1970; Adler et al., 2021):[4]

$$W(y_i, d_i) = \sum_{l>0}^{T-1} d_{l,i} \frac{U(y_i, l)^{1-v} - 1}{1-v}, \tag{1}$$

where $d_{l,i}$ is the proportion of individuals dying at exact age l in country i, which can be recovered from the age distribution of deaths in a standard life table; $U(y_i, l)$ is the lifetime utility derived from a lifespan of length l in country i; and T is the maximum possible lifespan. The parameter v reflects the degree of inequality aversion with respect to the distribution of lifetime utilities within each country.

An important issue arises from the outset - the available data do not allow us to observe the actual distribution of lifetime utilities within a country. This would require longitudinal data on a cohort of individuals followed from birth until death, a process that could last over a century. In the context of lifespan, demographers have tackled this issue by simulating distributions for a hypothetical cohort of individuals born in a given year, who face the cross-sectional mortality rates of their country throughout their lives. I follow this tradition with the aim of providing a summary measure of welfare at the national level. Namely, I define inequality in terms of the distribution of death for a hypothetical cohort of individuals born in a given year. For empirical tractability, I begin by assuming that all individuals in the cohort enjoy the same level of average income of their country (i.e., no within country income inequality) and that this income level is constant over their lives. In the following subsection, I weaken this assumption by introducing disparities in lifetime income across the hypothetical cohort.[5]

Assuming additive separability in period utilities, lifetime utility for a life of length l can be defined as:

[4] Since the SWF is undefined over zero values, I restrict attention to individuals that are born alive, i.e., $l > 0$. This does not restrict our empirical application since all individuals in a standard life table die at an age greater than zero.

[5] I refrain from including pure time preferences within the model to avoid conflating concavities in lifetime utility emerging from discounting and inequality aversion

$$U(y_i, l) = u(y_i)l \tag{2}$$

where y_i is the average income per capita within country i. Following prior works (Becker et al., 2005; Murphy and Topel, 2006), I define $u(.)$ as exhibiting constant relative risk aversion:

$$u(y_i) = \frac{y_i^{1-\gamma} - \underline{y}^{1-\gamma}}{1-\gamma} \tag{3}$$

where γ determines the concavity of period utility and $\underline{y}$ is a minimum subsistence income level at which an individual is indifferent between life and death (see Rosen, 1988). Higher values of γ yield more concavity in the period utility function, which in turn increases the value of life extension because increases in income are subject to larger diminishing returns (see Hall and Jones, 2007). The minimum income level $\underline{y}$ also maintains positive period utility when $\gamma > 1$, allowing for larger degrees of concavity.

Next, we can define the equivalent income as the hypothetical constant income level $\widehat{y_i}$ that if combined with a reference lifespan distribution d^* would yield the same level of social welfare as the actual situation defined by income y_i and lifespan distribution d_i:[6]

$$W(\widehat{y_i}, d^*) = W(y_i, d_i) \tag{4}$$

Using equations 1- 4, the equivalent income can be written as:

$$\widehat{y_i} = \begin{cases} \left[\left(\left(\frac{\sum_{l>0}^{T-1} d_{l,i} l^{1-v}}{\sum_{l>0}^{T-1} d_l^* l^{1-v}} \right)^{\frac{1}{1-v}} \left(y_i^{1-\gamma} - \underline{y}^{1-\gamma} \right) \right) + \underline{y}^{1-\gamma} \right]^{\frac{1}{1-\gamma}} & \text{if } v \neq 1, \\ \left[\left(exp\left(\sum_{l>0}^{T-1} d_{l,i} ln(u(y_i) l) - \sum_{l=0}^{T-1} d_l^* ln(l) \right) \right) (1-\gamma) + \underline{y}^{1-\gamma} \right]^{\frac{1}{1-\gamma}} & \text{if } v = 1, \end{cases} \tag{5}$$

where d_l^* is the proportion of individuals living to age l within the reference lifespan distribution. The equivalent income therefore depends on i) the income level, ii) the preference parameters γ, v, and $\underline{y}$ and iii) the ratio of lifespan distributions, given by the inner term in round brackets. The measure is increasing in income since higher levels of income raise the value of being alive relative to dead, highlighted by the term $(y_i^{1-\gamma} - \underline{y}^{1-\gamma})$ in the case of $v \neq 1$.

[6] The problem can be thought of as a decision maker facing the prospect of being born in one of two different societies, not knowing which position they will occupy (i.e., behind the veil of ignorance). The equivalent income is the level constant income level (over time and individuals) that, when combined with the reference lifespan distribution, would make the decision maker indifferent between being born in either society. Note that the welfare levels of these societies are known ex-post by the decision maker.

The measure can also be written as a combination of the actual income level and the willingness to pay to obtain the reference lifespan distribution, i.e. $\widehat{y_i} = y_i - WTP_i$. The willingness to pay depends on the ratio of mortality conditions in the actual and reference situations. Substituting the term $y_i - WTP_i$ into equation 5, we can re-write the willingness to pay as:

$$WTP_i = y_i - \left[\left(\frac{ELL_i}{ELL^*} (y_i^{1-\gamma} - \underline{y}^{1-\gamma}) \right) + \underline{y}^{1-\gamma} \right]^{\frac{1}{1-\gamma}}, \tag{6}$$

where,

$$ELL_i = \begin{cases} \left(\sum_{l>0}^{T-1} d_{l,i} l^{1-v} \right)^{\frac{1}{1-v}} & \text{if } v \neq 1, \\ exp\left(\sum_{l>0}^{T-1} d_{l,i} l^{1-v} \right) & \text{if } v = 1, \end{cases}$$

is the equivalent length of life defined by Silber (1983) and ELL^* is defined over the reference distribution. If societal welfare depended solely on lifespan,[7] the ELL_i denotes the average lifespan that, if enjoyed by all members of society, would yield the same level of welfare as the actual distribution of lifespan. More simply, it reflects life expectancy adjusted for inequalities in the underlying distribution lifespan for a given degree of aversion captured by v. Consequently, $WTP_i > 0$ if $ELL^* > ELL_i$ and WTP_i is increasing with the distance between the actual and reference values. When $v = 0$, this term reduces to the standard formula for life expectancy at birth, i.e., $LE_i = \sum_{l>0}^{T-1} d_{l,i} l$ and the WTP becomes:

$$WTP_i = \left[\left(\frac{LE_i}{LE^*} (y_i^{1-\gamma} - \underline{y}^{1-\gamma}) \right) + \underline{y}^{1-\gamma} \right]^{\frac{1}{1-\gamma}} \quad \text{if } v = 0 \tag{7}$$

Equation 7 is equivalent to that used in prior studies that evaluate changes in life expectancy at birth (Becker et al., 2005; Fleurbaey and Gaulier, 2009; Benczúr et al., 2023).[8]

2.2 Adjusting for income inequality

As noted above, it is not possible to observe the joint distribution of income and lifespan within a practical timescale. This is why demographers rely on period (rather than cohort) life tables to estimate life expectancy, which amounts to simulating the distribution of

[7] Within an Atkinson social welfare function (see Atkinson, 1970), that is $W(d_i) = \sum_{l>0}^{T-1} d_{l,i} \frac{l^{1-v}-1}{1-v}$.

[8] It differs slightly by excluding a pure time discount rate. I omit this from the model since the probabilities of death themselves act as a biological discount rate and I am solely interested in the effects of inequality aversion. Nevertheless, such rates could be easily incorporated within the model at the individual level.

lifespan for a hypothetical cohort facing the current age-specific mortality rates. I now extend this simulation to account for income inequalities.

Let each individual at age 0 be assigned an income level according to the actual distribution. Assume that income remains constant over a life.[9] At each age, we simulate whether an individual survives or dies, by drawing a random value $u \sim U(0,1)$ and comparing it with the conditional probability of death at each age:

$$q_{l,i} = \frac{d_{l,i}}{\sum_{k=l}^{T-1} d_{k,i}}$$

The individual dies if:

$$u \leq q_{l,i}$$

Otherwise, they survive to the next age. The simulation iterates through the ages, starting at age 0, until the individual dies or reaches the maximum lifespan T. This yields an age distribution of lifespan/deaths with different lifetime income levels. Let the lifespan and lifetime income of a simulant j be given by l_j and y_j, respectively. These values can be fed directly into the the social welfare function above. Specifically, we have:

$$W(f(y,d)) = \frac{1}{N}\sum_{j=1}^{N} \frac{U(y_j,l_j)^{1-v}-1}{1-v}, \tag{8}$$

where $U(y_j,l_j)$ represents the lifetime utility for simulant j. We have removed the country subscript i for ease of exposition. As before we can derive an equivalent income type measure by equating $(W(\widehat{y},d^*)) = W(f(y,d))$, where d^* is again the reference lifespan distribution. The equivalent income $\widehat{y}$ captures the societal WTP (i.e., reduction in average income) to achieve income equality and the reference level of lifespan equality, captured within d^*. Under these assumptions, the equivalent income can be written as:

$$\widehat{y} = \begin{cases} \left[\left(\left(\frac{\left(\frac{1}{N}\sum_{j=1}^{N} U(y_j,l_j)^{1-v}\right)^{\frac{1}{1-v}}}{ELL^*}\right)(1-\gamma)\right) + \underline{y}^{1-\gamma}\right]^{\frac{1}{1-\gamma}} & \text{if } v \neq 1, \\ \left[\left(\left(\frac{exp\left(\frac{1}{N}\sum_{j=1}^{N} ln(U(y_j,l_j))\right)}{ELL^*}\right)(1-\gamma)\right) + \underline{y}^{1-\gamma}\right]^{\frac{1}{1-\gamma}} & \text{if } v = 1, \end{cases} \tag{9}$$

Equation 9 can in principle be used to estimate equivalent incomes for any joint distribution of income and lifespan, $f(y,d)$. However, simulating such distributions is computationally intensive and cumbersome. A more tractable alternative is to assume independence between income and lifespan. Focusing on the numerator of equation 9 we

[9] If the data were available, one could simulate the lifetime profile of income by drawing from cross-sectional distributions at each age. However, our goal here is to create a measure that can be easily applied with the same data used in standard measures.

have:

$$\frac{1}{N}\sum_{j=1}^{N} U(Y_j, L_j)^{1-v}$$

where $\{(Yj, Lj)\}_{j=1}^{N}$ is a sample of size N. By the law of large numbers, if each (Y_j, L_j) is an independent draw from same underlying distribution $f(y, d)$, then as $N \to \infty$:

$$\frac{1}{N}\sum_{j=1}^{N} U(Y_j, L_j)^{1-v} \to E\big(U(Y, L)^{1-v}\big).$$

Then, under the independence assumption $Y \perp L$, we can further define:

$$\begin{aligned}\frac{1}{N}\sum_{j=1}^{N} U(Y_j, L_j)^{1-v} &= E\big(U(Y, L)^{1-v}\big) \\ &= E\big(u(Y)^{1-v}\, L^{1-v}\big) \\ &= E\big(u(Y)^{1-v}\big) \times E\big(L^{1-v}\big).\end{aligned}$$

Using this result and the definitions of the ELL, we can re-write equation 9 in a closed-form that doesn't require simulation:

$$\widehat{y} = \begin{cases} \left[\left(\left(\frac{1}{N}\sum_{j=1}^{N} u(y_j)^{1-v}\right)^{\frac{1}{1-v}} \frac{ELL}{ELL^*}(1-\gamma)\right) + \underline{y}^{1-\gamma}\right]^{\frac{1}{1-\gamma}} & \text{if } v \neq 1, \\ \left[\left(exp\left(\frac{1}{N}\sum_{j=1}^{N} ln(u(y_j))\right)\frac{ELL}{ELL^*}(1-\gamma)\right) + \underline{y}^{1-\gamma}\right]^{\frac{1}{1-\gamma}} & \text{if } v = 1, \end{cases} \tag{10}$$

Note that the term $(\frac{1}{N}\sum_{j=1}^{N} u(y_j)^{1-v})^{\frac{1}{1-v}}$ represents an equally distributed equivalent of the utilities derived from income. All of these terms can be calculated directly under the assumption of independence. In what follows, I use this formula to demonstrate the importance of considering the distributions of income and lifespan when measuring social welfare. As I discuss later, introducing correlations between the two variables would likely strengthen the results obtained.

There are two distinct sources of aversion to income disparities at play. The first emanates from the concavity of period utilities, governed by γ. The second comes from the explicit inequality aversion parameter v, which imposes another concave transformation over the period utilities $u(y_j)$. Thus, total aversion to income inequality can be thought of as a composite of both sources, which is approximately $\gamma + v - \gamma v$ as $\underline{y}$ approaches zero. To assess the importance of assumptions regarding the former, I conduct a sensitivity analysis in section 5. I also present additional results in the Annex (section A.1.2) in which I set $v = 0$ in equation 9, allowing us to examine the contribution of risk aversion to the measure.

One limitation of the underlying SWF is it's inability to capture negative utilities, i.e., the case of $y_i < \underline{y}$. For instance, the term $u(y_j)^{1-v}$ is undefined when $u(y_j) \leq 0$ and $v < 1$ or, more generally, when $1 - v$ is a non-integer. This is not an issue in our final dataset since $y_i > \underline{y}$ for all individuals. Nevertheless, it could be problematic for analysing countries in which large shares of the population are living at or below subsistence levels.[10] In such cases, one could impose the restriction that $\underline{y} < min(y_j)$ while acknowledging the constraints this places on the model and the implicit value of life years.[11] Another option is to adopt a SWF that can accommodate negative utilities (e.g., the Kolm-Pollak SWF, see Kolm, 1976; Pollak, 1971) or specify a different lifetime utility function.[12] Ultimately, the relevant value of $\underline{y}$ is an empirical question, since it reflects preferences that likely vary at the individual and country level. However, as I will discuss in the following section, there is little direct evidence on this parameter, and its value is typically inferred from estimates of the VSL, which may not be reflective of the general population.[13]

Setting γ and $\underline{y} = 0$ yields a simplified version of the measure, which could be applied without assumptions on individual preferences and is reminiscent of other indicators of social welfare, such as the inequality adjusted HDI:

$$\widehat{y} = \begin{cases} \left(\frac{1}{N}\sum_{j=1}^{N} y_j^{1-v}\right)^{\frac{1}{1-v}} \cdot \frac{ELL}{ELL^*} & \text{if } v \neq 1, \\ \exp\left(\frac{1}{N}\sum_{j=1}^{N} \ln(y_j)\right) \cdot \frac{ELL}{ELL^*} & \text{if } v = 1, \end{cases} \tag{11}$$

which can be further simplified as $\widehat{y} = y_{ede}\frac{ELL}{ELL^*}$, where y_{ede} is simply the Atkinson equally distributed equivalent of income. Equation 11 states that the equivalent income in this case is the equally distributed equivalent scaled by the ratio of ELLs. This measure may be useful for approximating social welfare in cases where data are lacking for the preference parameters γ and $\underline{y}$. I therefore present some results using this measure in the Annex.

2.3 Parameters

The calculation of the equivalent income requires the calibration of three parameters: γ , $\underline{y}$, and v. Estimates of γ are available from several sources. Risk aversion studies

[10] Becker et al. (2005) face a similar issue for the estimation of global inequality. They set $\underline{y}$ =\$353 and find that the Democratic Republic of Congo is below this value between 1994 and 1997.

[11] For instance, it may lead to implicit values of life years that are at odds with the empirical literature (see Weil, 2014).

[12] As noted by (Ferranna et al., 2024, footnote 8), the Atkinson SWF remains well defined if lifetime utility is written as $U_j = u(y_j)l_j - U_0$, where U_0 is the lifetime utility of a reference life at the zero point. In equation 8, I implicitly set $U_0 = 0$ so that the zero point is equivalent to a lifetime with the subsistence income level $\underline{y}$ in each period.

[13] For instance, many estimates of the VSL are based on studies compensating wage differentials, which by definition excludes the preferences of those outside of the labour market (e.g., the young and elderly).

report values of γ ranging from as low as 0.1 to as high as 10.[14] In contrast, studies on intertemporal choice imply values ranging from just below 1 to around 2 (Hall, 1988; Browning et al., 1999; Havranek et al., 2015). Empirical work on the value of life and global welfare inequality has typically used values ranging from 0.8 to 2 (Hall and Jones, 2007; Becker et al., 2005; Jones and Klenow, 2016).

To my knowledge, there are no studies that directly estimate $\underline{y}$. However, it can be identified by selecting a value of γ and then calibrating $\underline{y}$ to match empirical estimates of value of statistical life (VSL). For instance, Becker et al. (2005) recover a value that implies an individual would be indifferent between being alive or dead with annual income equal to \$353. However, as noted Ponthiere (2008), several combinations of γ and $\underline{y}$ may be consistent with the same VSL under this approach. An alternative is to consider a range of values as a proportion of average income per capita, as do Murphy and Topel (2006). This aligns with Cookson et al. (2020) who see $\underline{y}$ as a normative parameter, which can be set to different values when making assessments of changes in health.

A few studies have estimated aversion to pure lifespan inequalities. Hurley et al. (2020) recover a median value of between 1 and 1.5 using a survey with Canadian respondents. Pinho and Botelho (2018) estimate values of v between 3.24 and 5.85 in an experimental setting. Estimates of v defined over income-related health distributions range are often larger, ranging from 1.66 to as high as 23 (Dolan and Tsuchiya, 2011; Robson et al., 2017; Hurley et al., 2020). More recently, Robson et al. (2024) report estimates for lifespan and income-related inequalities of around 1.4 and 1.6, respectively. They note, however, that there is a substantial amount of preference heterogeneity leading to median values closer to 3.

Following previous works (e.g., Benczúr et al., 2023), I set $\gamma = 0.8$ and $\underline{y} = \$524$ as the baseline parameters for this analysis.[15] This allows us to compare how incorporating aversion to income and lifespan inequalities may affect prior results based on life expectancy alone. Given the lack of evidence and apparent certainty on the value of v, I consider a range of values from 0 to 1.5, which are frequently used in applied work and capture a broad spectrum of inequality aversion stances.[16]

From the outset, it should be recognised that values of $v > 0$ represent an underlying ethical principle that individuals with the lowest levels of lifetime utility, i.e., those with the lowest lifetime income and/or shortest lifespans, should be given priority in the social

[14] See Kaplow (2005) and Layard et al. (2008) for an overview of this literature.

[15] Only one percentile falls below this value in the year 2000 in the USA. This means that the 1st percentile has negative utility and does not enter the social welfare function for that year. I show below that our results are robust to using a lower threshold.

[16] While the risk and inequality aversion parameter values are similar, they represent distinct concepts. The former reflects an individual's preferences over risky outcomes, while the latter captures a social preference regarding differences between individuals.

welfare function (SWF). Prioritarianism is not the only ethical principle that could be applied within the model. In fact, setting $v = 0$ yields a traditional utilitarian social welfare function, which I also consider. Some may wish to go further by setting $v < 0$, which would place more weight on those with longer lifespans and larger incomes.[17] I do not consider this perspective for two reasons. First, the premature death of an individual can be considered a double tragedy since: i) they die early when they would prefer to live a longer life, and ii) they fail to live a reasonable length of life. Meanwhile, the death of an older individual who has lived a "reasonable" life only suffers from the first tragedy. [18] Second, while public opinion alone is insufficient to justify one particular normative approach, empirical evidence on social preferences provides little support for convex social preferences (i.e., $v < 0$) (see Robson et al., 2017, 2024).

3 Data

The data required for the calculation of lifespan distributions are contained within period life tables, which I obtain from the UN World Population Prospects. A period life table summarises the mortality patterns within a population by subjecting a hypothetical cohort of individuals to the age-specific mortality rates at a given point in time. The resulting distribution of deaths (equivalently lifespans) within this cohort can be utilised to estimate life expectancy at different ages as well as distributional measures. Figure 14 presents the lifespan distributions of the EU and US in the year 2022.[19] The average lifespans (life expectancy at birth) for each country are 80.5 and 78.0 years, respectively. In addition to having better average health outcomes, the EU also has lower levels of lifespan inequality. This is shown in table 1 which lists life expectancy (LE) and the ELLs for each country-year. The last two columns represent the Atkinson inequality index, which is derived as $Atk = 1 - ELL/LE$ in this context. While life expectancy has steadily grown in the EU, it has remained relatively stagnant in the US and even declined between 2010 and 2022. Lifespan inequality has also declined in the EU under all inequality aversion parameters considered, while it remains relatively constant for the US in the case where $v = 0.5$ and decreases slightly for $v = 1.5$. Note that these differing

[17] For example, it could be argued that the death of an older and richer person entails the end of more projects, relationships and friendships established over their life than a young individual at the start of their life.

[18] This aligns with the fair innings view in the bioethics literature that argues all individuals should be given the opportunity to live a reasonable length of life Harris (2006). Bognar (2008) reformulates this idea as giving priority to the worst off (i.e., those with the shortest lifespans).

[19] I plot this graph only for ages to 0 to 99 years to focus on the underlying mortality dynamics. There is an artificial concentration of deaths at age 100 because this is the upper limit of the life table imposed by the UN. However, this does not affect our core results, which are robust to the exclusion of these deaths or the extrapolation of the curve up to 110 years using a Kannisto model of mortality. Annex A.3 presents year-by-year changes in the lifespan distributions of both countries.

trends translate into steadily rising ELLs for the EU, while the picture is more mixed in the US.

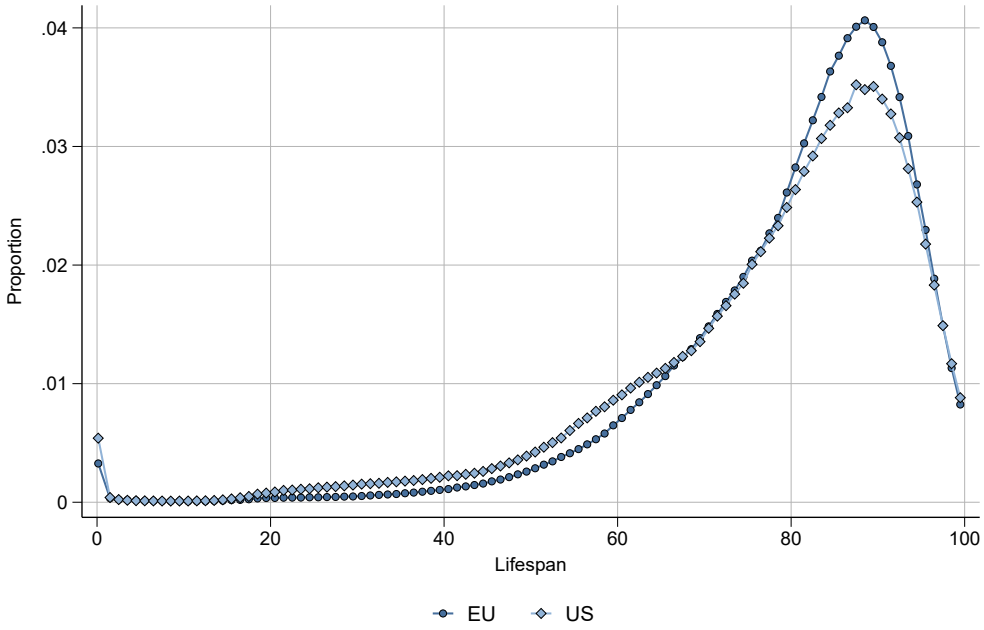

Figure 1: Lifespan distributions EU vs. US, 2022

			ELL			Atk. Index		
Location	Year	LE	$v = 0.5$	$v = 1$	$v = 1.5$	$v = 0.5$	$v = 1$	$v = 1.5$
EU	2000	77.1	75.8	72.7	57.2	0.02	0.06	0.26
	2005	78.3	77.2	74.5	61.2	0.01	0.05	0.22
	2010	79.6	78.6	76.2	64.6	0.01	0.04	0.19
	2015	80.4	79.4	77.3	66.7	0.01	0.04	0.17
	2019	81.1	80.1	78.1	67.9	0.01	0.04	0.16
	2022	80.5	79.5	77.5	67.5	0.01	0.04	0.16
US	2000	76.8	75.4	71.8	54.4	0.02	0.07	0.29
	2005	77.5	76.1	72.5	55.2	0.02	0.06	0.29
	2010	78.7	77.3	74.1	58.0	0.02	0.06	0.26
	2015	78.7	77.4	74.2	58.7	0.02	0.06	0.25
	2019	78.9	77.5	74.4	59.6	0.02	0.06	0.24
	2022	78.0	76.6	73.5	59.1	0.02	0.06	0.24

Table 1: Life expectancy and ELLs by country/year

To create the reference distribution of lifespan d^*, I follow the approach used by the Global

Burden of Disease (GBD) to create its own reference life table.[20] This is generated from the lowest age-specific mortality rates observed across countries (with populations greater than 5 million) in each year. The GBD employs this life table to measure the years of life lost to each disease, which underpins its headline population health measure of disability-adjusted life years (DALYs). Thus, the equivalent income measure captures how much a society would be willing to pay to obtain the reference lifespan distribution, which represents the annual feasible mortality frontier at the global level. Table 2 presents the values of the reference ELL^* for each year of the analysis. Since we are interested in long-term trends rather than transitory changes in welfare over time, I omit the year 2020 due to the COVID-19 outbreak and include an interval of seven years from 2015-2022.[21]

Year	ELL* ($v = 0$)	ELL* ($v = 0.5$)	ELL* ($v = 1$)	ELL* ($v = 1.5$)
2000	81.8	80.9	79.1	72.5
2005	82.7	81.9	80.4	75.0
2010	84.6	84.0	82.6	77.5
2015	85.4	84.8	83.7	79.6
2019	86.4	85.7	84.6	80.5
2022	86.1	85.5	84.7	81.1

Table 2: Reference ELLs by year

I collect post-tax income data from from the World Inequality Database, average values of which are available by percentile for the EU and US.[22] These values are based on the adult population (aged 18 years and older). Hereafter, all references to average income or income per capita, reflect this part of the population. The income variable includes labour and capital income as well as in-kind/in-cash redistribution. Table 3 presents summary statistics for the EU and US post-tax distributions. All monetary values are given in constant US $ PPP constant 2023 prices. The table demonstrates that income inequality in the EU is generally lower than in the US. However, average and median incomes are higher in the latter.

It is well known that the Atkinson inequality index is very sensitive to the changes at the lower end of the income distribution when $v > 1$ (see Cowell and Schokkaert, 2001, p.129). At the same time, we observe that the WID's reported incomes at the bottom of

[20] For more information, see accessed 31/08/22: https://ghdx.healthdata.org/record/ihme-data/global-burden-disease-study-2019-gbd-2019-reference-life-table

[21] Imagine one wants to approximate the *actual* change in life expectancy due to COVID. By construction, a life table approach will overstate the true impact of the pandemic on population health because it assumes a permanent rather than transitory increase in age-specific mortality rates over the lifetime of a cohort member. However, we know that the pandemic only lasted two years. For this reason, we prefer to rely on long-term trends in life expectancy.

[22] I directly import data from the World Inequality Database via the *wid* Stata command (06/01/2025). I utilise the post-tax national income variable (diinc), which is recorded for all adults +20 years. See the WID codebook for more information.

the distribution are very volatile, especially for the US. For example, the average income of the first percentile of the US distribution more than doubles between 2000 and 2001, and almost again between 2019 and 2020. These changes could reflect real changes in the distribution or modeling strategies to cope with uncertainty about incomes at the bottom of the distribution. Regarding the latter, the WID employs various imputation strategies to address missing incomes at lower percentiles (see Alvaredo et al., 2020). For instance, tax records, which are the primary data source used by the WID for high-income countries, often fail to capture income that is either unreported or exempt from taxation. To reduce the likelihood that our results may be driven by such modelling assumptions, I average incomes across the lowest five percentiles. While this does not change our overall findings it avoids large fluctuations in equivalent incomes over time due to income volatility among the lowest percentiles.

Location	Year	Mean	P10	P50	P90	Atk ($v = 1$)
EU	2000	50,395	16,366	41,663	85,553	0.22
	2005	53,641	18,301	43,776	90,096	0.21
	2010	54,490	19,729	44,914	89,794	0.19
	2015	55,625	20,489	45,400	89,089	0.19
	2019	60,941	23,760	49,977	96,518	0.18
	2022	62,454	25,029	50,860	98,501	0.18
US	2000	73,667	13,258	53,243	127,171	0.38
	2005	78,236	16,538	54,911	135,002	0.35
	2010	76,361	16,748	53,968	130,453	0.35
	2015	83,545	16,136	57,367	145,988	0.37
	2019	86,031	14,666	59,305	149,142	0.39
	2022	87,822	17,696	63,165	147,500	0.36

Table 3: Post-tax Income Distribution Metrics for EU and US (2000-2020), US $ Constant 2023 PPP

4 Results

In this section, I compare different welfare measures, starting from the traditional yardstick of income per capita and then moving to the equivalent income measure adjusted for: i) average lifespan (Equation 5 with $v = 0$), ii) lifespan inequality (Equation 5 with $v = 0.5$, 1 or 1.5) and iii) income+lifespan inequality (Equation 9 with $v = 0.5$, 1 or 1.5). Figures 2 to 4 compare these measures between the EU and the US over the period 2000 and 2022 in five-year intervals. The dark blue bars (average income per capita) indicate that US incomes are substantially higher than those within the EU, with the ratio of EU to US income at around 0.7 in 2022. Introducing an adjustment for life expectancy (light blue bars) reduces this gap somewhat, reflecting the US's poorer health outcomes.

For instance, the ratio of EU to US equivalent income increases to 0.8. Introducing aversion to lifespan inequality (dark red bars) leads to small adjustments to the equivalent incomes when $v = 0.5$. The adjustment is larger when v increases to either 1 or 1.5 (Figures 3 and 4). To understand this, recall that the WTP in this measure depends on the ratio ELL/ELL^*. As shown in the previous section, the difference between ELL and ELL^* is relatively small when $v = 0.5$, at around 6 years for EU in the year 2022. However, this difference more than doubles to around 14 years when $v = 1.5$. Note that the difference between ELL and ELL^* is much larger for the US, which results in lower equivalent incomes relative to the EU. This reflects the higher level of lifespan inequality in the US across all years of the analysis. The last set of bars (light red) presents the full adjustment including aversion to lifespan and income inequality (see equation 9). Even at low degrees of inequality aversion (Figure 2), the welfare ranking of the US and EU is reversed in 2022, relative to the income only case. When $v = 1.5$, which is close to empirical estimates from the literature (see Robson et al., 2024), the EU is ranked as better off than the US across all years. This reflects the lower level of income inequality within the former.

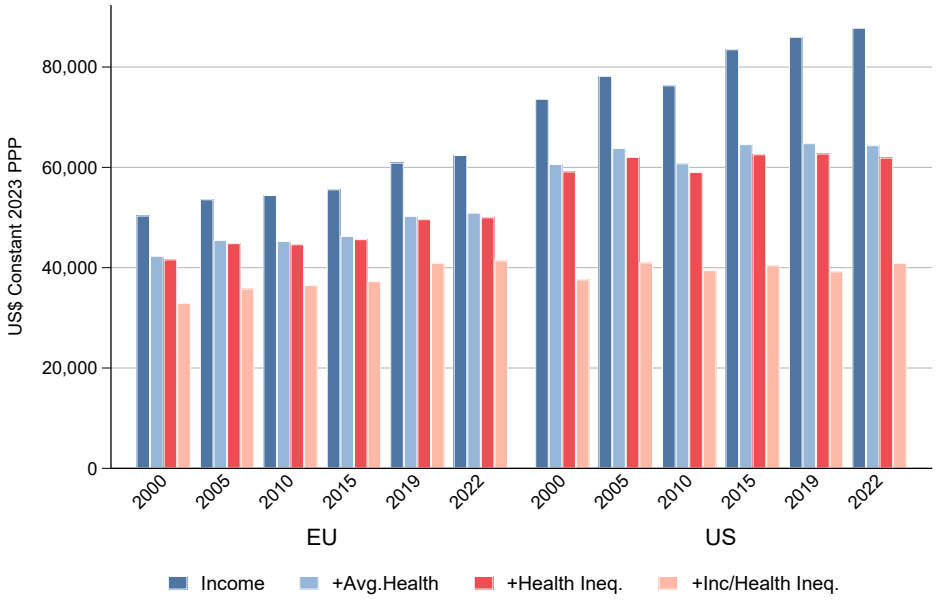

Figure 2: Equivalent income ($v = 0.5$), EU vs. US

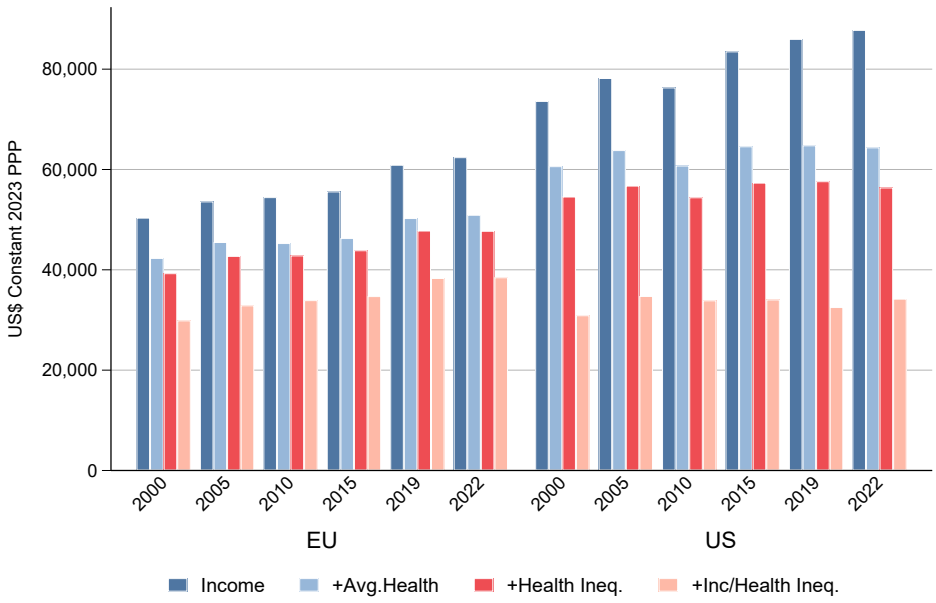

Figure 3: Equivalent income ($v = 1$), EU vs. US

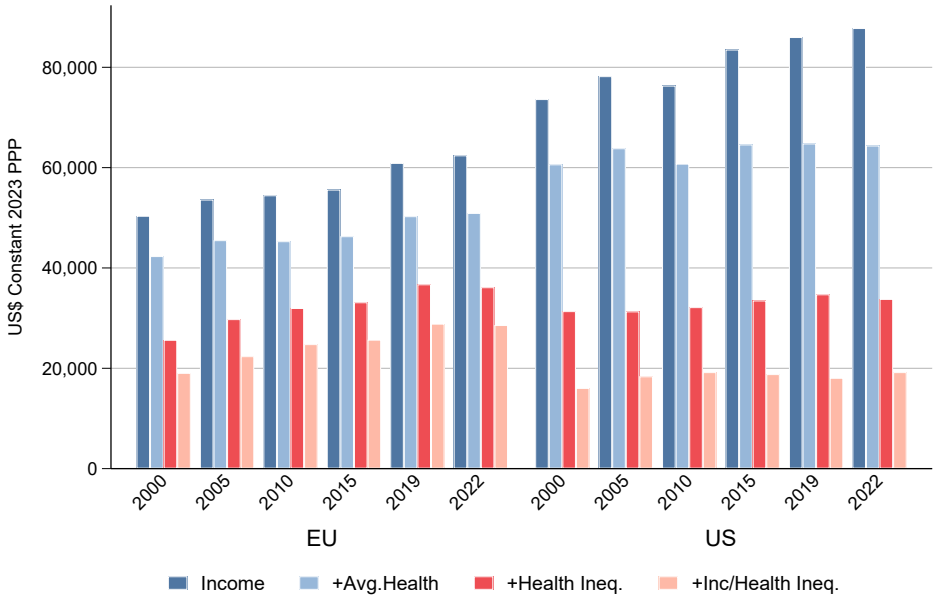

Figure 4: Equivalent income ($v = 1.5$), EU vs. US

Next we turn our attention to average annual growth rates across different welfare measures in Tables 4 and 5. The former adjusts income growth for changes in lifespan inequality only while the latter includes an additional adjustment for income inequality. I calculate growth rates for these measures for the same periods between 2000 and 2022. The tables demonstrate that income growth in the EU and US was relatively similar over the entire period 2000-22. Table 4 indicates that welfare growth rates in the EU tend to increase when more weight is placed on those with the shortest lifespans, particularly when $v = 1.5$. Conversely, the US experiences lower or even negative welfare growth when lifespan inequality adjustments are made. Turning to Table 5, the equivalent income columns suggest that the EU welfare growth rates are considerably larger (compared to the income-only case) when changes in income and lifespan inequality are considered for all values of $v > 0$. The picture is more mixed for the US. Welfare growth exceeds income growth over the period 2000-2005, reflecting a reduction in income inequality during these years. However, the reverse tends to hold in subsequent periods.

			Equivalent income			
Country	Period	Income	$v = 0$	$v = 0.5$	$v = 1$	$v = 1.5$
EU	2000-2005	1.26	1.45	1.50	1.70	3.03
	2005-2010	0.31	-0.09	-0.10	0.04	1.45
	2010-2015	0.41	0.44	0.45	0.47	0.70
	2015-2019	2.31	2.09	2.11	2.17	2.60
	2015-2022	1.67	1.37	1.31	1.22	1.24
	2000-2022	0.98	0.84	0.84	0.89	1.57
US	2000-2005	1.21	1.04	0.96	0.79	-0.03
	2005-2010	-0.48	-0.98	-0.99	-0.83	0.53
	2010-2015	1.81	1.23	1.16	1.05	0.81
	2015-2019	0.74	0.07	0.06	0.13	0.90
	2015-2022	0.72	-0.05	-0.15	-0.24	0.13
	2000-2022	0.80	0.27	0.21	0.15	0.34

Table 4: Average annual growth rates (2000-2022), lifespan inequality adjustments only, based on Equation 5

.

			Equivalent income			
Country	Period	Income	$v = 0$	$v = 0.5$	$v = 1$	$v = 1.5$
EU	2000-2005	1.26	1.45	1.66	1.93	3.27
	2005-2010	0.31	-0.09	0.38	0.62	2.06
	2010-2015	0.41	0.44	0.43	0.47	0.71
	2015-2019	2.31	2.09	2.38	2.50	2.97
	2015-2022	1.67	1.37	1.51	1.47	1.55
	2000-2022	0.98	0.84	1.04	1.15	1.86
US	2000-2005	1.21	1.04	1.73	2.37	2.73
	2005-2010	-0.48	-0.98	-0.76	-0.50	0.89
	2010-2015	1.81	1.23	0.48	0.10	-0.42
	2015-2019	0.74	0.07	-0.75	-1.13	-1.00
	2015-2022	0.72	-0.05	0.18	0.07	0.30
	2000-2022	0.80	0.27	0.38	0.46	0.82

Table 5: Average annual growth rates EU and US (2000-2022), lifespan and income inequality adjustments, based on Equation 9

.

5 Robustness checks

The baseline results rely on specific assumptions regarding the functional form of the utility function and its parameters. In this section, I test the robustness of our results to variations of the preference parameters. I hold inequality aversion fixed at either $v = 0$ or 1.[23] I test combinations of $\gamma = 0.5$, 0.8 or 1.1 and $\underline{y} =$ \$300 , \$524 or \$730. I select this set of parameters for two reasons. Firstly, they cover a broad spectrum of values used in prior studies concerning the value of longevity gains (e.g., Becker et al., 2005; Fleurbaey and Gaulier, 2009; Jones and Klenow, 2016). Secondly, they yield values of a life year (from the individual's perspective) that are reasonable in relation to the empirical literature and avoid very high minimum income levels that would exclude large proportions of the population.[24] For instance, based on 2022 average values of income, the different calibrations yield values of a life year, $u(y)/u'(y)$ ranging from 1.8 to 11 times average income. The baseline parameters yield values of 3 and 4.5 times average income in the EU and US, respectively.[25]

[23] I do not test different specifications of the utility function because has proved useful in explaining several real-world phenomena, e.g., stable growth rates Acemoglu (2008), increases in health spending Hall and Jones (2007).

[24] Recent studies have utilised values between 5 and 6 times income per capita Hall et al. (2020). Note that the two parameters γ and $\underline{y}$ are closely linked. For a given value of a life year, higher γ values correspond to a larger minimum income levels $\underline{y}$. We therefore restrict our attention to values of γ below 1.1 to avoid excluding large proportions of the populaton.

[25] The difference reflects the principle of diminishing marginal utility of income within the model. That is, richer individuals place more value on their lives as income increases. That is, as one becomes richer, lifetime utility is easier to increase via life extension than increasing income (see Hall and Jones, 2007).

Figure 5 presents welfare levels in 2022 for the EU and US using different preference parameters. I consider the same three adjustments keeping $v = 1$. Panel a) shows that as γ increases, in the life expectancy only case (equation 5 with $v = 0$), the difference in welfare levels between the EU and US decreases. As discussed above, the value of additional years of life increases with higher degrees of concavity in $u(c)$ and hence the WTP the reference life expectancy LE^* is also larger. Since the EU performs relatively better than the US in terms of life expectancy, the gap between the two narrows with higher values of γ . Increasing $\underline{y}$ has a smaller effect on the relative levels. Note that increasing the value of this parameter decreases the relative value placed on being alive versus being dead and thus reduces the WTP additional life years. Panel b) demonstrates that increasing the value of γ, in the case of the lifespan inequality adjustment (equation 5 with $v = 1$), almost eliminates or even reverses the gap between the two regions. Meanwhile, decreasing γ leads to more divergence. The mechanism operates in a similar way. Gains in equivalent length of life become more valuable as diminishing returns to income set in, resulting in a higher WTP to go from ELL to ELL^*. The last panel c), the lifespan and income inequality adjustment (equation 9 with $v = 1$), demonstrates that the EU has a higher welfare level than the US in all of the parameter specifications.

Table 6 presents average annual welfare growth rates (2000-2022) with different combinations of the preference parameters. The table demonstrates that the overall conclusions under the baseline scenario are relatively robust. More specifically, the EU demonstrates a higher welfare growth rate than the US across all parameterisations. In contrast to the baseline case, the US displays a negative welfare growth rate when $\gamma = 1.1$ and adjustments are made for mean lifespan ($v = 0$) or lifespan inequality ($v = 1$).

The annex presents further tests of the results. Firstly, the results are robust if we focus on a simplified case without individual preference parameters, i.e.,$\gamma = 0$ and $\underline{y} = 0$. Secondly, the gap is almost eliminated between the EU and US if $v = 0$ in equation 9. This is a case where an aversion to income inequality only emanates from the concavity of individual period utilities. Lastly, using a fixed rather than yearly reference ELL^* does not alter the conclusions.

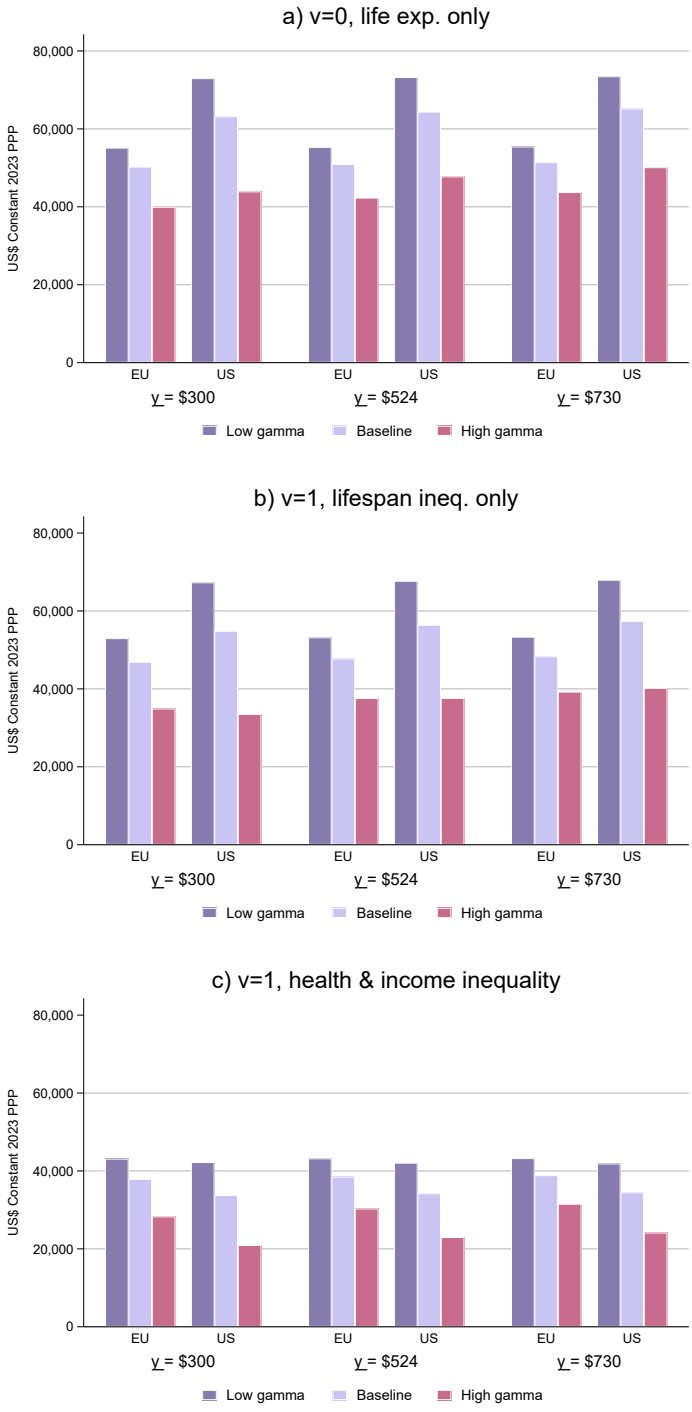

Figure 5: Robustness checks: Equivalent incomes, 2022

				$\underline{y}$			
			EU			US	
Measure	γ	\$300	\$524	\$730	\$300	\$524	\$730
$v = 0$	0.5	0.91	0.91	0.91	0.49	0.50	0.50
	0.8	0.84	0.84	0.85	0.24	0.27	0.29
	1.1	0.65	0.68	0.70	-0.37	-0.24	-0.16
$v = 1$ (lifespan)	0.5	0.94	0.94	0.94	0.42	0.42	0.43
	0.8	0.89	0.89	0.89	0.11	0.15	0.17
	1.1	0.73	0.75	0.77	-0.59	-0.44	-0.35
$v = 1$ (all)	0.5	1.17	1.17	1.18	0.61	0.65	0.69
	0.8	1.14	1.15	1.16	0.38	0.46	0.53
	1.1	1.01	1.05	1.07	-0.14	0.07	0.22

Table 6: Robustness checks: average annual growth rates EU and US (2000-2022).

6 Comparison with other measures

A closely related measure of social welfare is the UNDP's inequality adjusted HDI, which is a variant of the standard HDI that takes into account inequalities in income, health and education. Formally, the index is defined as:

$$\text{IHDI} = \left(I^{\text{Adj}}_{\text{Health}} \cdot I^{\text{Adj}}_{\text{Education}} \cdot I^{\text{Adj}}_{\text{Income}} \right)^{\frac{1}{3}}$$

where:

$$I^{\text{Adj}}_{\text{Health}} = I_{\text{Health}} \cdot (1 - A_{\text{Health}})$$

$$I^{\text{Adj}}_{\text{Education}} = I_{\text{Education}} \cdot (1 - A_{\text{Education}})$$

$$I^{\text{Adj}}_{\text{Income}} = I_{\text{Income}} \cdot (1 - A_{\text{Income}})$$

and I_{Income} is the normalised sub-index value for income dimension. The corresponding sub-indices for health and education are given by I_{Health} and $I_{Education}$, respectively. Each index is adjusted by an Atkinson inequality index, captured by the term A. Note that the UNDP also measures health inequality via an Atkinson index (A_{Health}) defined over the distribution of lifespan within a period life table. To allow for comparisons with the equivalent income measure, I calculate a restricted version of the IHDI for two dimensions: income and health:

$$\text{IHDI}_{restricted} = \left(I^{\text{Adj}}_{\text{Health}} \cdot I^{\text{Adj}}_{\text{Income}} \right)^{\frac{1}{2}}$$

This function represents an alternative way of aggregating average outcomes and inequal-

ities within the two dimensions, albeit using arbitrary assumptions. For instance, the income index I_{Income} utilises a logarithmic transformation of income and a min-max normalisation method to scale the variable between 0 and 1,[26] in which the upper bound is ln($75,000) and the lower bound is ln($100).[27] Similarly, the upper and lower scaling bounds for health (i.e., life expectancy) are 85 years and 20 years. Figures 6 and 7 compare trends in welfare for the equivalent income and the $IHDI_{restricted}$. The $IHDI_{restricted}$ measure ranks the EU above the US in all years. In contrast, the equivalent income ranks the US above the EU up to the year 2010 and reverses thereafter. There are also some differences in the trends over time. For instance, US equivalent income is higher in 2005 than in 2015, while the opposite is true for the $IHDI_{restricted}$. These examples demonstrate the importance of the underlying assumptions contained within composite indicators of welfare.

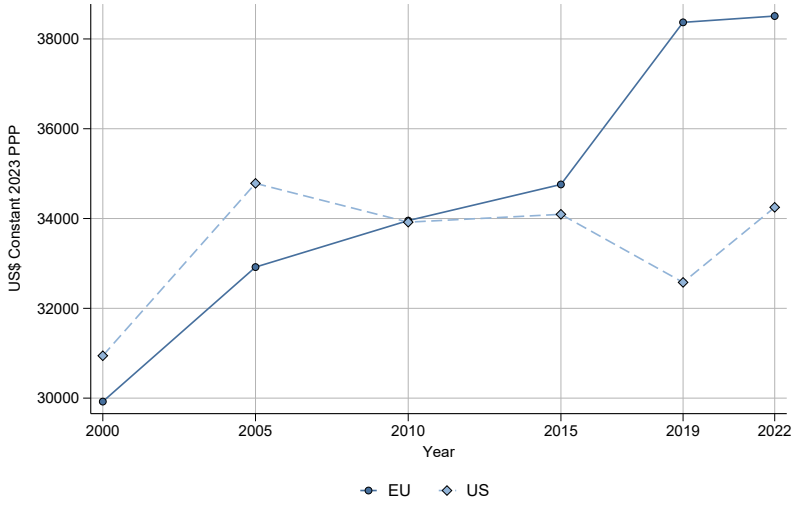

Figure 6: Equivalent income (health+income inequality), $v = 1$

[26] Thus we have: $I = \frac{\text{Actual Value} - \text{Minimum Value}}{\text{Maximum Value} - \text{Minimum Value}}$

[27] Note that the rationale for upper bound is based on a single study (Kahneman and Deaton, 2010), which looks at the relationship between emotional well-being and income. However, hedonic measures may not adequately capture well-being because they are subject to adaptation, meaning that individuals adjust to their circumstances over time. In addition, respondents may interpret and use scales differently when answering questions about their subjective well-being. This limits the inferences that can be made from the regression analysis of Kahneman and Deaton (2010)

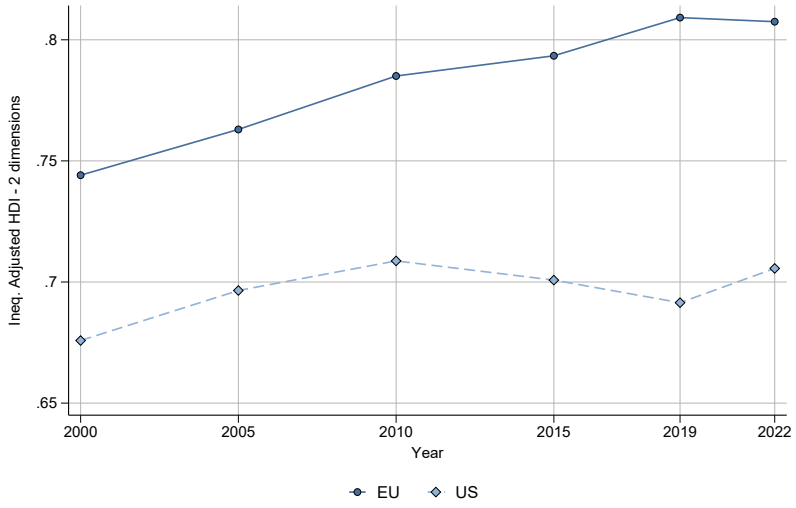

Figure 7: Inequality adjusted HDI (health+income only), $v = 1$

7 Discussion and concluding remarks

The aim of this paper has been to provide a simple measure of social welfare that can be estimated using the same data underpinning average income and life expectancy. A core starting assumption within the model is that mortality and income are independent. However, a broad literature, stretching back to Preston (1975, 1980), demonstrates that low income individuals typically face higher mortality rates than their richer counterparts. While we do not incorporate such aspects within our analysis, it is important to assess how the results would change if we took this positive correlation into account. In our prioritarian framework, which places additional weight on the well-being of the worst off, a positive correlation would tend to reduce social welfare (and thus equivalent incomes) relative to the case where mortality and income are independent. This is because the most-disadvantaged groups in society, i.e. those with the lowest incomes, would also suffer reduced longevity. The prioritarian approach would penalise such correlations because the SWF weights the outcomes of those with the lowest levels of well-being more heavily. We may therefore expect the welfare gap between the EU and US to be further reduced or reversed, assuming the correlation between income and lifespan is similar in each country.

Two approaches could be considered to incorporate such correlations. One possibility would be to estimate the relationship between mortality rates and income using a parametric model (see Chetty et al., 2016). The simulation above could then be conducted

again with adjusted mortality rates that vary by income level. Alternatively, the correlation structure between lifespan and income could be estimated directly via a copula function. For instance, one could construct a weighted life table from sub-regions or demographics for which average income data are also available. The correlation structure could then be inferred from the proportions of individuals dying at a different ages and income levels using a copula. A similar approach is utilised by (Decancq and Jorda, 2024). The estimated copula function could also be used to simulate other joint distributions based on different marginals (i.e., at the country level).

The equivalent income utilised in this paper also relies on an ex-post SWF, defined over 'observed' lifetime utilities. There are two reasons for this choice. Firstly, it reduces the data requirements for the measure because it does not require detailed information on outcomes at the individual level. Secondly, it demonstrates how conventional measures of social welfare (e.g., income per capita, life expectancy) can be expanded to incorporate such aspects. However, ex-post prioritarianism is only one form of aggregation that could be adopted.[28] Alternatively, one could aggregate via an ex-ante prioritarian SWF, defined over expected utilities. This would involve computing equivalent incomes based on expected utilities at the individual level and then aggregating using an type Atkinson SWF. Such an approach would require data on mortality risks at a very fine-grained level, which are often unavailable for many countries.[29]

To conclude, our simple model has demonstrated that going beyond GDP and averages can yield different conclusions on welfare levels and trends when making cross-country comparisons. More precisely, I find that focusing on income per capita alone may obscure underlying differences between the EU and US in terms of population health and inequalities. While there is considerable uncertainty regarding the underlying parameters of the model, the sensitivity analysis suggests that the baseline conclusions hold for most of the calibrations considered. Nevertheless, individual and social preferences may differ between countries. For example, countries may place more weight on health versus income, or average outcomes versus inequality. This paper, however, assumes that preferences are identical across countries. Differences in the weights placed on health arise solely through income effects. Future studies could explore such differences by estimating preferences directly, via revealed or stated preferences. This would help to reduce uncertainty and yield a better understanding of welfare across countries.

[28] A detailed discussion of the normative properties of each type of aggregation function is beyond the scope of this paper. Interested readers should see Adler et al. (2021).

[29] Future studies could assign life expectancies to individuals based on their age, sex, and location. Such information is available at the regional level for the EU and US via Eurostat and the Global Burden of Disease study.

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A Appendix

A.1 Simplified cases

A.1.1 No concavity in period utility: $\gamma = 0, \underline{y} = 0$

Under the assumption of independence between income and lifespan, we arrived at the following approximation of the equivalent income by setting $\gamma = 0$ and $\underline{y} = 0$:

$$\widehat{y} = \begin{cases} \left[\left(\left(\frac{1}{N}\sum_{j=1}^{N} u(y_j)^{1-v}\right)^{\frac{1}{1-v}} \frac{ELL}{ELL^*}(1-\gamma)\right) + \underline{y}^{1-\gamma}\right]^{\frac{1}{1-\gamma}} & \text{if } v \neq 1, \\ \left[\left(exp\left(\frac{1}{N}\sum_{j=1}^{N} ln(u(y_j))\right) \frac{ELL}{ELL^*}(1-\gamma)\right) + \underline{y}^{1-\gamma}\right]^{\frac{1}{1-\gamma}} & \text{if } v = 1, \end{cases}$$

This requires assumptions on several parameters, namely γ, $\underline{y}$, and v. If one is willing to make the strong assumptions of a linear utility function (γ=0) and the absence of a subsistence level of income ($\underline{y} = 0$), we can derive a simplified version of the measure:

$$\widehat{y} = \begin{cases} \left(\frac{1}{N}\sum_{j=1}^{N} y_j^{1-v}\right)^{\frac{1}{1-v}} \cdot \frac{ELL}{ELL^*} & \text{if } v \neq 1, \\ \exp\left(\frac{1}{N}\sum_{j=1}^{N} \ln(y_j)\right) \cdot \frac{ELL}{ELL^*} & \text{if } v = 1, \end{cases}$$

which can be further simplified as $\widehat{y} = y_{ede}\frac{ELL}{ELL^*}$ where y_{ede} is simply the Atkinson equally distributed equivalent of income.

Figure 8 presents the equivalent incomes derived from this measure. Overall, the core findings of the paper remain unchanged, namely the welfare level gap between the EU and US is substantially reduced or reversed when we account for inequalities in income and lifespan via the y_{ede} and ELL.

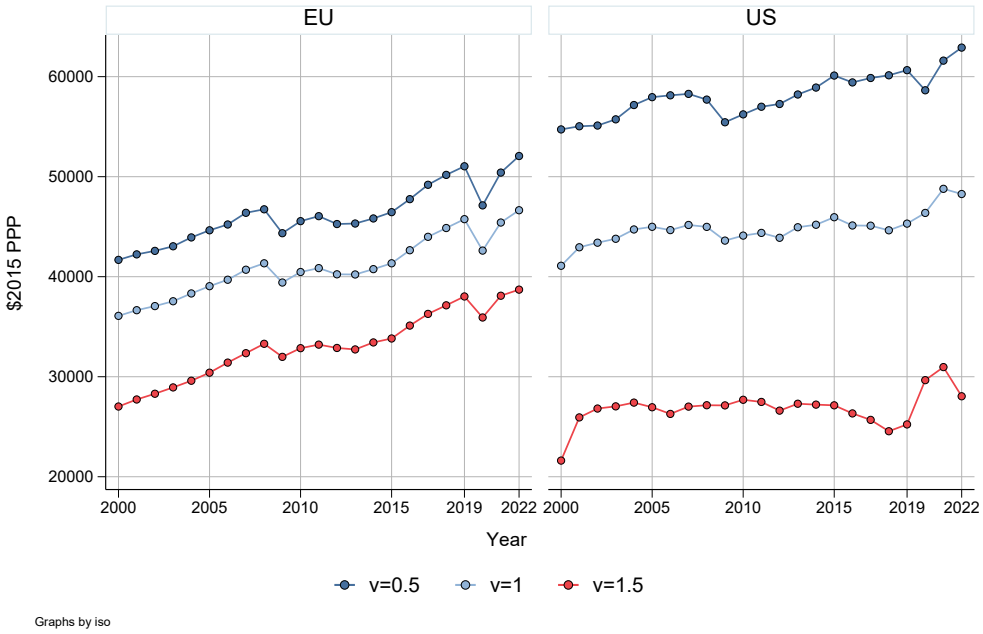

Figure 8: Equivalent incomes with $\gamma = 0, \underline{y} = 0$

A.1.2 No explicit inequality aversion: $v = 0$

As noted in the text, aversion to inequalities in incomes comes from two principle sources, the risk aversion parameter γ and the explicit inequality aversion parameter v. In this section, I estimate a model in which aversion to income inequality occurs through the former. That is, I estimate equation 9 with $v = 0$. Under this assumption the measure reduces to:

$$\widehat{y} = \begin{cases} \left[\left(\frac{1}{N}\sum_{j=1}^{N} u(y_j)\right)\frac{LE}{LE^*}(1-\gamma) + \underline{y}^{1-\gamma}\right]^{\frac{1}{1-\gamma}} & \text{if } v \neq 1, \\ \left[\left(\frac{1}{N}\sum_{j=1}^{N} ln(u(y_j))\right)\frac{LE}{LE^*}(1-\gamma) + \underline{y}^{1-\gamma}\right]^{\frac{1}{1-\gamma}} & \text{if } v = 1, \end{cases} \tag{12}$$

which is similar to prior works addressing solely inequalities in consumption (e.g., Jones and Klenow, 2016), in that it adjusts average income for income inequalities (via risk aversion through $u(y_j)$) and average lifespan. The results for this measure are presented in Figure 9 .

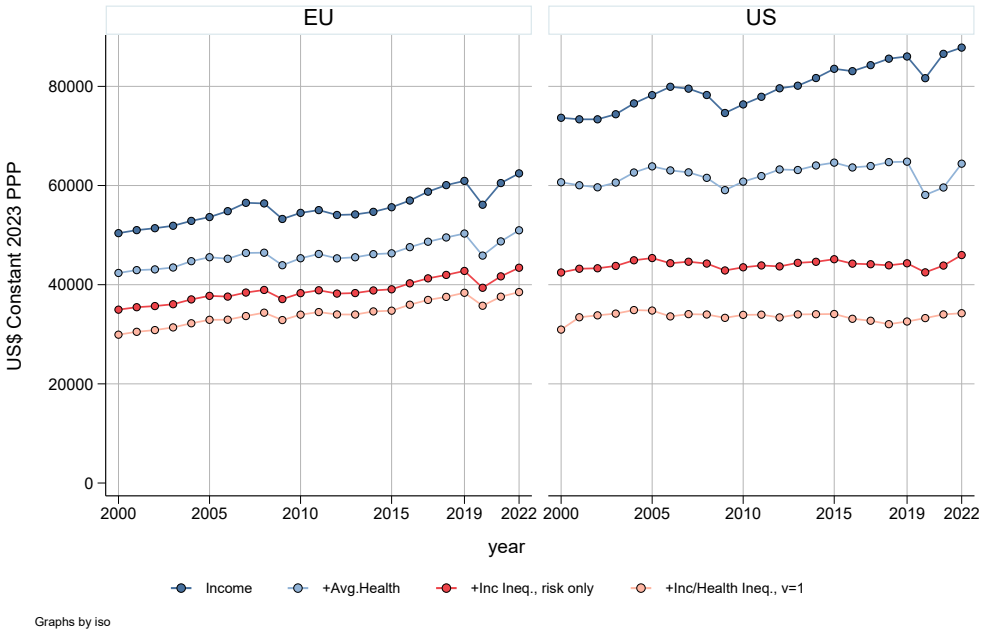

Figure 9: The role of risk aversion, equiv. incomes (equation 9, $v = 0$)

A.2 Fixed reference ELL

In this section, I recalculate equivalent incomes using a fixed rather than an annual reference ELL^*. I select the largest ELL within the dataset (across all years) for each degree of inequality aversion: 86.9 years ($v = 0$), 86.4 years ($v = 0.5$), 85.4 years ($v = 1$), and 81.7 years ($v = 1.5$).

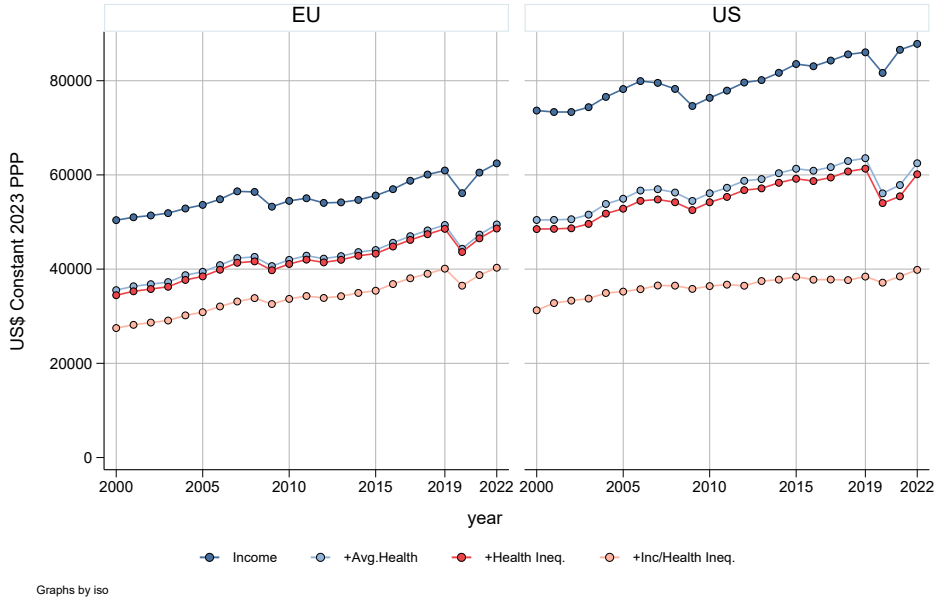

Figure 10: Equivalent incomes with fixed reference ELL, $v = 0.5$

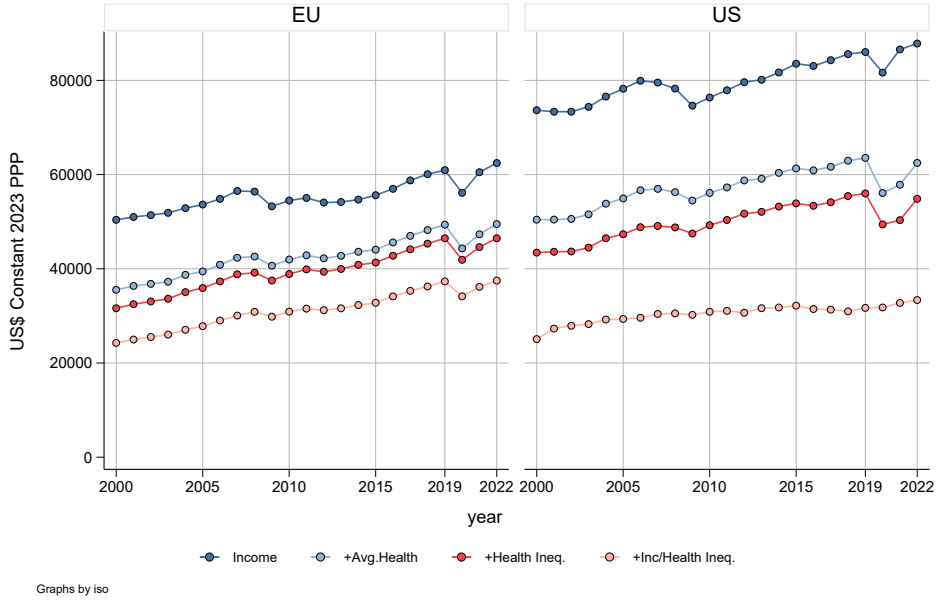

Figure 11: Equivalent incomes with fixed reference ELL, $v = 1$

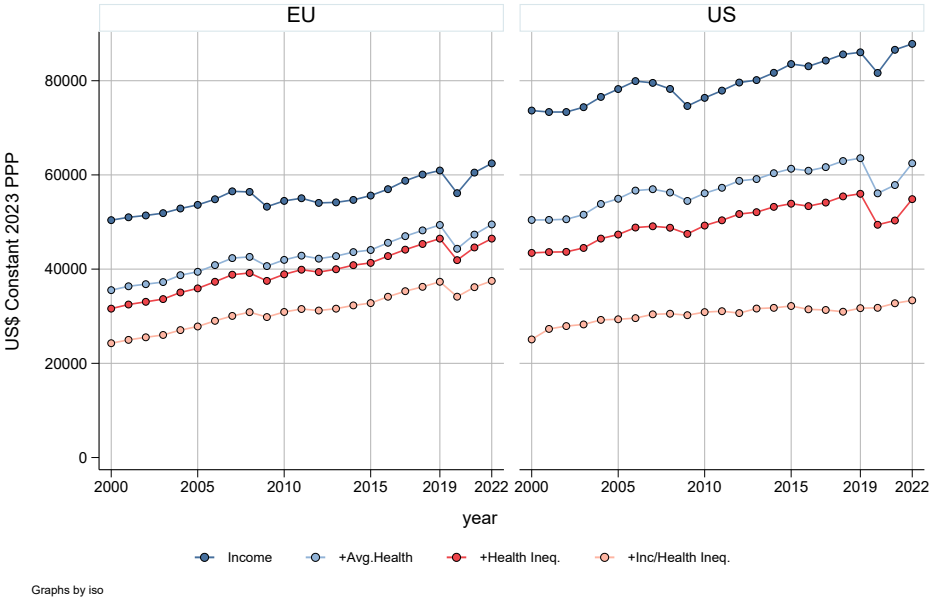

Figure 12: Equivalent incomes with fixed reference ELL, $v = 1.5$

A.3 Lifespan distributions by year

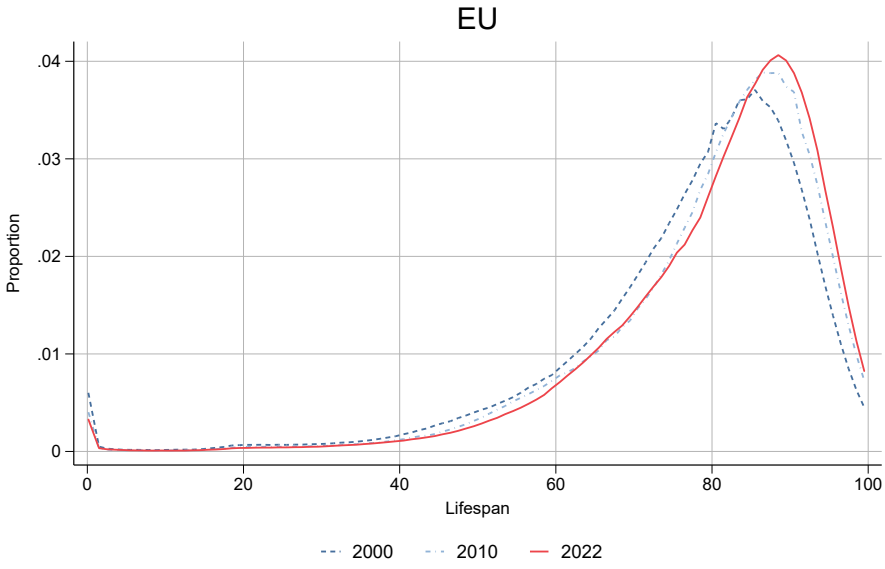

Figure 13: EU lifespan distributions by year, 2000-2020

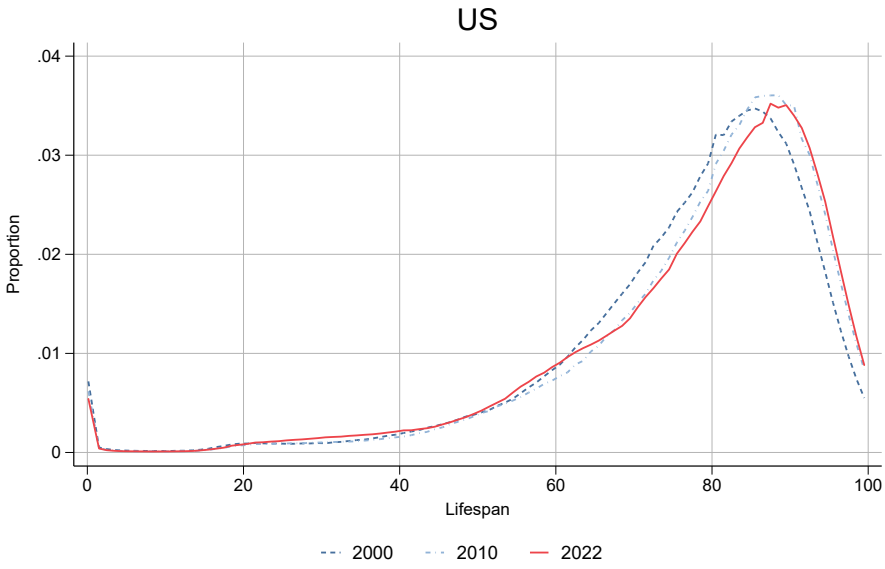

Figure 14: US lifespan distributions by year, 2000-2020

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