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Preferences and Equivalent Income in the UK

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Abstract

The use of multidimensional wellbeing has emerged from a shift of the main focus of policies from income to the consideration of other non-income dimensions. Using the ordered logit fixed effects modelling technique in a life satisfaction regression to estimate coefficients related to income and non-income life domains, the study has examined the computation of a preference-based single index measure of wellbeing called equivalent income. It is noted that one contribution from this study is that the analysis takes into account hedonic adaptation when computing of equivalent income. This aspect is new in the literature and none of the previous studies included adaptation in the estimation of equivalent income.

The coefficients related to income and non-income life domains estimated from the life satisfaction regressions are used to calculate equivalent income at the individual level. The results confirm low degree of overlap between individuals with the lowest equivalent income and those worst-off identified by equivalised income and by life satisfaction. The estimated willingness to pay (WTP) for perfect health accounts for a large proportion of equivalised income, while WTP for being employed is quite low.

In addition, the findings conclude that across wellbeing measures, women aged 40-50 with lower education, living with other people in an urban area, childless and do not own a home outright are often identified as the worst-off. Regarding adaptation, the results confirm no adaptation to impairment after more than three years since onset.

Keywords: Equivalent income, willingness-to-pay, subjective wellbeing, life satisfaction

JEL classification: D63; I3; I31

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1 Introduction

Wellbeing has been recognised as a combination of multiple life domains and in recent years, the use of multidimensional wellbeing measure has gained prominence in policy-related research with a number of measures that have been proposed (see Fleurbaey and Blanchet, 2013; Aaberge and Brandolini, 2015; Ledić and Rubil, 2016, for more discussion). In addition to monetary aspect, wellbeing measures should consider the impacts of non-monetary life domains as parts of wellbeing (Fleurbaey, 2009; Decancq et al., 2016, 2017). Reflecting this multi-dimensional approach of wellbeing, the OECD's Better Life Initiative identifies three pillars of wellbeing, which are 'material conditions' (or economic wellbeing, referring to material living conditions), 'quality of life' (combining the set of individual's non-monetary aspects that affect opportunities that people have in life), and 'sustainability' (i.e. related to the impact of current actions and policies on the socio-economic and natural systems, and how these assets would be transmitted to the future) (oec). In the OECD's framework, wellbeing is a combination of income and wealth and 10 non-income domains including jobs and earnings, housing, health, work–life balance, education, social connections, civic engagement; environmental conditions, personal security, and subjective wellbeing (dur). However, the literature has not been much concerned with how such wellbeing measure could be obtained to reflect both income and non-income aspects of people's lives, and capture opinions on what a good life is (Fleurbaey and Blanchet, 2013).

In addition, the distrust of the practical benefit of solely-income-based wellbeing measure has been pointed out in many recent studies (more detailed discussions are in Fleurbaey, 2009; Fleurbaey and Gaulier, 2009; Decancq and Neumann, 2014; Ledić and Rubil, 2016). The use of individual income alone as a wellbeing measure is criticised to be a too narrow information basis to compare individual wellbeing (see Stiglitz et al., 2009, for an extensive survey). The argument against income as a wellbeing measure criticises the assumption that all individuals with the same equivalised income level are equally well-off, regardless of their non-monetary domains of life such as health, educational achievements, or labour market status (Decancq and Neumann, 2014). This argument is backed by a well-documented literature on wellbeing that confirms the importance of non-monetary life domains which may not be directly bought with money (see Benjamin et al., 2012; Clark, 2016; Graham, 2016). As individual income does not capture sufficient information to compare wellbeing across individuals (Defloor et al., 2017), including other domains that extend beyond income could

provide more information to a wellbeing measure. One possible approach would be to collapse a multidimensional measure into a single index (see Sen, 1980, 1985; Kuklys, 2005; Stiglitz et al., 2009; Fleurbaey and Gaulier, 2009; Decancq and Neumann, 2014; Decancq et al., 2015a; Decancq and Schokkaert, 2016).

The concept of money-metric utility captured by an index number that represents individual preferences while being expressed in quantity (or monetary) units was introduced by Samuelson (1974) and Samuelson and Swamy (1974) and later the expression of it was proposed to be 'equivalent income' by King (1983). Following the equivalence approach, Fleurbaey and Gaulier (2009) and Fleurbaey (2011) introduce a simple generalisation of this idea to encompass all relevant non-monetary life dimensions. The concept of creating an inclusive wellbeing measure that represents both monetary and non-monetary aspects is not a novel idea itself. However, it is not until early 2000s that the emerge of this concept with a strong focus on preferences started drawing much attention, especially, regarding different approaches to obtain such a measure.

A variety of methods have been proposed to collapse a multidimensional measure into a single index that takes into consideration heterogeneous preferences and that can be used for interpersonal wellbeing comparison. This study follows an approach to capture the information regarding individual preferences which is based on the concept of subjective wellbeing (SWB) and estimates WTP for goods that cannot be bought in the market through analysing their impacts on SWB (see Clark and Oswald, 2002; van Praag and Ferrer-i Carbonell, 2007; Decancq et al., 2015b). In this approach, survey data with information on SWB is used to obtain a so-called 'equivalent income', that aggregates across several life dimensions and takes into account inter-individual preference heterogeneity across life dimensions (Fleurbaey, 2005, 2006, 2009; Fleurbaey and Gaulier, 2009).

The first branch of the literature includes multi-country analyses. These studies use cross-country data to compare social welfare, and inequality in some research using different measures of wellbeing. These studies started by computing the equivalent income at the individual level and then transformed that data to the societal level for international comparisons and inequality analyses. This could be done either through log transformation (Jones and Klenow, 2016) or through averaging method taking into account inequality (see Decancq and Schokkaert, 2016; Ledić and Rubil, 2016) and decomposing inequality in equivalent income (Ledić and Rubil, 2020). In most of these studies, GDP per capita is used as a comparator to equivalent income in ranking wellbeing in various regions and areas, such as among 24 OECD countries (Fleurbaey and Gaulier, 2009) or European nations

(Decancq and Schokkaert, 2016; Ledić and Rubil, 2016; Jara and Schokkaert, 2017; Petrillo, 2018; Ledić and Rubil, 2020).

Another branch of the empirical literature in equivalent income focuses on computing a wellbeing measure for individual comparisons within a certain country. The studies exploit micro-level data (e.g. household datasets) to construct equivalent income using equivalised disposable income (see Decancq and Neumann, 2014; Decancq et al., 2015a, 2016; Jara and Schokkaert, 2017; Defloor et al., 2017) or expenditure per consumption unit (Decancq et al., 2015a, 2017). In these works, monetary and non-monetary dimensions are used as covariates in SWB (e.g. mostly life satisfaction) regressions to estimate the coefficients which are then used to compute equivalent income. Some of these studies compare the portraits of the worst-off identified by equivalent income with those identified by other wellbeing measures such as life satisfaction, income or some objective measures. One point to note here is the differences in the data used across these studies. Although they all exploit micro-data, some papers construct equivalent income using single year data (see Schokkaert et al., 2011; Decancq and Neumann, 2014; Decancq et al., 2016; Jara and Schokkaert, 2017) while the others focus their analyses on a period of time (i.e. using panel data). Examples include Fleurbaey et al. (2009); Decancq et al. (2015a); Defloor et al. (2017) and Decancq et al. (2017).

It can be drawn from the literature review that although there is an extensive literature in the computation of equivalent income using data from several countries, very few or even no studies have been published using data from the UK. An exception is a study by Yang (2018), which does not obtain equivalent income specifically but applies the equivalence approach to obtain a multidimensional wellbeing index that integrates preferences and SWB using all waves of the British Household Panel Survey.

The main objective of this study is to compute equivalent income through the marginal rate of substitution between income and non-income dimensions along a SWB contour using the UK Household Longitudinal Study (UKHLS), a rich representative dataset providing a lot of information regarding SWB as well as different life aspects. Another advantage of the UKHLS is that it allows to apply panel data analysis, which means it is possible to follow individuals over time. By utilising the FE ordered logit models, this study will be able to control for unobserved heterogeneity that some previous studies did not manage to do due to data limitation (see Fleurbaey, 2009; Schokkaert et al., 2011; Decancq and Neumann, 2014; Decancq and Schokkaert, 2016; Ledić and Rubil, 2016). The computed results will then be compared with individual income to examine if different worst-off

groups are captured by different money-metric wellbeing measures.

2 Framework

Equivalised income

Let us consider individual income (i.e. equivalised income) as a solely measure of wellbeing and an interpersonal comparable measure. Therefore, wellbeing level of an individual 'i' is as captured by:

$$WB_{it} = Y_{it} \tag{1}$$

When considering only income information to compare individual wellbeing, we assume that two individuals 'i' and 'j' with information on equivalised income (has homogeneous preferences. If income is the only metric for this comparison as depicted in Figure 1, one can conclude that individual j is better off than individual i as j has higher income than i ($Y_{jt} > Y_{it}$).

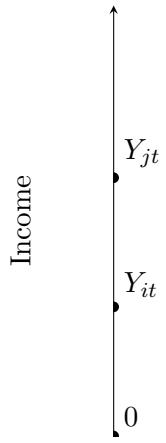

Figure 1: Considering income solely when comparing individual wellbeing

It is noted that the above example is a very plain case as using income solely as an inter-personal comparable wellbeing measure assumes that (i) everything which matters to wellbeing can be bought; (ii) everyone with the same income level or broadly with the same material resources is considered equally well-off or equally badly-off; and (iii) Y is permanent income. Such strong assumptions do not seem to be realistic as it implies that all the other life domains have no relations with individual wellbeing, which is considered to combine multi-domains of one's life. Indeed, empirical evidence has shown that different non-monetary life aspects and events have significant effects on individual

wellbeing (see Clark et al., 2001, 2008; Oswald and Powdthavee, 2008; Pagan, 2010; Clark and Georgellis, 2013; Pagan, 2012).

Equivalent Income

The equivalent income approach is a method that combines different life domains into one money-metric wellbeing measure. Expanding from the example above, let us relax the above-mentioned assumption and add information on a non-income aspect, such as health (see Fleurbaey et al., 2009; Schokkaert et al., 2011, for more discussion on having more than one domain in wellbeing and preferences). Adding information on health and indifference curves to this example allows individuals to trade-off between different life domains. Considering individual i with health condition H_{it} and individual j with health condition H_{jt}, their indifference curves are shown in Figure 2 and Figure 3.

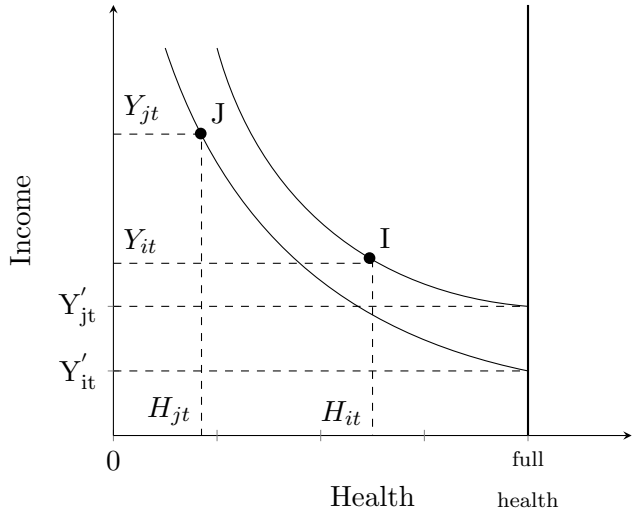

Figure 2: Same preferences across individuals

Figure 2 describes a scenario with an assumption that both individuals agree on preference between income and health. Individual i is considered to be better off than individual j as i is on a higher indifference curve than j. It is quite straightforward to compare individuals with same preferences in this case. However, the assumption of the same preferences across individuals is strong and not always realistic. If we allow heterogeneity in preferences (i.e. the two individuals have different preferences), it means that individuals' indifference curves (ICs) will have to intersect (e.g. Figure 3). In this case, there is no clear dominance, even if individuals i and j are in the same life situation 'K' (i.e. the intersection point at which both individuals have same income and health levels), individual wellbeing is still not comparable between i and j as they have different preferences. The indifference curve of individual i is steeper than individual j's, which implies that health is more

important to individual i than it it for j. In both Figure 2 and 3, there is no clear dominance as individual j has higher income ($Y_{jt} > Y_{it}$) while individual i has better health ($H_{it} > H_{jt}$).

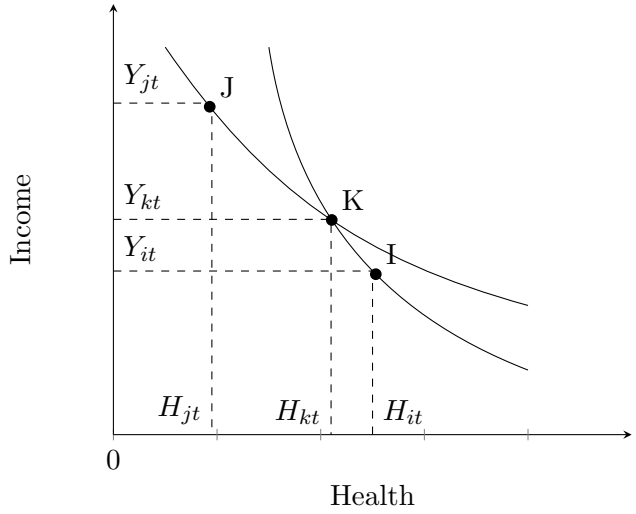

Figure 3: Heterogeneity in preferences across individuals

In this example, there is no clear dominance (i.e. individual j has higher income ($Y_j > Y_i$) while individual i has better health ($H_i > H_j$), even if individuals i and j are in the same life situation 'k' (i.e. the intersection point at which both individuals have same income and health levels), individual wellbeing is still not comparable between i and j as they have different preferences. The indifference curve of i is steeper than j's, which implies that health is more important to individual i than it it for j . From the figures above, adding information on health and indifference curves to this example allows individuals to trade-off between different life dimensions.

Comparing wellbeing between two people with two different life domains is complex. Once way to simplify the comparison is to keep one of the domain as a reference (i.e. keep one domain the same across individuals) and compare the other. For example, if both individuals have the same level of health, the other aspect (i.e. income) can be adjusted along their own indifference curves so that each individual is indifferent between their own original situation and their new situation. Hence, wellbeing comparisons can then be based on their positions on the other aspect (Decancq et al., 2015b). However, keeping same the health condition as poor health for both individuals and allowing one to have a slightly higher income may not provide the obvious conclusion that, for example, the wealthier individual is better off than the poorer counterpart who has the same poor health condition. If the richer person cares about their poor health and the poorer person does not mind the same poor health, the richer's wellbeing may not be as good as her/his poorer

counterpart. In contrast, if both individuals have perfect health (denoted by H^*), which is assumed to be preferred by all individuals and the health domain cannot get better than the 'perfect' level, wellbeing comparison between the two individuals i and j can now be solely in terms of their income levels (see Decancq et al., 2015b, for detailed discussion). In other word, the wellbeing comparison is now based on an approach that keeps health, a non-monetary life domain, at optimal level and compares individuals based on income domain (Decancq and Neumann, 2014; Decancq et al., 2015a; Decancq and Schokkaert, 2016).

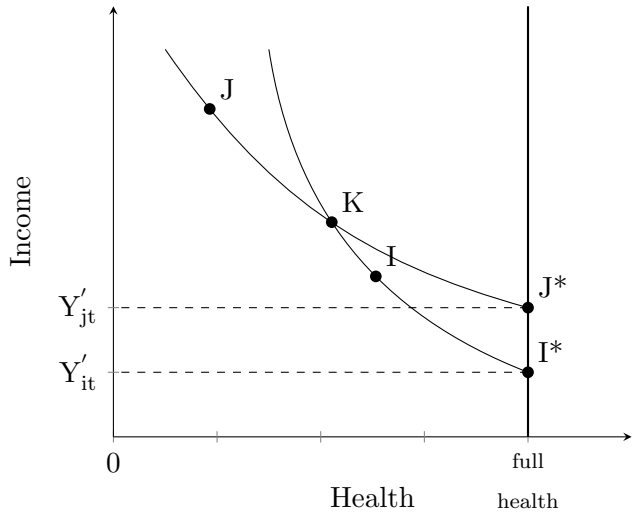

Figure 4: Heterogeneity in preferences and Equivalent income

From Figure 4, the current life situation of individual i at point 'I' gives him/her the same level of wellbeing compared to a hypothetical situation 'I^*' (i.e. I^* combines full health and income Y'_{it}) as they are on the same indifference curve. Similarly, individual j indifferences between his/her current life situation 'J' and the hypothetical situation 'J^*' at full health and income Y'_{jt}. As discussed before, it is reasonable to rank I^* and J^* on the basis of income solely. Therefore, individual i in situation 'I' is worst-off than individual j in situation 'J' as the hypothetical income Y'_{it} is lower than Y'_{jt}. Such a hypothetical income is equivalent income.

Equivalent income (EI) is the hypothetical income level that, if combined with a bundle of relevant non-monetary life domains at the optimal levels (e.g. perfect health), would make an individual indifferent between that scenario and his or her current situation (Decancq et al., 2015a).

In short, taking into account heterogeneity in preferences, when allowing the non-monetary life domains to be optimal, interpersonal comparison of wellbeing can be done by comparing only monetary or income domain. It is assumed that at full health H^*, individual i is equally satisfied

with her current life situation 'I' and life scenario 'I^*' while individual j is indifferent between his actual life scenario 'J' and the hypothetical one, 'J^*'. In this case, comparing individual wellbeing between individual i and individual j by ranking their current life situation 'I' and 'J' can be done by ranking 'I^*' and 'J^*' on the basis of equivalent income $Y^{'}_{it}$ and $Y^{'}_{jt}$. In particular, if $Y^{'}_{jt} > Y^{'}_{it}$ (i.e. equivalent income), individual i is worse-off.

Equivalent Income and Marginal rate of substitution

The computation of equivalent income in this context is based on the assumption that people's preferences are consistent with their evaluation of overall life satisfaction (denoted as L_{it}) (see Schokkaert et al., 2011; Decancq et al., 2015a).The expression of an individual's life satisfaction over different life domains is based on the comparisons with reference scenarios which can be expectations or aspirations, or the best or the worst possible situations, or other people's situations such as someone in one's family or one's friends and so on (Schokkaert et al., 2011; Decancq et al., 2015a). Those comparisons may vary across individuals or within an individual over time. Theoretically, as defined, scaling factors related to those characteristics, besides life domains, that change the calibration of satisfaction scores but not direct object to preferences (Decancq et al., 2015a, 2016). In other words, scaling factors include those aspects that only have impact on the cardinal characteristics of preferences but not the ordinalisation. However, it is not very straightforward to distinguish life domains and scaling factors empirically as some scaling factors of one individual may actually be direct objects or be considered as life domains for the others[1].

When people optimise between their income and non-income life domains, marginal rate of substitution (MRS) in this context is the rate at which an individual gives up some amount of his or her income in exchange for an improvement in the levels of non-monetary life domains while maintaining the same level of satisfaction. In order to compute equivalent income using life satisfaction function, let us specify the life satisfaction function as:

$$LS_{it} = f(Y_{it}, D_{it}, s_{it}) \tag{2}$$

in which Y_{it} captures income of an individual i at time t. D_{it} represent non-income life domains (e.g. health and employment status) and s_{it} consists of scaling factors.

[1]The discussion on the empirical application of life domains and scaling factors can be found in Decancq et al. (2015a).

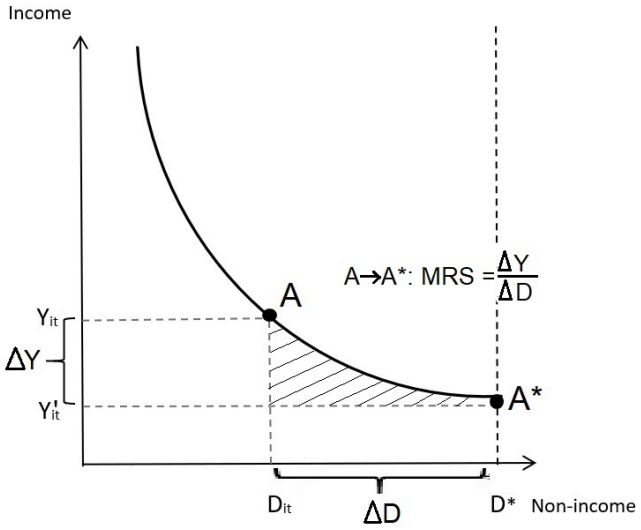

Figure 5: Indifference curve between income and non-income domains

In Figure 5 above, A is the current situation of individual i with income Y_{it} and other non-income domains captured by D_{it}. Applying the concept of equivalent income, A^* is the hypothetical situation in which individual i has optimal non-income life domains D^* and equivalent income $\mathrm{Y}'_{\mathrm{it}}$.

The process of computing equivalent income is divided into two steps. Firstly, the optimal outcome levels of individual's non-income life domains are determined as D^*. An important assumption here is that D^* captures optimal or reference values of all domains which are set at the same maximal value of each life aspects for all individuals (see Decancq et al., 2017, for more detailed discussion). Then, based on the definition of equivalent income, the life satisfaction level given by equation 1 is equalised with life satisfaction level attained when individuals experience optimal values of non-income domains combined with equivalent income[2]

As individual i is indifferent between situation A and A^*, they are depicted as two points on the same indifference curve. The differences between current income and equivalent income and current versus optimal non-income domains are denoted as ΔY and ΔD respectively. Applying the concept of marginal utility (MU), a change in utility when income (Y) and other domains (D) change is captured by:

$$MU(Y) = \frac{\partial LS}{\partial Y} \tag{3}$$

captures a change in utility from one unit change in income Y;

[2]The details of the calculation of equivalent income using estimated coefficients from the regression will be discussed in the Methodology section.

$$MU(D) = \frac{\partial LS}{\partial D} \tag{4}$$

captures a change in utility from one unit change in non-income domains D.

As MRS is the rate at which am individual is willing to and be able to give up some amount of one "good" (e.g income) in exchange for another "good" while maintaining the same level of utility, which is theoretically computed as:

$$\mathrm{MRS}_{\mathrm{Y}}^{D} = \frac{MU(D)}{MU(Y)} = \frac{\partial D}{\partial Y} \tag{5}$$

In the concept of equivalent income, MRS shows how much income to give up in order to get one unit increase in other non-income domains. Therefore, the total willingness to pay (WTP) is:

$$WTP = \mathrm{MRS}_{\mathrm{Y}}^{D}.\Delta D = \frac{\partial D}{\partial Y}.\Delta D \tag{6}$$

Based on the definition, equivalent income is the difference between individual i's current income and i's WTP to achieve the optimal level of non-income life domains (i.e. the part of current income after WTP, as shown in Figure 5)

$$\mathrm{Y}_{\mathrm{it}}^{'} = \mathrm{Y}_{\mathrm{it}} - WTP = \mathrm{Y}_{\mathrm{it}} - (\mathrm{MRS}_{\mathrm{Y}}^{D}.\Delta D) = \mathrm{Y}_{\mathrm{it}} - (\frac{\partial D}{\partial Y}.\Delta D) \tag{7}$$

3 Empirical demonstration

Data and econometric approach

The analysis uses all latest ten waves available of the UKHLS covering the period 2009 – 2020. The paper will include three life dimensions: income, health and employment (i.e. economic activities), which are the most commonly used in the literature and are also frequently considered as objective policy outcomes. Except for income, which is a cardinal variable, the other aspects are treated as categorical. The descriptive statistics of the data used in the analysis are reported in Table A1 in the Appendix.

Ordered Logit approach is chosen as the dependent variable, life satisfaction, is treated at an ordinal scale. Since many of the main variables in this study involve subjective scores (e.g. life satisfaction and self-assessed health), which might suffer from biases owing to unobserved hetero-

geneity or individual expectation and aspiration, the estimated parameters from the regression may be biased (see Ferrer-i Carbonell and Frijters, 2004; Defloor et al., 2017; Jara and Schokkaert, 2017, for more discussion). In this case, using panel data to control for the possibilities of correlated time-invariant unobserved heterogeneity could be a solution. Therefore, the UKHLS panel is utilised to model individual wellbeing through an Ordered Logit Fixed Effects approach using the 'Blow-up and Cluster' Stata program (BUCOLOGIT) by Dickerson et al. (2014).

Income and non-income dimensions

The income concept used in this study is attainment in the income domain measured by equivalised household income. The variable from the dataset is the net household monthly income, which summarises net monthly incomes from all members of the household including proxies and within household non-respondents (Understanding Society, 2017)[3]. Income levels from this variable is then equivalised using the OECD-modified equivalence scales, which is also provided within the UKHLS household database. The equivalised income values are adjusted for inflation using CPI data with base year 2009 (Data from Office for National Statistics, 2019). The study opts to use natural logarithm of real income as a common practice[4].

When considering non-income dimensions, health aspect is the first to include as the effect of health on individual wellbeing has been confirmed not only in the equivalent income literature but also the broader literature of wellbeing research (see Stiglitz et al., 2009; Fleurbaey and Gaulier, 2009; Decancq and Neumann, 2014; Decancq et al., 2015a; Adler and Fleurbaey, 2016; Clark, 2016; Chakravarty and Lugo, 2019). In this study, health is measured through the 'self-assessed health' variable that includes five categories: 'Excellent', 'Very good', 'Good', 'Fair', and 'Poor' health. The health dimension is treated as a categorical variable. From the original variable, three dummies are generated as 'Excellent and Very good Health', 'Good health' and 'Fair and Poor health', of which the last dummy will be treated as the base line in the model. There are two main practical reasons for grouping these categories. Firstly, a test for significant difference between categories shows that there is no statistically difference between 'excellent' and 'very good' health and between 'fair' and 'poor' health. Secondly, the distribution of 'excellent health', 'fair health' and 'poor health' are quite small compared to 'very good health' and 'good health', which in some models results in insignificant coefficients. By grouping the categories as discussed, the coefficients related to self-assessed health

[3]Data adjusted for council tax liability and benefit is available only with the Understanding Society Special Licence.

[4]Equivalised income has a right skew (mean=1925.28, which is larger than median=1627.05), hence using log transformation would make the distribution of income more symmetric.

become more significant and meaningful. Regarding the distribution of health across waves, the majority of respondents report very good or good health in all waves. More than 30% state that they have very good health and between 25% and 30% report good health. The figure for poor health accounts for the lowest proportion in all waves, around 5%.

The second non-monetary domain is employment, which is also included in many previous studies such as Decancq and Neumann (2014); Decancq et al. (2015a); Decancq and Schokkaert (2016); Ledić and Rubil (2016); Decancq et al. (2016); Defloor et al. (2017); Decancq et al. (2017) and Petrillo (2018). The variable is drawn from the question that asks respondents about their current economic activity "What best describes (your) current employment situation?". The answers include 10 to 11 options[5], of which a set of dummies capturing whether an individual reported being 'employed', 'unemployed' (the baseline) or 'not active in labour market' is generated. Most of the categories grouped into "Not active in labour market" account for less than 10% of the total distribution, except for 'retired' at 23%. Based on this question, this chapter does not distinguish between short-term (i.e. the unemployed duration is within a year) and long-term unemployment (i.e. at least 12 months out of work). It is noted that in this demonstration, the group approach contrasts being involuntarily 'unemployed' versus 'employed' and 'not active in labour market' (i.e voluntarily unemployed). Previous research has shown a strong effect of unemployment relative to employment on individual wellbeing, such as Clark and Oswald (1994); Di Tella et al. (2001); Clark (2003); Lucas et al. (2005); Clark (2006) and Clark and Georgellis (2013), hence unemployment is here considered. Distinguishing between being 'unemployed' and 'inactive in labour market' would separate the effects of being voluntarily out of labour market in comparison to whose who want to work but cannot find a job (i.e. unemployment).

Scaling factors

Besides the life dimensions, the study employs various scaling factors which includes demographic characteristics and a set of dummies accounting for disability and hedonic adaptation. A set of variables that describe respondents' socio-demographic characteristics are included such as age (i.e. included as age, age^2 and age^3), education (i.e. a dummy for having university degree or higher education), marital status (i.e. categories: married or as married, single and others), owned home outright[6], household size (i.e. dummy capturing whether an individual is living with other people),

[5] 1-Self employed, 2-In paid employment (full or part-time), 3-Unemployed, 4-Retired, 5-On maternity leave, 6-Looking after family or home, 7-Full-time student, 8-Long-term sick or disabled, 9-On a government training scheme, 10-Unpaid worker in family business, 11-Working in an apprenticeship (only starting from wave 3).

[6] The pooled data across all ten waves used in this study have 32.47% owning home outright, 37.91% on mortgage,

having dependent children, living in rural area, and social status (i.e. categories: higher social status, middle social status and lower social status). These variables have been used as standard controls in many studies using life satisfaction and happiness regressions (Di Tella et al., 2001; Clark, 2003; Clark and Georgellis, 2013; Decancq and Neumann, 2014, see). In addition to the standard controls, a set of dummies capturing duration of disability is included to account for hedonic adaptation to disability (i.e. dummies for onset of disability, being disabled for one to two years, two to three years and three years or longer).

As discussed in the Framework section, scaling factors might change the cardinalisation of preferences as they reflect expectations and aspirations. Having health as a life domain and including adaptation to disability as a scaling factor will help to capture any changes in the intercept of preferences (as opposed to changes in in gradient/ slope) due to adaptation and returning to the baseline of life satisfaction overtime after the onset of impairment. The significantly negative effect of disability and the evidence for partial adaptation and complete adaptation to disability has been confirmed in an extensive literature (see Oswald and Powdthavee, 2008; Powdthavee, 2009; Pagan, 2010, 2012, for more discussion). Hence, controlling for adaptation to disability is important as this may change individual's aspiration and expectation. The inclusion of adaptation to disability in this study is for illustrative purpose only, rather than implying a focus on impairment. In the adaptation literature, adaptation is confirmed in many life events such as changes in marital status (e.g. divorce, marriage) or employment (see Clark et al., 2008; Clark and Georgellis, 2013, for more discussion). Similar approach could be taken to account for adaptation to particular life events.

The computation and applications of equivalent income

In the first stage, the data from the UKHLS are used in the BUCOLOGIT regressions to estimate relevant coefficients that are used to construct equivalent income. The econometric specification of life satisfaction equation in the above equation is then written as:

$$LS_{it} = \alpha_i + \mu_t + \beta_1 ln(Y_{it}) + \beta_2 lnY_{it}\#Z_{it} + \sum_{k=1}^{K}(\gamma_1{}^k D_{it} + \gamma_2{}^k Z_{it}\#D_{it}) + \delta C_{it} + \epsilon_{it} \tag{8}$$

which can be simplified as:

28.50% renting or part-renting part-owning, and 1.12% on other schemes. Grouping the latter three categories into "not owning home outright" as opposed to "owning home outright" is to capture the distinction in the financial condition between the two groups. Those who own home outright are more likely to have less burden from housing costs as they do not have to pay mortgage or rent.

$$LS_{it} = \alpha_i + \mu_t + (\beta_1 + \beta_2 Z_{it}) \cdot ln(Y_{it}) + \sum_{k=1}^{K} ({\gamma_1}^k + {\gamma_2}^k Z_{it}) \cdot D_{it} + \delta C_{it} + \epsilon_{it} \tag{9}$$

in which Y_{it} captures income of an individual i at time t. D_{it} represents non-income life dimensions (e.g. health and employment status), Z_{it} are socio-demographic characteristics (e.g. education or social status) and C_{it} is a vector of standard controls (e.g. age, household size, etc.). β_1 and β_2 are coefficients capturing the effect of income and interactions between income and socio-demographic characteristics on life satisfaction, while ${\gamma_1}^k$ and ${\gamma_2}^k$ are coefficients related to k non-income dimensions and interactions between those and Z_{it}. Individual fixed effects and time trends are captured by α_i and μ_t. ϵ_{it} is the error term. The individual characteristics or scaling factor may include both socio-demographic characteristics Z_{it} and the standard controls C_{it}. The interaction effects between Z_{it} and relevant life dimensions are captured by the coefficients β_2 and ${\gamma_2}^k$ in equations (2), which have an impact on people's trade-off across various life aspects. The standard controls C_{it} may capture changes within individual and differences across individuals in aspirations and expectations that might affect life satisfaction levels even when preferences remain the same. In contrast, changes in so-called socio-demographic characteristics Z_{it} would change preferences. These effects are captured by the interactions between Z_{it} and life dimensions D_{it}. The differences between Z_{it} and C_{it} are displayed in the computation of equivalent income in equations (4), (5), (6) and (7). In particular, Z_{it} is included in the equivalent income equation, whereas C_{it} is not.

Based on the definition of equivalent income as the level of income combined with the optimal non-income life dimensions that would result in a bundle that an individual finds equally attractive as his or her current situation, the coefficients estimated from the life satisfaction regression expressed in equation 2 can be expanded as:

$$\begin{aligned} LS_{it} &= \hat{\alpha}_i + \hat{\mu}_t + \hat{\beta}_1 ln(Y_{it}) + \hat{\beta}_2 lnY_{it} \# Z_{it} + \sum_{k=1}^{K} (\hat{\gamma_1}^k + \hat{\gamma_2}^k Z_{it}) \cdot D_{\mathrm{it}} + \hat{\delta} C_{it} \\ &= \hat{\alpha}_i + \hat{\mu}_t + \hat{\beta}_1 ln(\mathrm{Y}'_{\mathrm{it}}) + \hat{\beta}_2 ln(\mathrm{Y}'_{\mathrm{it}}) \# Z_{it}) + \sum_{k=1}^{K} (\hat{\gamma_1}^k + \hat{\gamma_2}^k Z_{it}) \cdot \mathrm{D}^* + \hat{\delta} C_{it} \end{aligned} \tag{10}$$

in which D^* captures the optimal levels of non-income dimensions and $\mathrm{Y}'_{\mathrm{it}}$ is equivalent income. From the above functions equivalent income is calculated as:

$$(\hat{\beta}_1 + \hat{\beta}_2 Z_{it}) \cdot ln(\mathrm{Y}_{\mathrm{it}}^{'}) = (\hat{\beta}_1 + \hat{\beta}_2 Z_{it}) \cdot ln(Y_{it}) + \sum_{k=1}^{K} (\hat{\gamma_1}^k + \hat{\gamma_2}^k Z_{it}) \cdot D_{\mathrm{it}} - \sum_{k=1}^{K} (\hat{\gamma_1}^k + \hat{\gamma_2}^k Z_{it}) \cdot \mathrm{D}^* \quad (11)$$

$$ln(\mathrm{Y}_{\mathrm{it}}^{'}) = ln(Y_{it}) + \sum_{k=1}^{K} \left(\frac{\hat{\gamma_1}^k + \hat{\gamma_2}^k Z_{it}}{\hat{\beta}_1 + \hat{\beta}_2 Z_{it}} \right)' \cdot (D_{it} - \mathrm{D}^*) \quad (12)$$

which yields

$$\mathrm{Y}_{\mathrm{it}}^{'} = Y_{it} \cdot exp \left[\sum_{k=1}^{K} \left(\frac{\hat{\gamma_1}^k + \hat{\gamma_2}^k Z_{it}}{\hat{\beta}_1 + \hat{\beta}_2 Z_{it}} \right)' \cdot (D_{it} - \mathrm{D}^*) \right] \quad (13)$$

The equation (7) is used to compute equivalent income when the data for a given income level and values of other non-income dimensions are available. Marginal rate of substitution $\mathrm{MRS}_{\mathrm{it}}^{YD}$ between income and non-income dimensions can be computed using the corresponding estimated coefficients as in equation (8). It is noted that $\mathrm{MRS}_{\mathrm{it}}^{Y\&D}$ is time and individual dependent, which is expressed by subscripts it. In other words, individuals with different income and/or different socio-demographic characteristics at different time might have different MRS.

$$\mathrm{MRS}_{\mathrm{it}}^{Y\&D} = Y_{it} \cdot \frac{\hat{\gamma_1}^k + \hat{\gamma_2}^k Z_{it}}{\hat{\beta}_1 + \hat{\beta}_2 Z_{it}} \quad (14)$$

Due to data limitation, only three dimensions are included in this study namely income (Y_{it}), health condition (H_{it}) and employment status (E_{it}). Theoretically, to account for individual heterogeneity of preferences, the ideal model should include all possible interactions between life dimensions and scaling factors (i.e. individual characteristics) (Decancq et al., 2015a). With the empirical model in this study, there are many potential interactions between the three life dimensions and individual characteristics. Having too many interactions in a model is data-demanding given the high correlation between terms and increases the problem of driving out the main effects. Therefore, not all interaction terms are included in the empirical model. This results in only average preferences are estimated at the subgroup levels rather that at the individual levels.

In order to decide which interactions to take into consideration, stepwise procedures with backward and forward elimination are followed. The backward process started by running an ordered logit fixed-effects regression with a full set of possible interactions between life dimensions and scaling factors. Then, an interaction and a group of interactions are excluded based on the magnitude of

related p-value. Those with largest p-values that imply insignificant effects are excluded successively until only interaction terms at 5% significant level are kept in the estimation. In addition, a forward procedure is carried out to test the final result using backward stepwise procedure. In the forward stepwise procedure, firstly, the regression will all possible interactions are estimated, and p-values of those interactions are compared to decide which interactions to include first. In this case, a group of interactions with the lowest p-values in the full interactive regression is included first. Following that, those with the second lowest p-values are added. As the result, the final model only includes interactions between health and education, which is consistent regardless of the types of procedure, whether forward or backward.

The computed equivalent income is then compared with equivalised income to examine the similarities and differences between these two money-metric measures as well as the degree of overlap of the bottom 10% worst-off identified by both measures. To examine the extent of consistency between equivalised income and equivalent income to identify the worst-off, the study compares the group at the lowest end of the distribution for each of these two measures. First, the least-well-off 10% based on equivalent income are identified for each wave. Next, the same number of observations with lowest levels of equivalised income is identified to check for the level of overlap between the two groups. Another check is cross-tabulation of quintiles of equivalised income and equivalent income in the whole panel and across waves.

In addition, to check for degree of overlap between life satisfaction and equivalent income, a tabulation between life satisfaction when life satisfaction equals one, two or three and the quartiles of equivalent income is carried out. Across all the waves and in the pooled data sample, the distribution of the three lowest levels of life satisfaction (i.e. life satisfaction between one and three) is between 23% and 28% of total number of observations of self-reported life satisfaction. Therefore, these groups of the least satisfied with life overall are compared with the quartile groups by equivalent income to analyse the correlation across these two measures of wellbeing.

Furthermore, the portraits of the worst-off by equivalised income, equivalent income, life satisfaction and relevant life domains are captured to examine the characteristics of the worst-off identified by each measure and life domain. To do so, the first step is to capture the group of all observations reporting life satisfaction of one as the reference group. The reason to use life satisfaction as the reference is (i) life satisfaction is a discrete measure; and (ii) the number of observations with life satisfaction equal one is the smallest number of the worst-off across all the other measures and life

domains. Having the smallest number of observations as the reference group would mean that all the observations from other categorical life domains have the same (lowest) value (i.e. the worst-off in employment domain are those who are unemployed and those badly-off in health domain are fair and poor health). Secondly, the bottom groups identified by equivalised income and equivalent income are captured by restricting the group with the same number of observations in the reference group. As self-assessed health and unemployment are categorical variables and the number of observations at the bottom distribution is larger than the figure for the reference group, a random seed is included in the selection process to randomly capture the same number of observations identified as worst-off all domains across all waves. Lastly, in order to understand further the correlation between equivalent income and equivalised income, life satisfaction and relevant life domains, Spearman Rank Correlation tests are carried out.

Besides the main analysis, a number of checks are carried out to test for the robustness of the main results. As mentioned before, income used in the main analysis is equivalised income at a given time point. One possible check is to use 3-year moving average income as an alternative of income. This check aims to account for fluctuations in income across waves, for example, an artist has a boost in income in one year when he sells some of his paintings. The average level of equivalised income is calculated by taking the mean of income at the individual level across three continuous years (i.e. average income in 2010 is calculated by taking the mean of income in 2009, 2010 and 2011) in order to account for some of the above-explained fluctuations. Doing so leads to a loss in the number of observations as the observations in the first year and last year an individual appears in the panel are excluded. In this check, regressions are operated separately for equivalised income and average equivalised income using Ordered Logit Random Effects (OLOGIT) and Ordered Logit FE (BUCOLOGIT). It is noted that all regressions are run on the same number of observations which is restricted to only those included in regressions using average income. The second robustness check is to employ different techniques including Ordinary least squares (OLS), linear FE and OLOGIT to analyse the data so as to test whether the relationships between life dimensions and life satisfaction are maintained across different econometric approaches. Similar to the first robustness check, all of these techniques are applied on the same sample size to ensure that any potential differences across approaches come from different techniques rather than sample sizes. Lastly, the BUCOLOGIT regression is run in a balanced panel to ensure that the results in the unbalanced panel (the main analysis) are not driven by respondents in the panel for only a short time.

Since the main objective of this chapter is to estimate equivalent income using the parameters from the life satisfaction regressions, the coefficients from the regressions in the above-mentioned robustness checks are used to compute levels of equivalent income, which are then compared across the checks and with the main results.

4 Results

Regression results

Following the model specification given by equation (2), the estimation results are presented in Table 1. The first column shows the results of the regression including only equivalised income and non-income domains (i.e. no controls and no interactions). The second column reports the results of the same model specifications but the sample is restricted to the specific sample as one with controls. The next column presents a model that includes all of the chosen life domains and standard controls but does not account for preference heterogeneity by subgroups. The last column extends the regression in the third column by adding interactions between life domains and scaling factors to represent a model that captures differences in preferences across sub-groups such as people with university degree.

In comparison with the baseline, the effects of all life domains are in line with the wellbeing literature using life satisfaction (see Dolan et al., 2008; Ledić and Rubil, 2016). Log of equivalised income has positive and significant effect at 0.1% on life satisfaction. The estimated coefficient of income is 0.051 in the unrestricted-sample simplest model (i.e. first column), which becomes quite close to the results in the regression with controls when the sample is restricted to the same as the regression with controls (second result column). The figure for income in the model with controls and the full regression with controls and interactions are at 0.114 and 0.113 respectively.

The positive sign related to coefficients of 'Excellent or very good health' and 'Good health' implies that compared to the base line or reference group of 'Fair or poor health', better health states have positive impacts on individual wellbeing (i.e. positive corresponding coefficients significant at 0.1% in all regressions). In the full regression with interactions, having 'Excellent or very good health' compared to 'Fair or poor health' has a positive impact of a magnitude that is more than 11 times larger than the positive of doubling income (i.e. $0.890/0.078 \approx 11.4$). Having 'Good health' is almost twice less valuable for life satisfaction than having 'Excellent or very good health'

(i.e. $0.890/0.504 \approx 1.77$), ceteris paribus. These results confirm the importance of health aspect in individual wellbeing measured by life satisfaction and reaffirm that this domain should be taken into account when measuring wellbeing.

Likewise, the strong positive impact of being 'Employed or self-employed' on life satisfaction is confirmed at 0.1% significant. The figures for the other regressions including one with controls and one with controls and interactions are 0.601 and 0.599 respectively. 'Not active in labour market' also shows positive and significant effects at 0.1% on life satisfaction when compared to the baseline of unemployment. This effect is consistent across all regressions in Table 1.

The interaction effects between self-assessed health and higher education highlight some interesting results. The positive and significant coefficients between 'Excellent or very good health' and 'Good health' with the dummy 'Higher education' show that life satisfaction of people with university degrees or equivalent is more influenced by given improvements in health condition compared to people with lower education levels.

The effects of the socio-demographic variables are generally as expected in a typical wellbeing regression using overall life satisfaction (Clark et al., 2008). In addition, the regressions control for adaptation to impairment with the set of dummies capturing the duration of impairment from the onset to three or more years remaining impaired. The set of dummies for duration of impairment have negative and significant coefficients between 0.1% and 5% significance. This set of dummies capture changes in life satisfaction related to the effects of and hedonic adaptation to impairment. There is no evidence to confirm complete adaptation to health impairment after three or more years since onset as all coefficients related to duration of impairment remain negative and significant. This result is in line with those found in Chapter 2. Controlling for adaptation to impairment in this chapter accounts for fluctuations in life satisfaction levels when individuals experience long-term health conditions that might affect their aspiration and evaluation of overall life satisfaction.

Regrading the effect of age on life satisfaction, the U-shaped pattern is confirmed as the coefficient related to age is negative while one related to age squared is positive. In average, at the age of 53, life satisfaction is at its lowest level of 4.9 and started increasing again with age. This result is commonly found in the literature (see Frey and Stutzer, 2002; Clark, 2003; Blanchflower and Oswald, 2004; Clark and Oswald, 2006; Oswald and Powdthavee, 2008; Pagan, 2010; Frijters and Beatton, 2012; Van Landeghem, 2012). Keeping all other factors the same, being married or living together as married and being single both show a positive relationship with life satisfaction with significant

coefficients at at least 5%. Higher education shows negative but insignificant effect on life satisfaction in the model without interactions. The effect becomes significant at 5% when interactions with health domains are included in the regression (see Decancq et al., 2015a, 2017; Yang, 2018, for discussion with similar results). Living in a rural area in comparison with urban lives seems to be related to higher level of satisfaction with life, which is implied by a positive and significant coefficient of 0.099 and 0.101 in the regression including controls and one with controls and interactions. Owning a home outright is associated with a positive and significant effect on life satisfaction (p-value < 0.05) Other controls including owning home outright, living with other people (i.e. household size is larger than one), having children and having high or middle social status are insignificant.

	No controls	No controls (Restricted sample§)	With controls (C_{it})	With interactions ($C_{it}, Z_{it}\#D_{it}$)
Equivalised income	0.051***	0.122***	0.114***	0.113***
	(0.01)	(0.02)	(0.02)	(0.02)
Excellent or Very Good Health	0.999***	1.015***	0.994***	0.890***
	(0.02)	(0.03)	(0.03)	(0.04)
Good health	0.628***	0.589***	0.576***	0.504***
	(0.02)	(0.02)	(0.02)	(0.03)
Employed and self-employed	0.284***	0.588***	0.601***	0.599***
	(0.03)	(0.13)	(0.13)	(0.13)
Not active in labour market	0.392***	0.681***	0.624***	0.622***
	(0.03)	(0.14)	(0.14)	(0.14)
Year became disabled-a			-0.114***	-0.114***
			(0.02)	(0.02)
Disabled for 1-2 years			-0.161***	-0.160***
			(0.04)	(0.04)
Disabled for 2-3 years			-0.128*	-0.127*
			(0.05)	(0.05)
Disabled for 3 years or more			-0.157**	-0.155**
			(0.06)	(0.06)
Age			-0.071	-0.074
			(0.05)	(0.05)
Age squared			0.002**	0.002**
			(0.00)	(0.00)
Age cubic			-0.000	-0.000
			(0.00)	(0.00)
Married or as married			0.410***	0.409***
			(0.05)	(0.05)
Single			0.113^{+}	0.111^{+}
			(0.06)	(0.06)
Education: University			0.031	-0.187*
			(0.07)	(0.09)
Owned home outright			0.092*	0.093*
			(0.04)	(0.04)
Living with others			-0.072	-0.072
			(0.05)	(0.05)
Having children			0.038	0.038
			(0.03)	(0.03)
Rural			0.099^{+}	0.101^{+}
			(0.06)	(0.06)
Higher social status			-0.003	-0.003
			(0.04)	(0.04)
Middle social status			-0.010	-0.010
			(0.04)	(0.04)
Interaction terms				
Excellent or V.Good Health # University				0.267***
				(0.06)
Good Health # University				0.191***
				(0.05)
Wave dummies			Yes	Yes
Pseudo R^2	0.0154	0.0154	0.0165	0.0168
Log likelihood	-322674.73	-322674.73	-132843.51	-132814.3
Observations	369,915	173,731	173,731	173,731
Individuals	75,547	39,662	39,662	39,662

Standard errors in parentheses
Source: The Understanding Society - The UK longitudinal study: 2009-2020
$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Note: Baseline: having fair and poor health, being unemployed, not disabled, neither married nor single, having no university degree, not own home, living alone, having no dependent children, living in urban area and having lower social status
§: This regression is ran on the same sample in column 3 (i.e. model includes life domains and controls) but only include the effects of life domains

Table 1: Ordered Logit FE models

The level of overlap between equivalised income and equivalent income when identifying the worst-off

Firstly, all coefficients that determine preferences from the full regression are used to calculate equivalent income. From the data for equivalised income and the computed equivalent income, the groups at the bottom 10% are selected to compare the worst-off identified by these two measures. Table 2 presents the number of observations of the worst-off captured by at least one measure, by both measures and the degree of overlap between the individuals identified as the worst-off when using income-based measures (equivalised income vs. equivalent income). In the pooled sample, there are 36,639 observations (i.e. person-waves) in the lowest equivalent income decile (equivalent to the bottom 10% in this measure). From the data on equivalised income, 36,639 observations in the lowest income decile are identified to compare with those in the lowest equivalent income decile group. There are 64,201 observations that are in the lowest equivalised income or the lowest equivalent income decile groups (i.e. the third row of Table 2), while 9,077 of them are identified as the worst-off by both income-based measures (i.e. those both belong to the lowest income decile groups). This result implies a percentage overlap between the individuals identified as the worst-off between equivalent income and equivalised income of just above 14% when comparing the 10% bottom distribution. The results across ten waves vary slightly but keeps the same trend, which remain between 11% and up to almost 17%.

	Overlap between EI and equivalised income
	Pooled data
10% lowest EI (no. of obs)	36,639
No. of worst-off captured by at least 1 measure	64,201
No. of worst-off captured by both measures	9,077
% overlap between EI and equivalised income	14.14

Source: Own calculations based on the Understanding Society - The UK longitudinal study: 2009 - 2020

Table 2: The extent of overlap between the individuals identified as the worst-off by income-based wellbeing measures

The second check is based on cross-tabulation of each quintile of equivalised income across all quintiles of equivalent income in the whole panel and across waves. The dominators (i.e. 1.00) reflect the 100% degree of overlap if all the group of individuals ranked by equivalised income is the

same as one ranked by equivalent income. Table 3 shows the result for the whole sample in which the highest percentage overlap between the two measures is at 61% and in the fifth quintile (i.e. the highest 20% of the distribution). In other words, 61% of those in the best quintile group for equivalent income are also in the best quintile group for equivalised income. The extent of overlap is lower, at about half size (e.g. around 30%) in the first and second quintiles, which are the worst-off among all quintile groups. The third and forth quintiles only contain an overlap of 16% and 19% respectively. The trend is similar across all waves when the cross-tabulation is carried out for each of the waves.

	Quintiles of Equivalent Income					
Quintiles of Equivalised Income	1	2	3	4	5	Total
1	0.32	0.32	0.32	0.04	0.00	1.00
2	0.26	0.27	0.13	0.34	0.00	1.00
3	0.21	0.15	0.16	0.44	0.04	1.00
4	0.14	0.15	0.17	0.19	0.35	1.00
5	0.06	0.11	0.22	0.00	0.61	1.00
Total	1.00	1.00	1.00	1.00	1.00	

Source: Calculations based on the UK household longitudinal study

Table 3: Cross-tabulation of Equivalised income and Equivalent income (Pooled data: 2009 - 2020)

In addition, a tabulation between the quartiles of equivalent income and life satisfaction when life satisfaction equals one, two or three is carried out to check for degree of overlap between these two approaches. The results for pooled data (see Table 4) show that the degree of overlap between equivalent income and life satisfaction at the first quartile (i.e. the worst-off) is less than half (i.e. at 45.58%). The figures across waves range between 42% and 49% (Details are reported in Table A3.). Given that the share of those with lowest life satisfaction is around one forth of the sample both across waves and in the pooled data, if there was full overlap between the worst-off in terms of equivalent income and the worst-off in terms of life satisfaction, the first quartile should be always 100% (or very close) while the others should be approximately 0%. In other words, if this was the case, the worst-off identified by equivalent income would be the same as those in life satisfaction.

	Lowest life satisfaction: LS = 1 or 2 or 3
Quartiles of Equivalent Income	Full Sample
1	45.58
2	25.16
3	17.21
4	12.04
Total	100.00
Total no. of observations	93,532

Source: Calculations based on the UK household longitudinal study 2009 - 2020

Table 4: Cross-tabulation of Equivalent Income and Life satisfaction (Pooled data) 2009 - 2020

In order to understand further the correlation between equivalent income and equivalised income, life satisfaction and relevant life dimensions, Spearman Rank Correlation tests are carried out and reported in Table 5.

The results show that all of the pairwise Spearman Rank correlations are significant at 0.1% to 5% in pooled sample and across waves. The correlation is relatively low between equivalised income and equivalent income with the Spearman coefficient at 0.53. This highlights that a high income level does not guarantee a high level of wellbeing when considering other non-income life dimensions.

Equivalent income shows even lower correlation with life satisfaction. The magnitude of the Spearman Ranking coefficients is barely more than half of those between equivalent income and equivalised income. These results empirically emphasise a clear distinction between respecting preference heterogeneity as well as life evaluation and using life satisfaction score as a SWB measure (see Decancq et al., 2016; Defloor et al., 2017). When comparing the correlation between life satisfaction and income-based wellbeing measures, the figure for the correlation with equivalent income (i.e. at 0.28) is higher than one related to equivalised income (i.e. at 0.12).

The figure for correlation between equivalent income and health shows negative sign as the self-assessed health is coded as a 5-category variable ranging from '1' for excellent health to '5' for poor health. As the values of this variable increase, general health gets worse. The rank correlation between equivalent income and self-assessed health is the highest among all life dimensions, which reaffirms that equivalent income is considerably influenced by health aspect. The figures for correlation of equivalent income with employment, not being active in the labour market and unemployment are 0.33, -0.17 and -0.33 respectively. The results across waves are robust and similar to those in the pooled sample.

Domains/ WB measure	Equivalent income	Equivalised income	Life satisfaction	Self-assessed health	Employment	Not active in labour market
Equivalised income	0.53	1.00				
Life satisfaction	0.28	0.12	1.00			
Self-assessed health	-0.82	-0.19	-0.28	1.00		
Employment	0.33	0.42	-0.01	-0.22	1.00	
Not active in LM	-0.17	-0.32	0.06	0.21	-0.88	1.00
Unemployment	-0.33	-0.22	-0.10	0.04	-0.29	-0.20

Source: Calculations based on the UK household longitudinal study: 2009 - 2020

Key: WB, wellbeing; LM, labour market

Table 5: Spearman Rank Correlation Between Well-being measures and Life Domains

Who are the worst-off?

In order to examine the characteristics of the worst-off identified by equivalised income, equivalent income, life satisfaction and relevant life dimensions, the portraits of the worst-off by each measure and life dimension are captured and reported in Table 6. First, the number of observations with life satisfaction equals one is identified as the reference sample for the worst off. Based on the number of observations with life satisfaction of one, the same number of observations are identified as the worst-off by each dimension and measure: those with poor health, those with lowest income, those with lowest equivalent income and those who are unemployed.

Overall, across all measures (equivalent income, equivalised income and life satisfaction) and relevant life dimensions (health and unemployment aspects), it seems that women at the aged 40-50 with lower education, living with other people in urban area, childless and do not own home outright are usually identified as the worst-off.

Another information reported in these tables is willingness to pay (WTP) for perfect health and for being employed. These values are calculated separately for the worst-off across measures and life dimensions. It is clear that WTP for perfect health usually accounts for a large proportion of individual income, which is consistent across all measures and waves. Hence, the percentage of equivalent income as a part versus equivalised income is quite small. This result is in line with many studies in the literature such as Decancq and Neumann (2014) and Ledić and Rubil (2016). By contrast, WTP for not being unemployed is quite low compared to the figures for the health aspect, similar results of which are also confirmed by the above-mentioned studies. This also means equivalent income in these cases accounts for larger proportion of equivalised income.

	Full sample N = 173,731	Income N = 7,110	Equivalent income N = 7,110	Life satisfaction N = 7,110	Self-assessed health N = 7,110	Unemployment N = 7,110
Life satisfaction (mean between 1-7)	5.21	4.88	3.88	1.00	3.68	4.45
Equivalised income (£/month)	2,260.80	234.10	1,027.44	1,641.98	1,545.62	1,143.33
Average equivalised income (£/month)	2,280.52	807.74	1,202.22	1,694.51	1,584.05	1,291.17
Health aspect						
Self-assessed health (mean between 1-5)	2.35	2.70	4.20	3.28	5.00	2.83
Excellent and very good health (in %)	58.66	46.13	0.37	34.05	0.00	40.15
Good health (in %)	29.99	29.73	4.02	18.76	0.00	31.35
Fair and poor health (in %)	11.36	24.14	95.61	47.20	100.00	28.50
Having long-term impairment	24.32	33.07	69.74	54.15	93.68	35.12
Onset of impairment	7.96	8.56	12.97	8.25	6.91	8.91
Impaired for 1-2 years	3.10	3.12	6.50	4.01	4.69	3.90
Impaired for 2-3 years	1.59	1.68	3.74	2.03	3.18	1.93
Impaired for 3+ years	1.81	2.00	5.09	3.75	7.11	2.32
Employment aspect						
Employed (in %)	95.34	21.56	23.43	34.92	15.17	0.00
Unemployed (in %)	0.24	21.21	55.21	11.27	6.43	100.00
Not active in labour market (in %)	4.42	57.23	21.36	53.81	78.39	0.00
Marital status						
Married and as married (in %)	69.61	40.13	48.51	51.38	53.88	42.75
Single (in %)	21.45	40.64	30.61	26.87	16.55	46.67
Others (in %)	8.94	19.23	20.88	21.75	29.57	10.58
Age (mean)	42.90	44.59	45.78	49.19	58.00	37.38
Male	46.91	48.09	44.23	40.25	40.54	53.91
Education: University (in %)	45.65	26.70	55.05	21.64	19.00	23.07
Own home outright (in %)	21.19	29.16	21.44	27.97	32.60	15.40
Living with others (in %)	89.75	63.76	76.87	78.67	72.26	86.17
Having children (in %)	40.00	27.18	35.45	28.35	18.59	39.64
Living in rural area (in %)	24.27	16.08	17.48	21.43	20.44	14.53
Having high social status (in %)	43.19	27.56	38.86	28.42	33.61	21.71
Having middle social status (in %)	39.19	53.86	40.95	45.69	44.40	45.55
Having low social status (in %)	17.62	18.58	20.19	25.89	21.99	32.74
WTP for perfect health (£/month)	1,992.90	223.79	1,027.30	1,625.90	1,545.25	1,109.47
% of EI in income to achieve perfect health	11.85%	4.40%	0.01%	0.98%	0.02%	2.96%
WTP for being employed (£/month)	8.41	148.65	969.95	633.93	256.96	1,137.63
% of EI in income to achieve 'employment'	99.63%	36.50%	5.60%	61.39%	83.37%	0.50%

Source: Own calculations based on the Understanding Society - The UK longitudinal study

Table 6: Average characteristics of the worst-off in pooled data: 2009 - 2020

Robustness checks

Regression results:

In the first robustness check, the data is examined using both FE ordered logit (BUCOLOGIT) and RE ordered logit (OLOGIT) on regression using equivalised income at each point in time and using the 3-year moving average of equivalised income. The results are reported in Table A5 in Appendix. Overall, the results remain robust regardless of different income variables used.

In addition to the BUCOLOGIT, OLS and Ordered logit RE) are also employed to analyse the data (see Table A6, Appendix). Comparing across techniques regarding life domains (i.e. income, health and employment), the signs and significance of main variables remain robust regardless of the model used. When considering the interaction terms, only those analysed through the RE Ordered logit regression are insignificant. However, the sign of these parameters remain the same, which are all positive. Regarding the scaling factors, there are no noticeable changes in the coefficients related to an individual's socio-demographic characteristics. Across all other techniques, the parameters related to lags of impairment remain significant and negative, which is in line with the results of Chapter 2 (i.e. no evidence for complete adaptation in average).

In the third robustness check, restricting the unbalanced panel to generate a balanced panel leads to a decrease in the sample size by 2.6 times. While 173,731 observations are included in the unbalanced panel regression, only 67,189 observation-years are analysed in the balanced panel as some individuals were not involved in all ten waves of the UKHLS. Overall, the main results of the regression and the conclusion are robust (see Table A7 Appendix for detailed results).

Comparing equivalent income estimated across robustness checks:

As the key output from the econometric modelling is equivalent income, an obvious robustness check is to compare the values of equivalent income computed from parameters estimated across the above-mentioned checks.

Table 7 presents some examples of estimated equivalent income as percentage of equivalised in come using parameters from the main analysis and those regressions from robustness checks. Overall, there is not much difference in the estimations of equivalent income across these regressions. The first scenario is when an individual's current situation is at optimal (i.e. having excellent or very good health and being employed or self-employed), hence, equivalent income equals to equivalised income. The next five scenarios are when the individual has at least one life domain not at optimal, which results in a lower equivalent income than equivalised income. The last scenario is when the

individual has the 'worst' situation (i.e. having fair or poor health and being unemployed), which is shown by an equivalent income close to zero (equivalent to a range between 0.00001% and 0.09%).

The closest estimations with the main analysis are those based on a linear FE regression. When comparing between the main analysis using FE ordered logit model and the OLS and OLOGIT, which do not control for unobserved heterogeneity, equivalent income seems to be over-estimated. Across all of the non-optimal scenarios, the estimated levels of equivalent income are higher in the random effects regressions compared to the main analysis and the linear FE regression.

When using average levels of equivalised income in BUCOLOGIT, the estimations of equivalent income are slightly higher but not much different from the main analysis. In contrast, the estimated levels of equivalent income from the unbalanced panel are much higher than those from the analysis, which could also be seen from the smaller magnitudes of relevant coefficients to the calculation which are estimated from the balanced panel compared to the unbalanced panel from the main analysis.

Scenarios			Equivalent income as % of equivalised income					
Health	**Employment**	**Education**	**Main analysis ∓**	**BUCOLOGIT (Average Y_{it})⋆**	**OLS §**	**OLOGIT §**	**Linear FE §**	**BUCOLOGIT Balanced panel #**
Excellent/ very good health	Employed or self-employed	University degree	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
Good health	Employed or self-employed	University degree	1.68%	2.74%	6.92%	5.58%	2.53%	5.53%
Fair or poor health	Employed or self-employed	No university degree	0.04%	0.09%	0.30%	0.41%	0.02%	0.56%
Excellent/ very good health	Not active in labour market	No university degree	122.57%	131.06%	143.04%	159.66%	114.52%	103.77%
Excellent/ very good health	Unemployed	University degree	0.50%	2.04%	16.42%	23.71%	0.27%	12.96%
Good health	Unemployed	University degree	0.01%	0.06%	1.14%	1.32%	0.01%	0.72%
Fair or poor health	Unemployed	University degree	0.00%	0.00%	0.03%	0.09%	0.00%	0.01%

Note: ∓: Calculations are based on estimated parameters from column 5, Table 1.
⋆: Calculations are based on estimated parameters from column 3, Table A5 Appendix.
§: Calculations are based on estimated parameters from column 2, 3, 4, Table A6 Appendix.
#: Calculations are based on estimated parameters from column 3, Table A7 Appendix.

Table 7: Estimated equivalent income across robustness checks

5 Discussion and Conclusion

This study has explored the concept of equivalent income and computed this monetary metric using the UKHLS (2009 – 2020). Using the ordered logit FE model on a life satisfaction function against income and non-income life domains, the study has investigated the differences in wellbeing ranking between the individual income level (i.e. equivalised income) and equivalent income in the UK.

Theoretically, equivalent income is computed by collapsing income and all possible relevant non-income domains into a single-index measure. However, from a practical point of view, constructing equivalent income empirically using a subjective wellbeing function, for instance life satisfaction, requires a lot from the data when including interaction effects to capture subgroup preferences. Therefore, this study opts to include only those interactions that are statistically significant. Including as many individually specific characteristics as possible to account for differences in individual situations is potentially desirable. Due to data limits, this cannot be done as expected in the theory. Empirically, including interactions and controls to capture the average preferences of socio-demographic sub-groups rather than individuals could provide a simplified procedure to capture preferences.

The effects of all life domains from the life satisfaction regressions show expected results which are in line with the wellbeing literature using life satisfaction. With the baseline of individuals who report fair or poor health, are unemployed and have no university degree, the positive and significant coefficients capturing the interaction effects between self-assessed health and higher education highlight that life satisfaction of people with university degrees or equivalent is more influenced by given improvements in health compared to those with lower education levels.

Following the regressions, equivalent income levels were computed using the estimated parameters. The values were then compared with other measures including household equivalised income and life satisfaction to analyse the extent of overlap in individuals identified as the worst-off using different measures of wellbeing. For both the comparisons between equivalent income and equivalised income and between equivalent income and life satisfaction, the degree of overlap is quite low, at 20% and under 50% respectively

It is noted that the range of overlap in individuals identified as the worst-off by equivalent income and equivalised income in this chapter is higher than the results reported in other studies (i.e. most at less than 10%) such as Decancq and Neumann (2014) using German data and the Colombia

(Decancq et al., 2016). This result might be due to the differences in the number of non-income life domains and specific domains included in the computation of equivalent income across studies. It is expected that the more non-income domains to include in the life satisfaction regression to estimate equivalent income, the lower the degree of overlap in the worst-off groups identified by equivalent income and equivalised income.

In addition, the study examines the characteristics of the worst-off identified by equivalised income, equivalent income, life satisfaction and relevant life domains and reports similarities and differences across these indicators. There are many discrepancies regarding who is identified as the badly-off based on different approaches. Overall, it seems that women at aged 40-50, living with other people in an urban area, childless and do not own a home outright are mainly identified as the worst-off.

The reported willingness to pay (WTP) for perfect health and for being employed shows that WTP for perfect health often accounts for a large proportion of individual income, which is consistent across all waves. This result is in line with many studies such as Decancq and Neumann (2014) and Ledić and Rubil (2016). By contrast, WTP for being employed is quite low compared to the figures for the health aspect. Similar results are also confirmed by the above-mentioned studies.

In sum, this paper has made three contributions to the literature. Firstly, the analysis takes into account the effect of hedonic adaptation on aspirations through the inclusion of a set of controls for onset and the duration of disability. Despite an extensive literature investigating empirical computation and application of equivalent income, no empirical study to date has explored the effect of hedonic adaptation in general and adaptation to disability in particular in this context. Furthermore, the study compares equivalised income and equivalent income regarding the worst-off groups that these measures identify. The discrepancies in ranking by equivalised income and ranking by equivalent income highlights that collapsing the outcomes across multiple domains of wellbeing into one number would lead to a better and broader view and focus of public policies when considering the worst-off compared to using income alone. The last contribution is that the paper contributes to the wellbeing literature by being the first one to compute equivalent income using UK data.

There are still opportunities for further research. The analyses in this study only include two non-income domains: health and unemployment, which results in a quite narrow-context measure of wellbeing. In addition, including hedonic adaptation to the computation of equivalent income in

this paper is currently just an example of the application using the set of lags of impairment. This issue leaves more room for future research to extend the list of relevant non-income domains and adaptation to different life events included in the computation of equivalent income. On the other hand, one could obtain equivalent income through stated preference data in which different domains of interest can be included. This approach has been discussed in Abasolo et al. (2018).

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A Appendices

Variable	No. of Obs	Mean	Std. Dev.	Min	Max
Life satisfaction	173,731	5.20	1.38	1.00	7.00
Equivalent Income	173,731	1,445.83	2,358.39	0.00	247,768.70
Income and Non-income Life Domains					
Income domain					
Equivalised income	173,731	2,318.30	2,367.59	0.10	247,768.70
Log equivalised income	173,731	7.60	0.52	-2.32	12.42
Average equivalised income	131,578	2,280.66	1,726.40	35.95	139,837.60
Log average equivalised income	131,263	7.58	0.47	2.61	11.55
Health domain					
Self-assessed health	173,731	2.36	0.94	1	5
Excellent health	173,731	0.18	0.39	0	1
Very good health	173,731	0.40	0.49	0	1
Good health	173,731	0.30	0.46	0	1
Fair health	173,731	0.10	0.30	0	1
Poor health	173,731	0.02	0.12	0	1
Excellent and Very good health	173,731	0.59	0.49	0	1
Fair and poor health	173,731	0.11	0.32	0	1
Employment domain					
Employed	173,731	0.96	0.20	0	1
Unemployed	173,731	0.00	0.05	0	1
Not active in labour market	173,731	0.04	0.20	0	1
Scaling factors and controls					
Disability and adaptation					
Onset of disability	173,731	0.08	0.27	0	1
Disabled for 1-2 years	173,731	0.03	0.17	0	1
Disabled for 2-3 years	173,731	0.02	0.12	0	1
Disabled for 3+ years	173,731	0.02	0.13	0	1
Marital status					
Married and as married	173,731	0.70	0.46	0	1
Single	173,731	0.20	0.40	0	1
Divorced	173,731	0.06	0.24	0	1
Widowed	173,731	0.01	0.11	0	1
Separated	173,731	0.02	0.13	0	1
Other demographic characteristics					
Age	173,731	43.64	13.01	16	92
Male	173,730	0.47	0.50	0	1
Education: University	173,731	0.46	0.50	0	1
Own home outright	173,731	0.22	0.41	0	1
Living with others	173,731	0.90	0.31	0	1
Having children	173,731	0.40	0.49	0	1
Living in rural area	173,731	0.24	0.43	0	1
Having high social status	173,731	0.44	0.50	0	1
Having middle social status	173,731	0.39	0.49	0	1
Having low social status	173,731	0.17	0.38	0	1
Wave	173,731	5.67	2.60	1	10
Year	173,731	2014.14	2.66	2009	2020

Source: The Understanding Society - The UK longitudinal study 2009 - 2020

Table A1: Descriptive Statistics

	% Overlap between EI and equivalised income										
	Wave 1	Wave 2	Wave 3	Wave4	Wave5	Wave6	Wave7	Wave8	Wave9	Wave10	Pool data
10% lowest EI (no. of obs)	3,920	4,264	4,029	3,859	3,692	3,516	3,625	3,471	3,191	3,073	36,639
No. of worst-off captured by at least 1 measure	7,041	7,438	7,063	6,748	6,444	6,331	6,354	6,013	5,458	5,359	64,201
No. of worst-off captured by both measures	799	1,090	995	970	940	701	896	929	924	787	9,077
% overlap between EI and equivalised income	11.35	14.65	14.09	14.37	14.59	11.07	14.10	15.45	16.93	14.69	14.14

Source: Own calculations based on the Understanding Society - The UK longitudinal study: 2009 - 2020

Table A2: Worst-off Overlap Captured by Different Well-being Measures

	Lowest life satisfaction: LS = 1 or 2 or 3										
Quartiles of Equivalent Income	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	Wave 8	Wave 9	Wave 10	Full Sample
1	44.65	46.12	42.87	43.61	43.29	44.84	49.1	48.57	46.41	48.27	45.58
2	25.71	25.44	24.48	24.26	25.86	24.98	24.85	25.71	25.67	24.9	25.16
3	17.68	17.09	18.61	18.05	17.65	18.5	15.59	15.4	16.87	16.99	17.21
4	11.96	11.35	14.04	14.08	13.2	11.68	10.46	10.32	11.06	9.83	12.04
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Total no. of observations	9,357	10,462	10,438	10,906	10,420	8,227	8,510	8,608	8,376	8,228	93,532

Source: Calculations based on the UK household longitudinal study 2009 - 2020

Table A3: Cross-tabulation of Equivalent Income and Life satisfaction

Table A4: Spearman Rank Correlation Between Well-being measures and Life Domains

Waves	Dimensions or WB measure	Equivalent income	Equivalised income	Life satisfaction	Self-assessed health	Employment	Not active in labour market
Wave 1	Equivalised income	0.53	1.00				
	Life satisfaction	0.28	0.12	1.00			
	Self-assessed health	-0.82	-0.19	-0.28	1.00		
	Employment	0.33	0.42	-0.01	-0.22	1.00	
	Not active in LM	-0.17	-0.32	0.06	0.21	-0.88	1.00
	Unemployment	-0.33	-0.22	-0.10	0.04	-0.29	-0.20
Wave 2	Equivalised income	0.52	1.00				
	Life satisfaction	0.31	0.12	1.00			
	Self-assessed health	-0.85	-0.20	-0.31	1.00		
	Employment	0.34	0.37	-0.01	-0.27	1.00	
	Not active in LM	-0.20	-0.28	0.06	0.26	-0.89	1.00
	Unemployment	-0.33	-0.21	-0.10	0.05	-0.27	-0.19
Wave 3	Equivalised income	0.53	1.00				
	Life satisfaction	0.28	0.13	1.00			
	Self-assessed health	-0.81	-0.18	-0.28	1.00		
	Employment	0.30	0.35	-0.01	-0.23	1.00	
	Not active in LM	-0.16	-0.26	0.06	0.22	-0.90	1.00
	Unemployment	-0.31	-0.21	-0.10	0.04	-0.27	-0.19
Wave 4	Equivalised income	0.54	1.00				
	Life satisfaction	0.30	0.13	1.00			
	Self-assessed health	-0.81	-0.20	-0.30	1.00		
	Employment	0.29	0.33	0.01	-0.25	1.00	
	Not active in LM	-0.16	-0.24	0.04	0.23	-0.90	1.00
	Unemployment	-0.31	-0.20	-0.10	0.06	-0.26	-0.18
Wave 5	Equivalised income	0.52	1.00				
	Life satisfaction	0.31	0.13	1.00			
	Self-assessed health	-0.83	-0.19	-0.31	1.00		
	Employment	0.27	0.31	0.01	-0.23	1.00	
	Not active in LM	-0.15	-0.24	0.04	0.22	-0.91	1.00
	Unemployment	-0.29	-0.19	-0.10	0.05	-0.25	-0.17
Wave 6	Equivalised income	0.51	1.00				
	Life satisfaction	0.31	0.14	1.00			
	Self-assessed health	-0.83	-0.18	-0.30	1.00		
	Employment	0.29	0.31	-0.01	-0.26	1.00	

Table A4 –continued on next page

Table A4 – continued from previous page

	Not active in LM	-0.18	-0.24	0.05	0.24	-0.92	1.00
	Unemployment	-0.28	-0.19	-0.10	0.04	-0.24	-0.17
Wave 7	Equivalised income	0.48	1.00				
	Life satisfaction	0.36	0.11	1.00			
	Self-assessed health	-0.85	-0.16	-0.37	1.00		
	Employment	0.24	0.30	-0.02	-0.21	1.00	
	Not active in LM	-0.13	-0.23	0.05	0.19	-0.92	1.00
	Unemployment	-0.28	-0.18	-0.09	0.05	-0.24	-0.17
Wave 8	Equivalised income	0.48	1.00				
	Life satisfaction	0.36	0.11	1.00			
	Self-assessed health	-0.86	-0.17	-0.38	1.00		
	Employment	0.25	0.28	-0.02	-0.24	1.00	
	Not active in LM	-0.15	-0.22	0.06	0.22	-0.93	1.00
	Unemployment	-0.27	-0.17	-0.10	0.05	-0.23	-0.16
Wave 9	Equivalised income	0.46	1.00				
	Life satisfaction	0.36	0.12	1.00			
	Self-assessed health	-0.87	-0.17	-0.38	1.00		
	Employment	0.22	0.26	-0.04	-0.21	1.00	
	Not active in LM	-0.12	-0.20	0.07	0.19	-0.93	1.00
	Unemployment	-0.27	-0.16	-0.09	0.06	-0.22	-0.16
Wave 10	Equivalised income	0.46	1.00				
	Life satisfaction	0.38	0.14	1.00			
	Self-assessed health	-0.87	-0.17	-0.39	1.00		
	Employment	0.22	0.24	-0.03	-0.22	1.00	
	Not active in LM	-0.12	-0.18	0.06	0.20	-0.93	1.00
	Unemployment	-0.26	-0.16	-0.10	0.05	-0.22	-0.16

Source: Calculations based on the UK household longitudinal study: 2009 - 2020

	BUCOLOGIT (Yit)	BUCOLOGIT (Average Yit)	OLOGIT (Yit)	OLOGIT (Average Yit)
Log Equivalised income/	0.109***	0.122**	0.284***	0.340***
Average income per capita	(0.03)	(0.04)	(0.01)	(0.01)
Excellent or Very Good Health	0.856***	0.856***	1.517***	1.509***
	(0.04)	(0.04)	(0.02)	(0.02)
Good health	0.497***	0.496***	0.725***	0.719***
	(0.04)	(0.04)	(0.02)	(0.02)
Employed and self-employed	0.472**	0.475**	0.410***	0.411***
	(0.16)	(0.16)	(0.11)	(0.11)
Not active in labour market	0.504**	0.508**	0.573***	0.575***
	(0.17)	(0.17)	(0.11)	(0.11)
Excellent or Very Good Health # University	0.251***	0.251***	0.008	0.007
	(0.07)	(0.07)	(0.03)	(0.03)
Good Health # University	0.171**	0.172**	0.004	0.006
	(0.06)	(0.06)	(0.04)	(0.04)
Year became disabled	-0.076**	-0.076**	-0.056**	-0.056**
	(0.03)	(0.03)	(0.02)	(0.02)
Disabled for 1-2 years	-0.137**	-0.137**	-0.051+	-0.050+
	(0.04)	(0.04)	(0.03)	(0.03)
Disabled for 2-3 years	-0.116+	-0.116+	-0.019	-0.019
	(0.06)	(0.06)	(0.04)	(0.04)
Disabled for 3 years or more	-0.118+	-0.119+	-0.070+	-0.070+
	(0.07)	(0.07)	(0.04)	(0.04)
Age	-0.106+	-0.105+	-0.108***	-0.108***
	(0.06)	(0.06)	(0.01)	(0.01)
Age squared	0.003**	0.003**	0.001***	0.001***
	(0.00)	(0.00)	(0.00)	(0.00)
Age cubic	-0.000+	-0.000+	-0.000	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Married or as married	0.382***	0.382***	0.509***	0.499***
	(0.07)	(0.07)	(0.02)	(0.02)
Single	0.100	0.099	-0.011	-0.011
	(0.07)	(0.07)	(0.02)	(0.02)
Education: University	-0.186+	-0.187+	-0.026	-0.033
	(0.11)	(0.11)	(0.03)	(0.03)
Owned home outright	0.085+	0.087+	0.175***	0.176***
	(0.05)	(0.05)	(0.01)	(0.01)
Living with others	-0.024	-0.019	-0.087***	-0.093***
	(0.06)	(0.06)	(0.02)	(0.02)
Having children	0.056	0.055	0.052***	0.063***
	(0.04)	(0.04)	(0.01)	(0.01)
Living in rural area	0.119+	0.122+	0.078***	0.076***
	(0.07)	(0.07)	(0.01)	(0.01)
Higher social status	0.016	0.016	-0.008	-0.024
	(0.05)	(0.05)	(0.02)	(0.02)
Middle social status	0.017	0.016	-0.050**	-0.056***
	(0.04)	(0.05)	(0.02)	(0.02)
Wave dummies	Yes	Yes	Yes	Yes
Pseudo R^2	0.0148	0.0146	0.0391	0.0394
Log likelihood	-93544.244	-93555.405	-190241.34	-190195.01
Observations	131,263	131,263	131,263	131,263

Standard errors in parentheses. $^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Source: The Understanding Society - The UK longitudinal study: 2009-2020

Note: Baseline: having fair and poor health, being unemployed, not disabled, neither married nor single, having no university degree, not own home, living alone, having no dependent children, living in urban area and having lower social status

Table A5: Ordered Logit models: Income versus Average Income in OLOGIT and BUCOLOGIT

	OLS	Fixed Effect	Ordered Logit RE	Ordered Logit FE (BUCOLOGIT)
Log Equivalised income	0.176***	0.059***	0.280***	0.113***
	(0.01)	(0.01)	(0.01)	(0.02)
Excellent or Very Good Health	1.025***	0.511***	1.536***	0.890***
	(0.01)	(0.02)	(0.02)	(0.04)
Good health	0.591***	0.304***	0.738***	0.504***
	(0.01)	(0.02)	(0.02)	(0.03)
Employed and self-employed	0.318***	0.348***	0.403***	0.599***
	(0.07)	(0.07)	(0.09)	(0.13)
Not active in labour market	0.381***	0.356***	0.534***	0.622***
	(0.07)	(0.07)	(0.10)	(0.14)
Excellent or Very Good Health # University	0.085***	0.087**	0.028	0.267***
	(0.02)	(0.03)	(0.03)	(0.06)
Good Health # University	0.049*	0.077**	0.018	0.191***
	(0.02)	(0.03)	(0.03)	(0.05)
Year became disabled	-0.049***	-0.061***	-0.072***	-0.114***
	(0.01)	(0.01)	(0.02)	(0.02)
Disabled for 1-2 years	-0.052**	-0.082***	-0.071**	-0.160***
	(0.02)	(0.02)	(0.03)	(0.04)
Disabled for 2-3 years	-0.013	-0.067**	-0.015^{+}	-0.127*
	(0.03)	(0.02)	(0.04)	(0.05)
Disabled for 3 years or more	-0.041	-0.074**	-0.079*	-0.155**
	(0.02)	(0.03)	(0.03)	(0.06)
Age	-0.067***	-0.039*	-0.104***	-0.074
	(0.01)	(0.02)	(0.01)	(0.05)
Age squared	0.001***	0.001***	0.001***	0.002**
	(0.00)	(0.00)	(0.00)	(0.00)
Age cubic	-0.000*	-0.000*	-0.000	-0.000
	(0.00)	(0.00)	(0.00)	(0.00)
Married or as married	0.331***	0.230***	0.493***	0.409***
	(0.01)	(0.02)	(0.02)	(0.05)
Single	-0.007	0.075**	-0.009	0.111^{+}
	(0.01)	(0.03)	(0.02)	(0.06)
Education: University	-0.052**	-0.067^{+}	-0.048^{+}	-0.187*
	(0.02)	(0.04)	(0.03)	(0.09)
Owned home outright	0.100***	0.043**	0.176***	0.093*
	(0.01)	(0.02)	(0.01)	(0.04)
Living with others	-0.063***	-0.040^{+}	-0.088***	-0.072
	(0.01)	(0.02)	(0.02)	(0.05)
Having children	0.033***	0.024^{+}	0.050***	0.038
	(0.01)	(0.01)	(0.01)	(0.03)
Living in rural area	0.049***	0.048*	0.077***	0.101^{+}
	(0.01)	(0.02)	(0.01)	(0.06)
Higher social status	0.023*	-0.003	-0.004	-0.003
	(0.01)	(0.02)	(0.01)	(0.04)
Middle social status	-0.015^{+}	-0.007	-0.045***	-0.010
	(0.01)	(0.02)	(0.01)	(0.04)
Wave dummies	Yes	Yes	Yes	Yes
Constant	3.804***	3.762***		
	(0.12)	(0.52)		
R^2	0.0937			
Adjusted R^2	0.0935			
R^2 within		0.0150		
R^2 between		0.0182		
R^2 overall		0.0154		
Pseudo R^2			0.0396	0.0168
Log likelihood			-253478.18	-132814.30
Observations	173,731	173,731	173,731	173,731

Standard errors in parentheses
Source: The Understanding Society - The UK longitudinal study: 2009-2020
$^{+}$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Note: Baseline: having fair and poor health, being unemployed, not disabled, neither married nor single, having no university degree, not own home, living alone, having no dependent children, living in urban area and having lower social status

Table A6: Robustness Check: OLS - FE - OLOGIT - BUCOLOGIT

	Unbalanced Panel	Balanced Panel
Log Equivalised income	0.113***	0.162***
	(0.02)	(0.03)
Excellent or Very Good Health	0.890***	0.840***
	(0.04)	(0.06)
Good health	0.504***	0.487***
	(0.03)	(0.05)
Employed and self-employed	0.599***	0.331
	(0.13)	(0.21)
Not active in labour market	0.622***	0.337
	(0.14)	(0.23)
Excellent or Very Good Health # University	0.267***	0.351***
	(0.06)	(0.09)
Good Health # University	0.191***	0.235**
	(0.05)	(0.08)
Year became disabled	-0.114***	-0.117***
	(0.02)	(0.03)
Disabled for 1-2 years	-0.160***	-0.116*
	(0.04)	(0.05)
Disabled for 2-3 years	-0.127*	-0.153*
	(0.05)	(0.07)
Disabled for 3 years or more	-0.155**	-0.164*
	(0.06)	(0.08)
Age	-0.074	-0.169*
	(0.05)	(0.07)
Age squared	0.002**	0.003*
	(0.00)	(0.00)
Age cubic	-0.000	-0.000
	(0.00)	(0.00)
Married or as married	0.409***	0.424***
	(0.05)	(0.08)
Single	0.111+	0.079
	(0.06)	(0.09)
Education: University	-0.187*	-0.071
	(0.09)	(0.15)
Owned home outright	0.093*	0.143**
	(0.04)	(0.05)
Living with others	-0.072	-0.034
	(0.05)	(0.07)
Having children	0.038	0.009
	(0.03)	(0.05)
Living in rural area	0.101+	0.046
	(0.06)	(0.09)
Higher social status	-0.003	-0.074
	(0.04)	(0.07)
Middle social status	-0.010	-0.008
	(0.04)	(0.06)
Wave dummies	-0.079*	-0.034
	(0.03)	(0.04)
Pseudo R^2	0.0168	0.0168
Log likelihood	-132814.300	-57783.738
Observations	173,731	67,189

Standard errors in parentheses

Source: The Understanding Society - The UK longitudinal study: 2009-2020

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Baseline: having fair and poor health, being unemployed, not disabled, neither married nor single, having no university degree, not own home, living alone, having no dependent children, living in urban area and having lower social status

Table A7: Robustness Check: Unbalanced Panel versus Balanced Panel

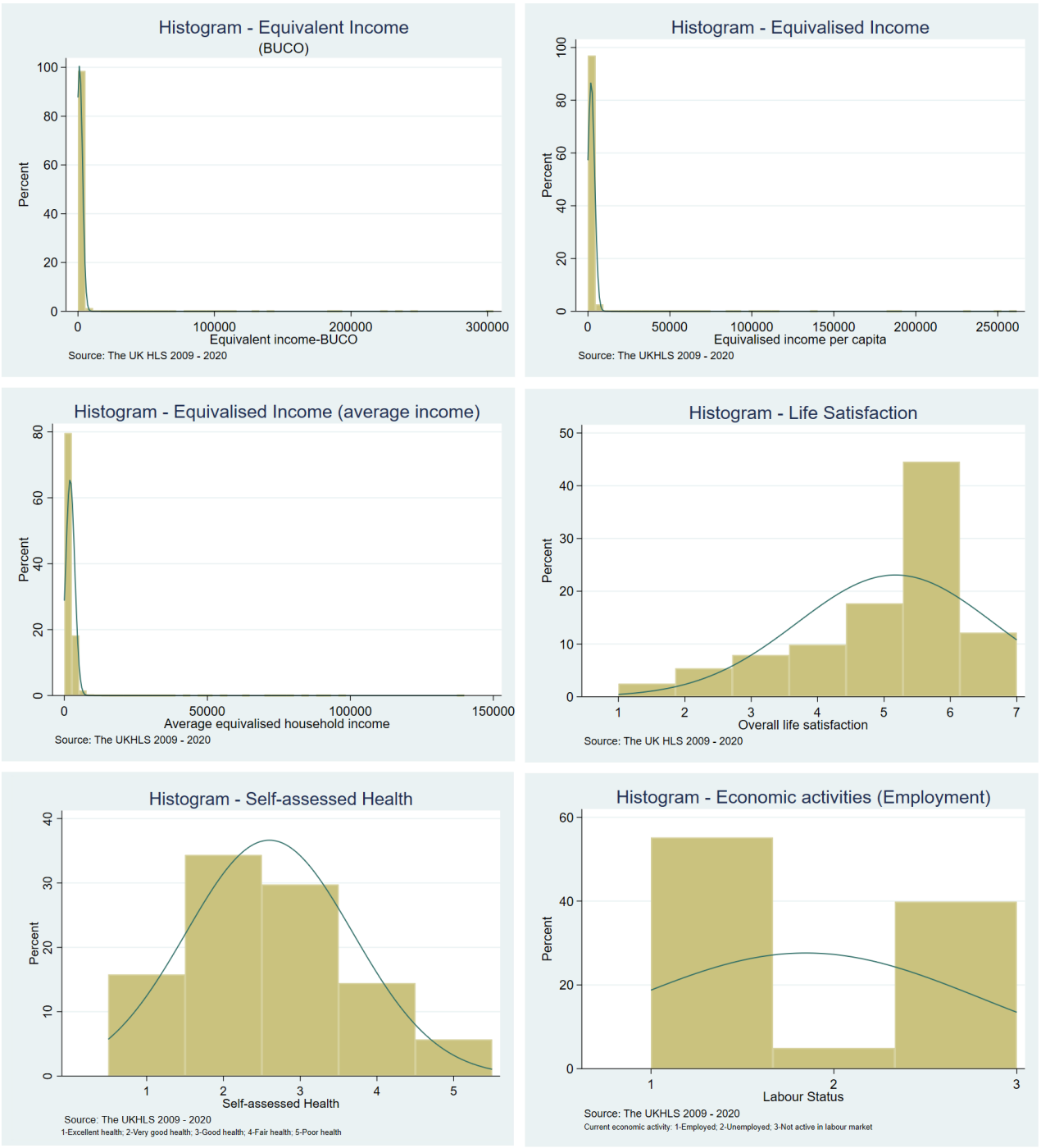

Figure A1: Histogram of wellbeing measures and life aspects

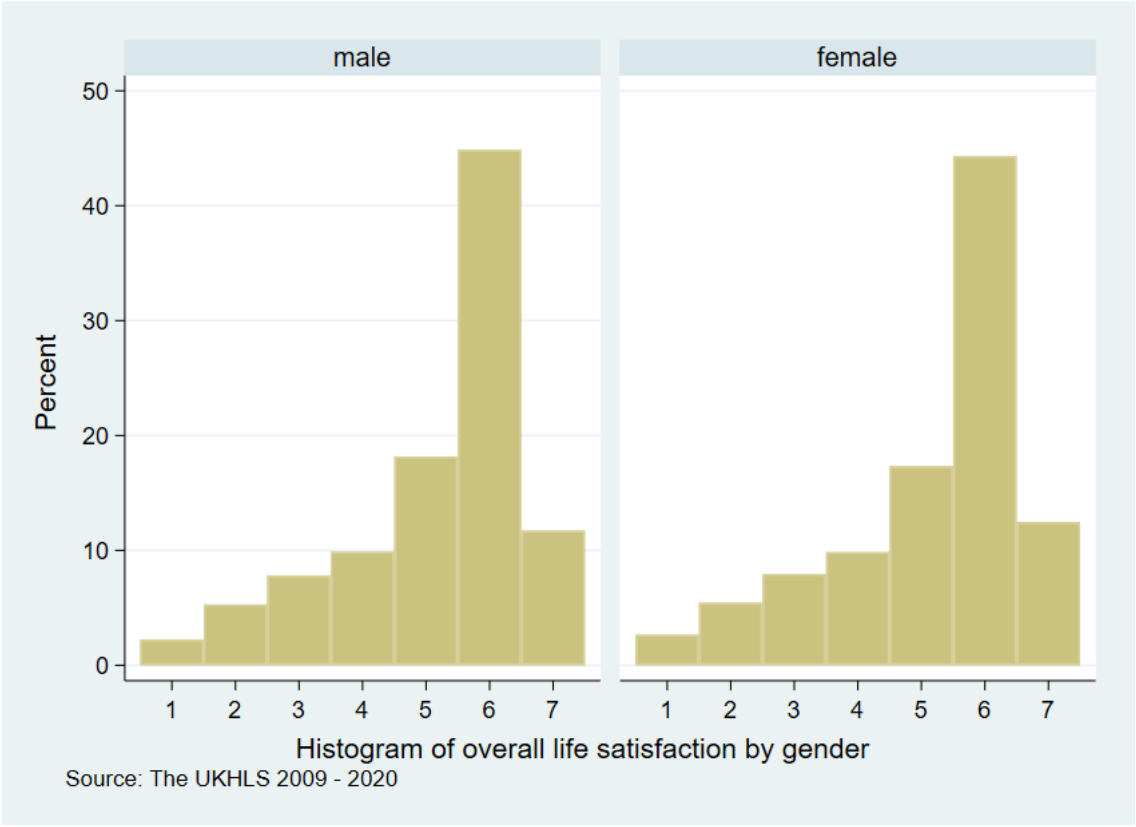

Figure A2: Histogram of life satisfaction by gender

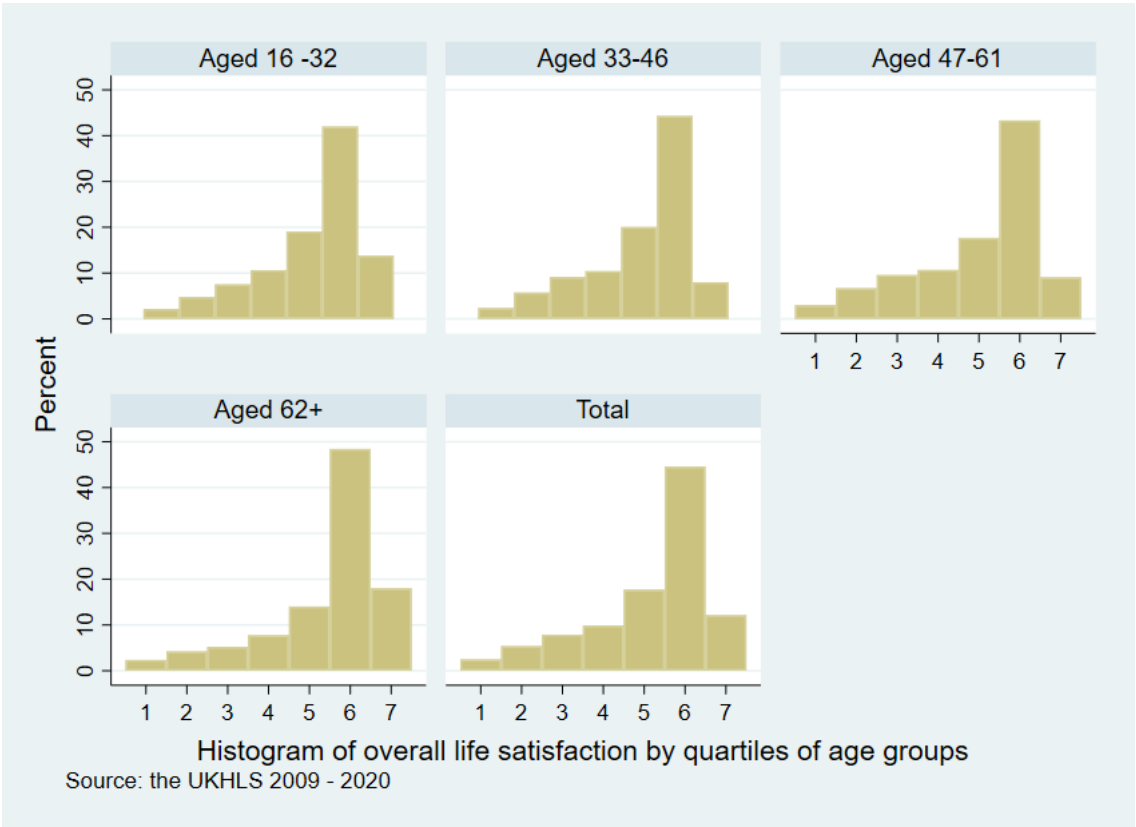

Figure A3: Histogram of life satisfaction by age groups

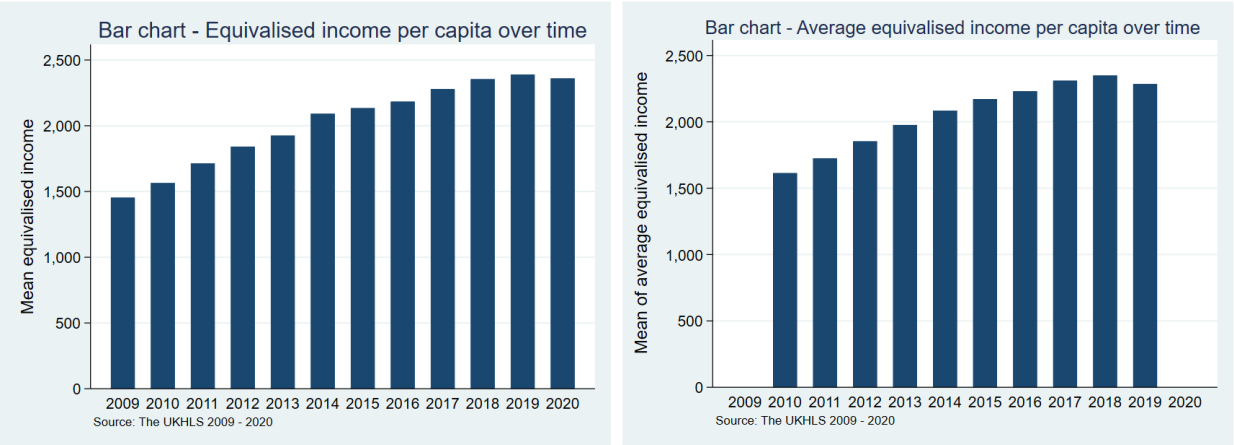

Figure A4: Bar chart - Annual Mean values of Equivalised Income and Average Equivalised Income

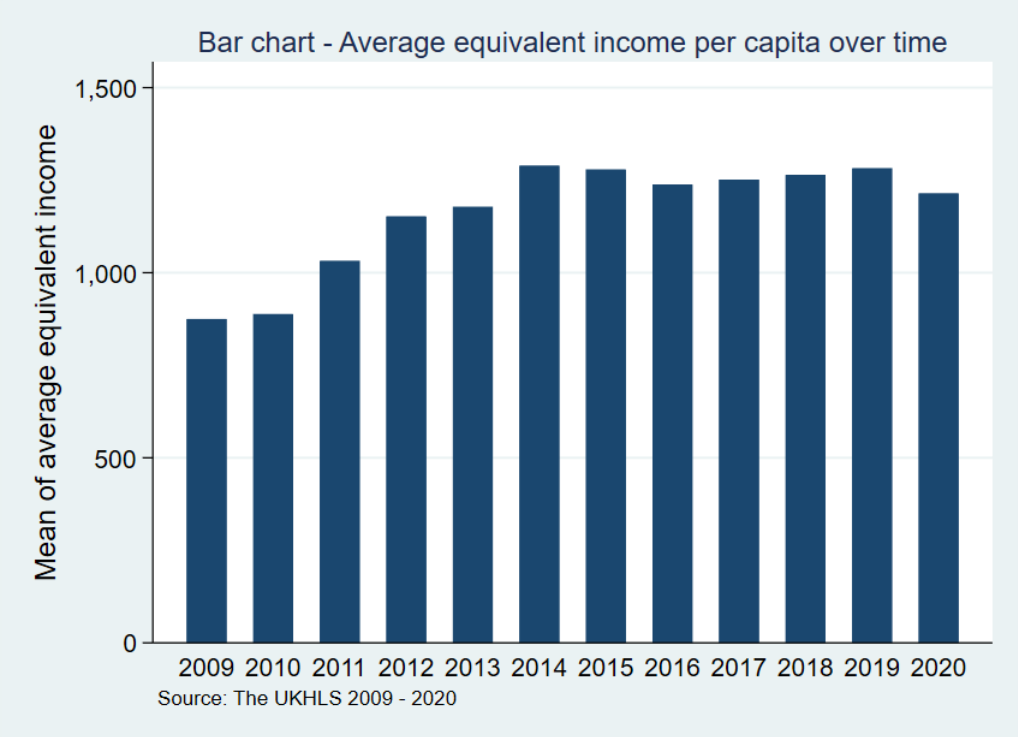

Figure A5: Bar chart - Annual Mean values of Equivalent Income

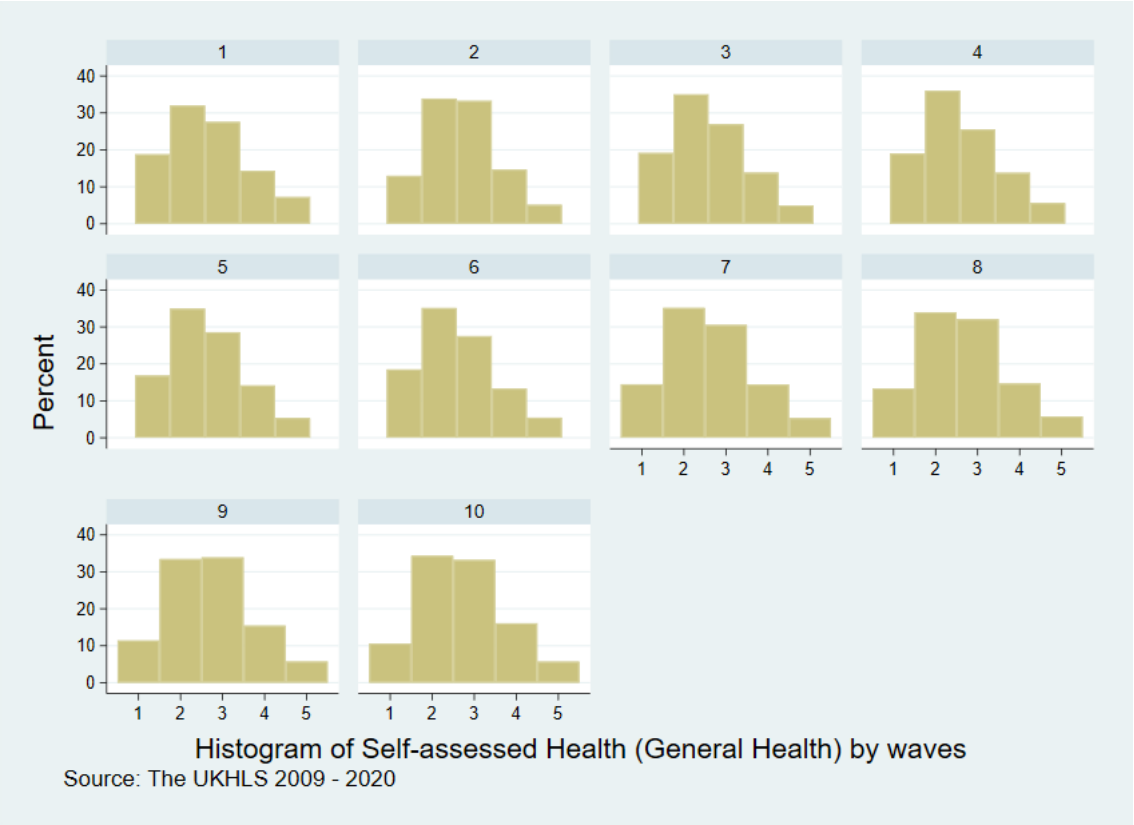

Figure A6: Histogram - Self-assessed health by waves

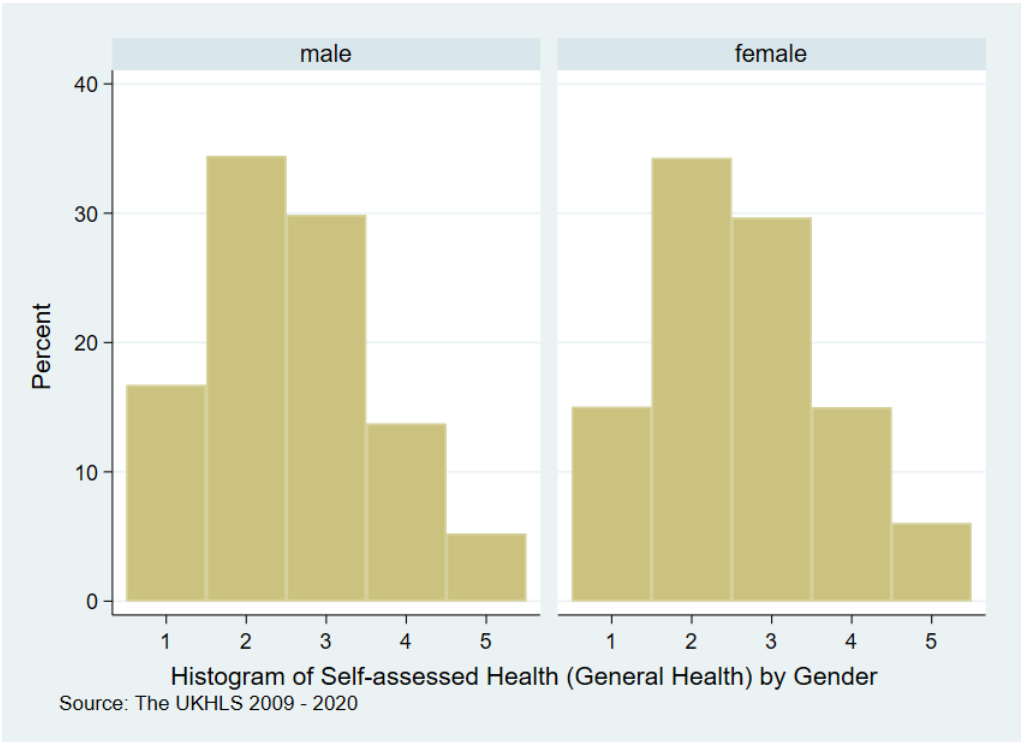

Figure A7: Histogram - Self-assessed health by gender

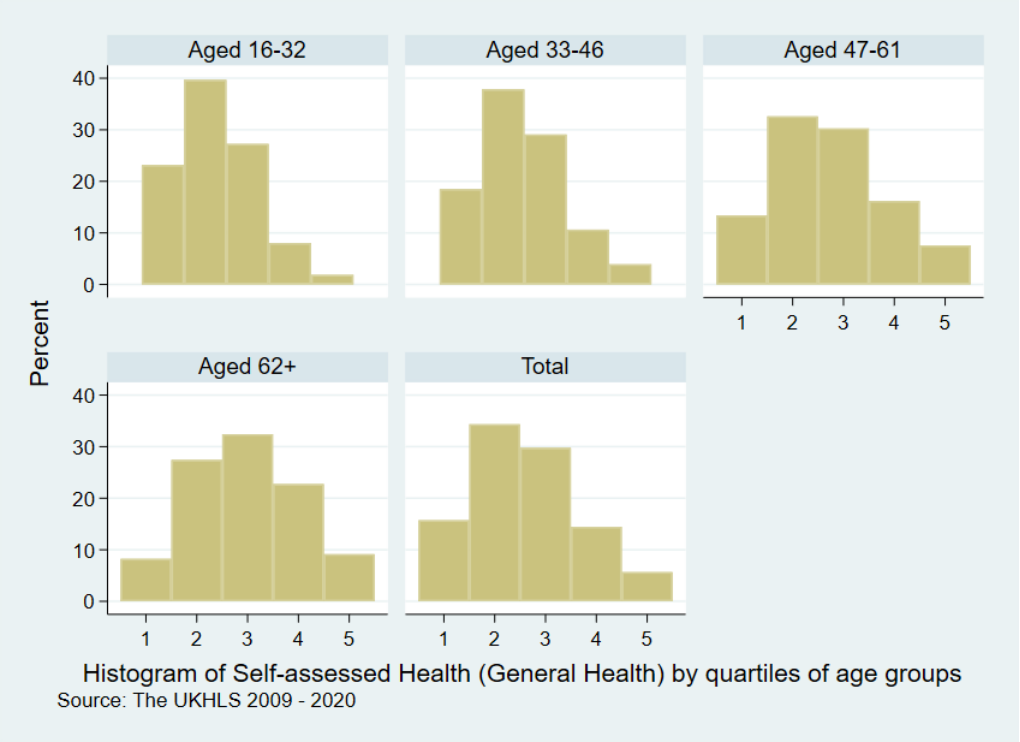

Figure A8: Histogram - Self-assessed health by age groups

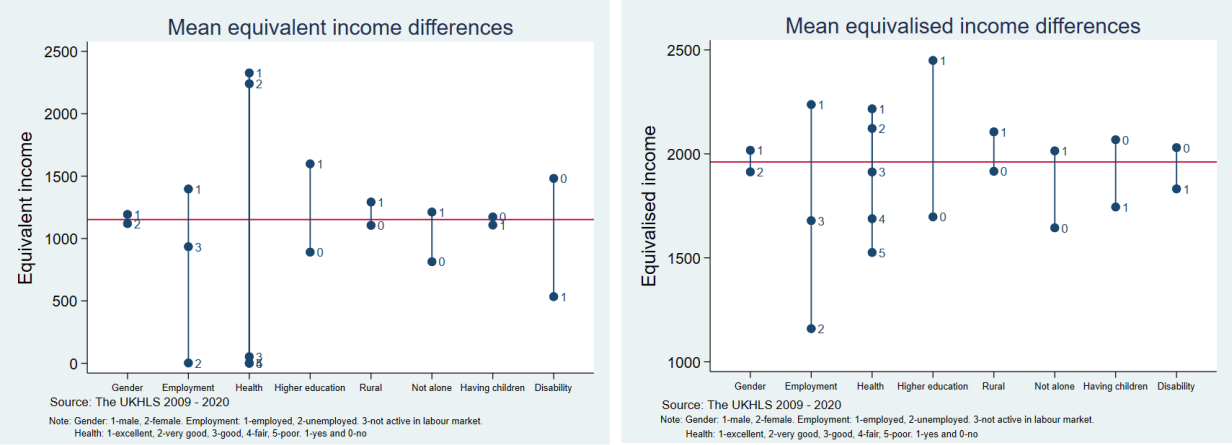

Figure A9: Differences in mean of income and equivalent income across groups - pooled data (2009 - 2020)