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**Missing Dimensions of Well-being and Respect for Individual
Preferences: How Affected is Equivalent Income?**

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Missing dimensions of well-being and respect for individual preferences: How affected is equivalent income?*

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Abstract

It has become increasingly recognized that in order to measure individual well-being, a wide range of life dimensions should be considered. Recent studies have highlighted the importance of using individual valuations to determine the weights of the different dimensions in order to define a measure of well-being that respects individual preferences. Equivalent income has been proposed as a measure of individual well-being respecting individual preferences over different life dimensions. However, this recent strand of the literature has considered only a limited number of life dimensions in the analysis, most likely due to data limitations. Our analysis makes use of a rich dataset from Ecuador, which allows us to account for a broader range of life dimension, such as social isolation, gender-based violence, unfair treatment, political participation and empowerment. Our analysis shows that these additional dimensions are significant determinants of life satisfaction. Moreover, considering this wider range of dimensions changes the picture of those considered the most deprived. Only around 39 percent of those considered the most deprived when all life dimensions are included are among the most deprived based on equivalent incomes including only the basic dimensions (income, health, unemployment and housing quality). Additionally, a noticeable degree of reranking is observed between equivalent incomes with and without the additional life dimensions, with a Spearman correlation coefficient of 0.78. The inequality within each additional outcome dimension, and to some extent preference heterogeneity, account for an important part of re-ranking.

JEL Classification: D60, H23, I31

Key Words: *equivalent income, life dimensions, life satisfaction, missing dimensions*

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1. Introduction

Traditionally, poverty and inequality studies have rooted their analysis on interpersonal comparisons based on a single dimension, either income or expenditure-based. However, individuals do not only care about income, other life dimensions such as health, employment, leisure, housing, and environmental quality are also highly valued as determinants of a good life. As such, it has become increasingly recognised, both at the academic and at the public policy arena, that a broader picture of social progress should be captured via a myriad of life dimensions, which complement income based measures of poverty and inequality (Stiglitz, Sen and Fitoussi, 2009; Alkire and Foster 2011).

Importantly, recent studies have highlighted that individuals differ in their preferences over different life dimensions and that these preferences should be respected when measuring poverty and inequality (Decancq et al. 2019). Equivalent income has been proposed as a measure of well-being which respects individual preferences (Fleurbaey and Blanchet 2013; Decancq et al., 2015). This approach provides a money-metric measure but rather than aiming to rank utility levels, it aims to rank individuals by their levels of well-being, taking into account their own preferences over different dimensions. Provided that information about individual preferences over different life dimensions is available, “the equivalent income of an individual is the hypothetical income that, if combined with the best possible value on all non-income dimensions, would place the individuals in a situation that he/she finds equally good as his/her actual situation” (Decancq et al., 2016). In addition to fulfilling the principle of respect for individual preferences, equivalent income has the advantage of being a monetary measure, which can be used to calculate inequality and social welfare. The information about individual preferences plays a central role in the calculation of equivalent incomes.

While this growing strand of the literature has acknowledged the importance of accounting for a wide range of life dimensions, most likely due to data limitations, empirical applications have considered a limited number of them, e.g. income, employment, health and housing quality (Decancq et al., 2015b; Decancq et al. 2019). This paper contributes to this literature by illustrating the extent to which analysis based on equivalent incomes is affected by the set of life dimensions included in the measurement.

The empirical analysis that we perform in this paper makes use of a rich dataset from Ecuador, which in addition to the life dimensions previously considered in the literature allows us to account for other dimensions, such as social isolation, gender-based violence, unfair treatment, political participation and empowerment. In addition, the specific context of Ecuador allows to account for preference heterogeneity across different population groups, for instance ethnic minorities. To estimate equivalent income, we follow the approach proposed by Decancq et al. (2015b) and Schokkaert et al. (2011) and derive preference information based on life satisfaction regressions.

Our study provides a number of interesting findings. First, our results confirm the importance of accounting for a wide range of life dimensions in well-being analysis. Social isolation, gender-based violence and unfair treatment are found to be significant determinants of life satisfaction. Second, an important degree of reranking is observed between equivalent incomes based on a basic set of life dimensions used in previous studies (income, health, unemployment and housing quality) and those including the additional “missing” dimensions available in our data, with a Spearman correlation coefficient of 0.78. As a consequence, only around 39 percent of those considered the most deprived when all dimensions are considered are among the most deprived based on equivalent incomes including only the basic dimensions. The life dimensions contributing the most to reranking are social isolation and unfair treatment. Third, in the same vein as Decancq et al. (2017), our analysis provides some insights into the drivers of reranking by

comparing the distribution of equivalent income based on the basic dimensions, with counterfactual equivalent income distributions that neutralize different factors contributing to reranking: omitted variable bias in the estimated preference parameters from the basic regression, heterogeneity in preferences over the additional dimensions, inequality within the additional outcome dimensions, correlation between the outcome dimensions, and correlation between outcomes and preferences. Omitted variable bias has only a minor effect on re-ranking, whereas inequality in outcomes and to some extent preference heterogeneity account for an important part of re-ranking. The correlation between the outcome dimensions mitigates the degree of re-ranking.

On the empirical side, our paper highlights the importance of collecting information on different dimensions that individuals consider important determinants of a good life. The lack of data over a wide range of life dimensions can affect our evaluation of the population deemed the most deprived, which would in turn limit the impact of public policies aiming to protect the most vulnerable. On the normative side, the analysis of well-being over a broad range of life dimensions raises interesting questions about the principle of respecting individual preferences. Should preferences of someone who favours gender-based violence be respected? We conclude with a discussion on the implications for welfare analysis.

The remainder of the paper is structured as follows. Section 2 presents the conceptual background on equivalent income and the most recognized empirical approaches in literature to measure it. Section 3 describes the data and the measures that we use to capture additional/missing dimensions of well-being. Section 4 presents the results, focusing on the differences between the basic and extended specification of equivalent incomes in terms of identification of the most deprived and welfare ranking, and discusses the factors driving differences between the two distributions. The paper finalises presenting some concluding remarks.

2. Equivalent income in literature

This section presents the conceptual background on equivalent income and the empirical approach used in this paper to measure it. It reviews the most relevant literature on the topic to set the conceptual and empirical background of the analysis.

2.1 Conceptual background

The literature on multidimensional inequality and poverty dates back to the late 70's with pioneering studies such as Kolm (1977), followed by Atkinson and Bourguignon (1982, 1987), and Tsui (1995). This literature advocates for measures of multidimensional inequality or poverty, which consider several aspects of well-being and provides methodologies to portrait the joint distribution of these several dimensions into a single metric – not necessarily monetary – that enables to rank individuals from worse off to better off in society. This literature avoids assuming that a one-dimensional money-metric (income or expenditure) subsumes all different dimensions of well-being and resembles individuals' utilities.

Despite this initial literature on measurement issues to account for well-being “beyond GDP”, and the conceptual approaches which they rely on, such as Sen's capability approach (Sen, 1980), it is only after the Stiglitz, Sen and Fitoussi commission (Stiglitz, Sen and Fitoussi, 2009) that an applied literature using multidimensional measures has grown in importance and relevance in the policy arena. An example of this applied literature in the context of public policy is the development of the Colombian Multidimensional Poverty Index, which is currently used as the national reference for poverty assessment in Colombia (Angulo et al. 2016).

However, most of this literature does not consider measures that respect individual ideas on what makes a good life, i.e. individual preferences. Multidimensional well-being is, in general, measured by selecting a set of well-being dimensions and applying weights a priori set by the analyst – via several different criteria – which are not necessarily consistent with individual preferences over these dimensions, and which are assumed equal for all individuals,¹ disregarding the intrinsic heterogeneity of preferences across people.

To overcome this limitation while measuring multidimensional well-being, a different strand of the literature proposes an alternative measurement approach which allows for interpersonal comparability and respects individual preferences. This is the *equivalent income* approach (Decancq et al, 2015a and 2015b), which defines equivalent income as “the hypothetical income that, if combined with the best possible values on all non-income dimensions, would place the individual in a situation that she/he finds equally good as his/her actual situation” (Decancq and Schokkaert, 2016).

More formally, following Decancq et al. (2017), let $l_i = (l_i^1, l_i^2, \dots, l_i^m)$ denote a vector containing individual i 's outcomes in m life dimensions, where the first dimension l_i^1 is assumed to represent income and the remaining dimensions represent non-income dimensions. In a population with n individuals, let L denote the $(n \times m)$ outcome matrix containing the outcome vectors for all individuals.

Assume that each individual i has a well-behaved preference ordering R_i over their vector l_i . This preference ordering is interpreted as the individual's well-informed judgements about what makes ‘a good life’ (Decancq et al. 2015b). Individual preferences are modelled as a function of a preference vector of k individual parameters, $R_i = R(a_i)$, with $a_i = (a_i^1, a_i^2, \dots, a_i^k)$. Let A denote the $(n \times k)$ preference matrix containing all n preference vectors in the population. The strict preference and indifference orderings are denoted $P(a_i)$ and $I(a_i)$, respectively.

Following the definition of equivalent income presented above, let $(\hat{l}_i^2, \dots, \hat{l}_i^m)$ denote the vector containing the optimal values of the non-income dimensions for individual i . Analytically, the equivalent income of individual i , denoted l_i^{1*} , is defined by the expression:

$$(l_i^{1*}, \hat{l}_i^2, \dots, \hat{l}_i^m) I(a_i) (l_i^1, l_i^2, \dots, l_i^m), \quad (1)$$

The intuition behind the concept of equivalent income is presented in Figure 1, where two life situations, A and B, are compared within a two-dimensional setting, where income and health are considered as life dimensions. In Figure 1a, the case of one individual, i , is represented by a single indifference curve. The figure shows that individual i perceives the same level of well-being from A than from B, as both situations are in the same indifference curve.

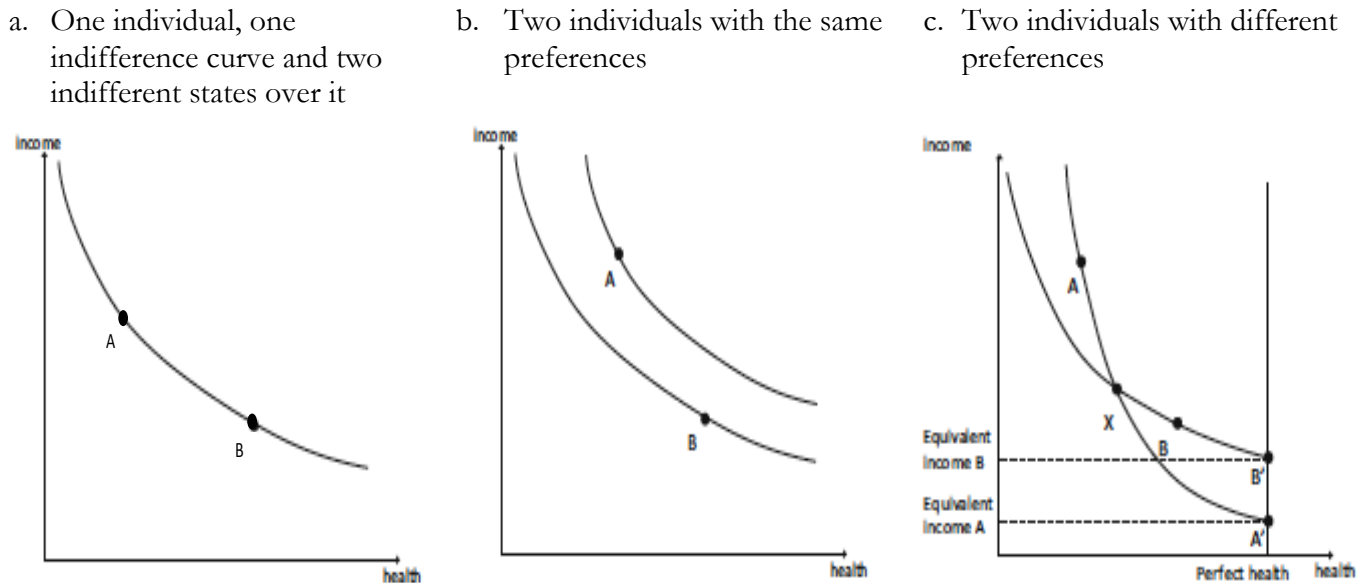
Take now the case of two individuals with the same preferences, as in Figure 1b. The indifference curves through A and B represent the preferences of individuals i and j , respectively. The comparison between life situation A and B is straightforward. Respecting individual preferences implies that A is better than B because A lies in a higher indifference curve than B (i.e. a higher level of well-being is perceived in A than in B).

However, in reality, individuals exhibit heterogeneous preferences, and this possess further challenges for interpersonal comparability. Take for instance Figure 1c, in such a case we cannot assert whether or not A is better than B because the indifference curves of the two individuals considered cross each other. In fact, given her preferences (i.e. the shape of her indifference

¹ A review on the different approaches used in literature to set weights in this context can be found in Decancq and Lugo (2013).

curves) individual i in situation A would prefer to be in B, because as B lies in a higher indifference curve. In the same way, individual j in situation B would prefer to be in A. But, there is a situation where differences in preferences should not matter, that is, when both individuals are in perfect health. In that case, their well-being can be compared based on their income, irrespective of their preferences. This is the equivalent income, which therefore represents the hypothetical level of income that combined with the level of perfect health places individuals in a situation that provides them the same level of well-being than their current situation (See Figure 1c). This can be easily extrapolated to several others well-being dimensions.

Figure 1. The equivalent income concept



Source: Adapted from Decancq & Schokkaert (2016)

The criterion to set the reference values for the non-income dimensions is that at these reference values differences in preferences should not matter for measuring well-being. If preferences can be assumed to be monotonic in a life dimension that has a natural upper bound (as is the case for health), this upper bound is a natural choice for the reference value. If the non-income dimension does not have an upper bound (e.g. quality of housing), one may use a value that is close to the maximum of the observed distribution.²

From this conceptual background, it is clear that the equivalent income measure indeed respects individual preferences. In addition to respecting of preferences, the concept of equivalent income also exhibits the following characteristics which makes it appealing for the purposes of policy uses. First, contrary to subjective measures of well-being (e.g. life satisfaction or happiness) which have become increasingly popular, it does not suffer from “physical-condition neglect” (see Decancq et al. 2015b). Second, despite the fact that equivalent income is expressed in monetary terms (which has some practical advantages when it comes to measurement), it is multidimensional concept which takes into account the well-being loss that follows from not achieving the reference values for the non-income dimensions. We now move into describing how this concept has been empirically approached in literature.

² With non-monotonic preferences the most natural choice is the individual-specific best value for that dimension - see Fleurbaey and Blanchet (2013) and Decancq et al. (2015b).

2.2 Empirical approach to implement the equivalent income

Implementation of the equivalent income measure requires information on individual preferences. Three different methods have been considered in the literature to empirically derive individual preferences for the calculation of equivalent incomes. The first approach relies on deriving preference information from subjective well-being regressions (Decancq et al. 2015b, 2017 and Schokkaert et al. 2011). The second method consists of a revealed preferences approach, where preference information is derived from individual choices over different dimensions. Bargain et al. (2013) and Decoster and Haan (2015) use, for instance, a revealed preferences approach to derive income-leisure preferences with random utility models of labour supply. Finally, the third method uses contingent valuation techniques as part of a stated preference approach (Fleurbaey et al. 2013 and Schokkaert et al. 2013).

In this paper, we follow the literature that derives preference information based on life satisfaction regressions. More formally, let $S_i(l_i, a_i)$, represent life satisfaction of individual i , which is a function of outcome vectors l_i and preferences parameters a_i . A life satisfaction regression can be empirically expressed as:

$$S_i = \alpha + \beta^1 \ln(l_i^1) + \sum_{j=2}^m (\beta^j + \mu^{j'} Z_i) l_i^j + \delta' Z_i + \xi_i, \quad (2)$$

where the observed l_i^1 income level enters the life satisfaction regression with a logarithmic functional form and β^1 corresponds to its associated coefficient to be estimated. l_i^j corresponds to the outcome of non-income dimension j , and β^j its associated parameter, for $j = 2, \dots, m$. The vector Z_i contains sociodemographic characteristics. The vector Z_i is interacted with non-income life dimensions to capture differences in preferences over life dimensions across population subgroups. The direct effect of Z_i , parametrized with δ , and the idiosyncratic disturbance term ξ_i , both are interpreted as capturing aspirations and expectations.

Starting from the econometric specification of life satisfaction in equation (2), we can implement the definition of equivalent income in equation (1) as:

$$\begin{aligned} S_i &= \alpha + \beta^1 \ln(l_i^1) + \sum_{j=2}^m (\beta^j + \mu^{j'} Z_i) l_i^j + \delta' Z_i + \xi_i, \\ &= \alpha + \beta^1 \ln(l_i^{1*}) + \sum_{j=2}^m (\beta^j + \mu^{j'} Z_i) \hat{l}_i^j + \delta' Z_i + \xi_i, \end{aligned}$$

which yields

$$l_i^{1*} = l_i^1 \exp \left[\sum_{j=2}^m \frac{\beta^j + \mu^{j'} Z_i}{\beta^1} (l_i^j - \hat{l}_i^j) \right] \quad (3)$$

Let $I(L, A)$ represent the distribution of equivalent income in (3). Note that the issue of “missing” well-being dimensions in the data would yield a different distribution of equivalent income $I(L', A')$, which could be interpreted as having zero values for outcome dimensions and/or preference parameters for all individuals in the population. Our empirical application will consist of comparing equivalent incomes based on a reduced set of life dimensions commonly available in survey data and an extended specification of equivalent income including additional life dimensions from a novel data set collected in Ecuador, as discussed in the next section.

3. Data and well-being dimensions

This section firstly describes the data that we use for the empirical analyses of this paper and then it presents the indicators through which we approach the missing dimensions of wellbeing.

3.1 Data

The data used in the analysis was collected in 2015 following the questionnaire modules on missing dimensions of poverty developed by the Oxford Poverty & Human Development Initiative (OPHI).³ The survey follows a multi-stage sample design. The primary sampling units are 10 regional domains including the provinces of Azuay, Esmeraldas, Guayas, Imbabura, Manabí and Pichincha, the Amazonian region, the central Highlands (Sierra Centro), the rest of the Highlands, and the rest of the Coast. The secondary sampling units are census sectors containing approximately 150 dwellings in the urban area and 80 in the rural area. The final sampling units are the households: 12 households per census sector were interviewed. The survey is representative at the level of the regional sampling domain.

The survey contains a sample of 23,535 individuals living in 6,342 households. The data contains information on personal and household characteristics, employment, labour and non-labour income, public and private transfers, health and health care access and fertility. Additionally, the data contains a battery of questions with information on OPHI's five 'missing dimensions' of poverty: quality of work, empowerment, physical safety, social connectedness and psychological well-being.

Finally, in terms of life satisfaction, this question asks how satisfied or unsatisfied an individual is in relation to life and provides as response options a 4-point scale, which ranges from one ('very dissatisfied') to four ('very satisfied'). Given that this question was elicited exclusively to individuals identified as household heads in the survey, our sample gets automatically restricted to these individuals, which correspond to 6,342.

3.2 Life dimensions

The life dimensions that we operationalize in this paper, are mainly restricted by the available information in our Ecuadorian survey. For the purposes of this paper, we split life dimensions available in the data into two groups. We refer to dimensions which have been previously used in the equivalent income literature as 'basic dimensions', whereas we termed 'missing dimensions' those which have not been previously considered in this type of analyses. This section describes the measures used within each category.

Basic dimensions. Four basic dimensions of well-being are considered in our analysis: income, absence of good health (illness), unemployment status and housing quality. Income is defined as the natural logarithm of the per capita household disposable income. Absence of good health is a dummy variable that takes the value of one if the person has experienced an illness during the week before the interview. Here, given that the survey contains very detailed information about the type of illness, we consider as illness only severe illnesses, or moderate illnesses resulting in an absence from work.⁴

Unemployment status is measured by a dummy that takes values of one if the person did not have a job the week before the interview but is available for work. Housing quality is measured by an index taking values between 0 and 1, and derived from a battery of questions about housing characteristics, such as dwelling type, material of the walls, roof and floor, number of

³ For more information see: <https://ophi.org.uk/research/missing-dimensions/survey-modules/>

⁴ The data also provides information about accidents experienced the week before the interview but these have been excluded.

rooms in the dwelling, access to water and electricity, availability of bath, toilet, telephone, and internet.

Missing dimensions. Five missing dimensions of well-being based on information available in the survey were considered: social isolation, gender-based violence, unfair treatment, political participation and empowerment. In general, we have aimed to use information on objective outcomes describing the situation of the person in each dimension, leaving aside information which could be considered as subjective. For instance, social isolation is measured by a count score based on questions related to the frequency of social contact, the absence of social network support, the absence of emotional support and the need for relatedness. However, information such as satisfaction with social relations, feelings of belonging and loneliness are excluded.⁵ Gender-based violence is measured by a dummy variable taking the value of 1 if the person is aware of cases of gender-based violence in her community or household. Unfair treatment is measured by a count score based on questions related about the frequency of disrespectful or unfair treatment, and whether the person has been discriminated over the last three months.⁶ Political participation is captured by a dummy variable taking the value of 1 if the person is member of a political group or voted in the last elections. Finally, we use a basic definition of empowerment, related to the decision to work. More precisely, empowerment is measured by a dummy variable taking the value of 1 if the person made her own decision in deciding which job to take.

Our analysis uses the observations for which information for all necessary have non-missing values. This leaves us with a sample of 5,508 observations. Descriptive statistics are presented in Table A1 in the Appendix.

4. Empirical results

4.1 Missing life dimensions and subjective well-being

As previously mentioned, our calculation of equivalent incomes relies on deriving preference information from life satisfaction regressions. Table 1 presents the estimates obtained from a model where only the basic set of life dimensions are included in the regression (Model 1) and those obtained where all life dimensions available in the data are considered (Model 2). To model differences in preferences across population subgroups, the non-monetary life dimensions in each model are interacted with dummies for being female, belonging to an ethnic minority group,⁷ being aged 50 or more, and having a higher education degree.

⁵ The four items used to generate the social isolation count score are measured as follows. Frequency of social contact takes the value of one if the person reports not having spent any days with family, friends or neighbours over the last two weeks. Absence of social network support takes the value 1 if the person indicates not having any relatives or friends who could provide economic support. Absence of emotional support takes the value 1 if the person reports not having anyone with whom to discuss about personal or intimate matters. Finally, the need for relatedness is based on three questions asking individuals how much they agree with the following statements: (i) you get along well with the people you have contact with; (ii) you consider close the people you interact with; and (iii) the people around you care about you. The responses are provided in a 4-point scale, which ranges from one ('totally disagree') to four ('totally agree'). The need for relatedness takes the value one if the person disagrees or totally disagrees with at least one of the three statements.

⁶ The unfair treatment count score is generated based on three questions asking respondents the extent to which they consider that (i) people treat them with disrespect; (ii) people treat them unfairly; and (iii) people have treated them discriminatorily over the last three months. The responses are provided in a 4-point scale, which ranges from one ('always or almost always') to four ('never'). Each of the items in the unfair treatment count score takes the value of one if the person responds 'always or almost always' or 'frequently' to the questions.

⁷ The ethnic minority group is composed of five different ethnic groups: indigenous origin, afro-Ecuadorian, black origin, mixed white and black origin, and montubio. Unfortunately, due to sample size limitations, we are not able to

Table 1. Life satisfaction regressions (ordered probit)

	Model 1		Model 2	
Disposable income (log)	0.0388*	(0.0212)	0.0467**	(0.0214)
Housing quality	1.246***	(0.141)	1.173***	(0.148)
Illness	-0.0305	(0.116)	-0.00619	(0.117)
Unemployment	-0.550**	(0.241)	-0.490**	(0.243)
Social isolation	-	-	-0.115***	(0.0284)
Gender violence	-	-	-0.113**	(0.0453)
Unfair treatment	-	-	-0.295***	(0.0500)
Political participation	-	-	0.0748	(0.0695)
Empowerment	-	-	0.0829	(0.0562)
Housing x female	-0.414*	(0.218)	-0.469**	(0.225)
Housing x ethnicity	-0.0654	(0.237)	0.00968	(0.241)
Housing x age over 50	0.0126	(0.0741)	0.0442	(0.146)
Housing x higher educ.	-0.410	(0.385)	-0.475	(0.393)
Illness x female	-0.228*	(0.133)	-0.243*	(0.135)
Illness x ethnicity	0.0468	(0.163)	0.0263	(0.164)
Illness x age over 50	-0.0332	(0.129)	-0.0194	(0.131)
Illness x higher educ.	0.425*	(0.227)	0.420*	(0.231)
Unempl. x female	-0.122	(0.393)	-0.213	(0.397)
Unempl. x ethnicity	0.994***	(0.372)	0.997***	(0.375)
Unempl. x age over 50	0.391	(0.334)	0.342	(0.337)
Unempl. x higher educ.	0.697	(0.455)	0.551	(0.460)
Isolation x female	-	-	-0.0528	(0.0415)
Isolation x ethnicity	-	-	-0.105**	(0.0485)
Isolation x age over 50	-	-	0.0599	(0.0391)
Isolation x higher educ.	-	-	-0.0675	(0.0676)
Gender viol. x female	-	-	0.0966	(0.0729)
Gender viol. x ethnicity	-	-	-0.0811	(0.0869)
Gender viol. x age over 50	-	-	-0.0563	(0.0655)
Gender viol. x higher educ.	-	-	-0.0305	(0.103)
Unfair treat. x female	-	-	0.0482	(0.0799)
Unfair treat. x ethnicity	-	-	0.0671	(0.0844)
Unfair treat. x age over 50	-	-	0.163**	(0.0707)
Unfair treat. x higher educ.	-	-	-0.00274	(0.128)
Pol. Partic. x female	-	-	-0.0641	(0.114)
Pol. Partic. x ethnicity	-	-	-0.273**	(0.126)
Pol. Partic. x age over 50	-	-	-0.00964	(0.0911)
Pol. Partic. x higher educ.	-	-	0.0985	(0.190)
Empowerm. x female	-	-	0.0231	(0.116)
Empowerm. x ethnicity	-	-	-0.0141	(0.105)
Empowerm. x age over 50	-	-	-0.0666	(0.0830)
Empowerm. x higher educ.	-	-	-0.0289	(0.134)
N. observations	5,508		5,508	
Pseudo R ²	0.0704		0.0818	

Notes: Life satisfaction regressions include the following additively separable controls: gender, education, marital status, ethnic groups, labour market status, rural area and province dummies. Variables on reciprocity, trust, life purpose and autonomy are used as controls for individual-specific time-invariant characteristics. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

differentiate across ethnic groups. The largest ethnic group is the indigenous origin group, which represents 5.5 percent of the sample, all other groups represent less than 2.5 percent of the sample

It is important to note that our data is cross-sectional, therefore, we are unable to account for unobserved individual heterogeneity in the estimation of life satisfaction, which might result in a bias in the estimated coefficients (Ferrer-i-Carbonell and Frijters 2004). In the absence of panel data, a second best solution is to use information on personality traits as controls in the estimation of life satisfaction. Such information is also not available in our data. As a sort of third best solution to control for individual-specific time-invariant characteristics, we use a set of variables which are likely to be related with personality traits, such as non-reciprocity, distrust, lack of autonomy and lack of life purpose.⁸

The results of our life satisfaction regressions are in line with previous findings in the literature. The logarithm of per capita household disposable income has a positive and significant effect on life satisfaction, although only at the 10% level in Model 1. The expected effects are also found for illness, unemployment status and housing quality, although health is not significant. This might be due to the fact that the health question relates to illnesses in the past week and might therefore not capture the overall level of health.

Under Model 2, social isolation, gender-based violence and unfair treatment have a negative and significant effect on life satisfaction, highlighting the importance of accounting for a broad range of life dimensions in the analysis of well-being. The effect of political participation is not significant except for ethnic minorities, for whom the effect is negative. The effect of empowerment is positive but not significant. Most interaction terms are not significant but present the expected signs. Under both models, housing quality is less important for females, and illness affects a stronger negative effect for this group. Individuals with higher education value more health. Unemployment affects life satisfaction of ethnic minorities less. In fact, the effect of unemployment status for this group is positive. Under model 2, social isolation affects more ethnic minorities and the effect of empowerment on this group is negative. Individuals aged 50 or more seem to value more political participation. Other results in line with the literature include the U-shaped relationship between age and life satisfaction and the positive effect of being married.

4.2 Equivalent income and missing life dimensions

Based on the results of models 1 and 2, we can now calculate equivalent incomes. Following the normative reasoning in the previous section, reference values of non-income dimensions must be chosen to derive equivalent incomes. For health, the absence of health problems over the last week is chosen as reference value and “not being unemployed” as the reference for employment status. For housing quality, the 90th percentile in the sample is taken as reference value as there is no upper boundary for this dimension. “Not being social isolated”, “not experiencing gender-based violence”, and “not experiencing unfair treatment” are used as reference values for social

⁸ Non-reciprocity, lack of life purpose, and lack of autonomy are measured based each on three questions asking individuals how much they agree with three statements. The responses are provided in a 4-point scale, which ranges from one (‘totally disagree’) to four (‘totally agree’). For non-reciprocity, the statements are: (i) if someone does you a favour, you are willing to return the favour; (ii) you make a big effort to help someone who has been generous to you; and (iii) you are willing to incur a personal cost to help someone who has helped you. For lack of life purpose, the statements are: (i) your life has a clear sense or purpose; (ii) you have discovered a satisfactory purpose of life; (iii) you have a clear idea of what makes your life meaningful. For lack of autonomy, the statements are: (i) you feel you are free to decide how you want to live your life, (ii) you feel that you can freely express your ideas, and (iii) you feel that in every situation you can be honest with yourself. Non-reciprocity, lack of life purpose, and lack of autonomy take the value of one if the person disagrees or totally disagrees with at least one of the three statements. Distrust is measured based on four questions about the level of trust the person has in (i) national government officials, (ii) local government officials, (iii) private companies, and (iv) the country’s legal system. The responses are provided in a 4-point scale, which ranges from one (‘a lot’) to four (‘none’). Distrust takes the value one if the person responds ‘little’ or ‘none’ in at least one of the four statements.

isolation, gender-based violence and unfair treatment, respectively. For political participation, “active political engagement” is chosen as reference value and “deciding which job to take on one’s own” as reference for empowerment. Based on these reference values, the observed outcomes for the different life dimensions and the estimated coefficients in Table 1, equivalent incomes are calculated as in equation (3).

To assess the extent to which equivalent incomes are affected by the introduction of additional life dimensions, we first focus on the individuals identified as the most deprived according to each measure. Here, we defined as the most deprived the 5 per cent of individuals with the lowest levels of equivalent income. Table 2 presents the overlap of individuals identified as the most deprived with seven different measures of equivalent incomes. Column 1 refers to equivalent incomes with our basic dimensions of well-being (disposable income, health, unemployment status and housing quality). The second column refers to equivalent incomes based on all additional dimensions of well-being available in the data (social isolation, gender-based violence, unfair treatment, political participation and empowerment). To provide an idea of the effect of the different life dimension on equivalent income, columns 3 to 7 are based on equivalent incomes when each of the additional dimensions is included separately as part of equivalent incomes. The latter set of results is based on specific life satisfaction regressions where each additional life dimension enters separately. The results of these regressions are presented in the Appendix.

Only around 39 percent of those considered the most deprived when all life dimensions are included are among the most deprived based on equivalent incomes including only the basic dimensions. Table 2 shows that the little overlap is mainly driven by the introduction of social isolation and unfair treatment. For these two dimensions, around 54 percent of the most deprived are among the poorest in terms of equivalent income with the basic dimensions. The overlap is higher for all other dimensions. The overlap among individuals identified as the worst off is particularly high if only political participation or empowerment are considered as additional dimensions (92.4 percent and 87.4 percent, respectively) because participation and empowerment have a negligible effect on life satisfaction.

In addition to our focus on the most deprived, we can also compare the ranks of each individual according to the different measures of equivalent income. Figure 1 plots individual ranks according to equivalent income based on the basic dimensions of well-being and that including all life dimensions available in the data. If individuals were ranked equally according to the two dimensions, all observations should be aligned in the 45 degree line. The higher the dispersion of individual observations from the 45 degree line, the larger the degree of reranking between the two measures.

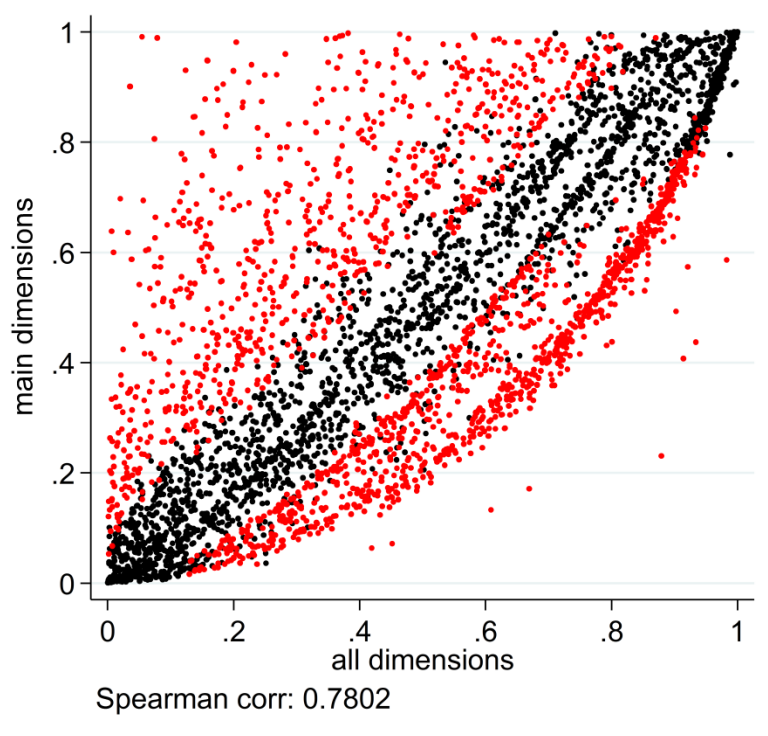
Table 2. Overlap (%) between individuals identified as the most deprived

	Eq. income (basic)	Eq. income (all)	Eq. income (social isolation)	Eq. income (gender violence)	Eq. income (unfair treatment)	Eq. income (political participation)	Eq. income (empowerment)
Eq. income (basic)	100.0	-	-	-	-	-	-
Eq. income (all)	39.0	100.0	-	-	-	-	-
Eq. income (social isolation)	53.4	58.3	100.0	-	-	-	-
Eq. income (gender violence)	73.3	46.4	52.2	100.0	-	-	-
Eq. income (unfair treatment)	54.2	63.4	48.2	55.8	100.0	-	-
Eq. income (political participation)	92.4	39.9	51.8	73.6	55.8	100.0	-
Eq. income (empowerment)	87.4	42.0	52.2	72.1	58.0	85.5	100.0

Source: Own calculations.

Figure 1 shows a significant degree of reranking between equivalent incomes with and without the additional life dimensions, with a Spearman correlation coefficient of 0.78 between the two metrics. Ranks are statistically different in 44 percent of cases (red dots) based on bootstrapped confidence intervals for welfare rankings. Additionally, a Wilcoxon signed-rank test to assess whether the population mean ranks of the two distributions differ confirms the rejection that the two distributions are similar.

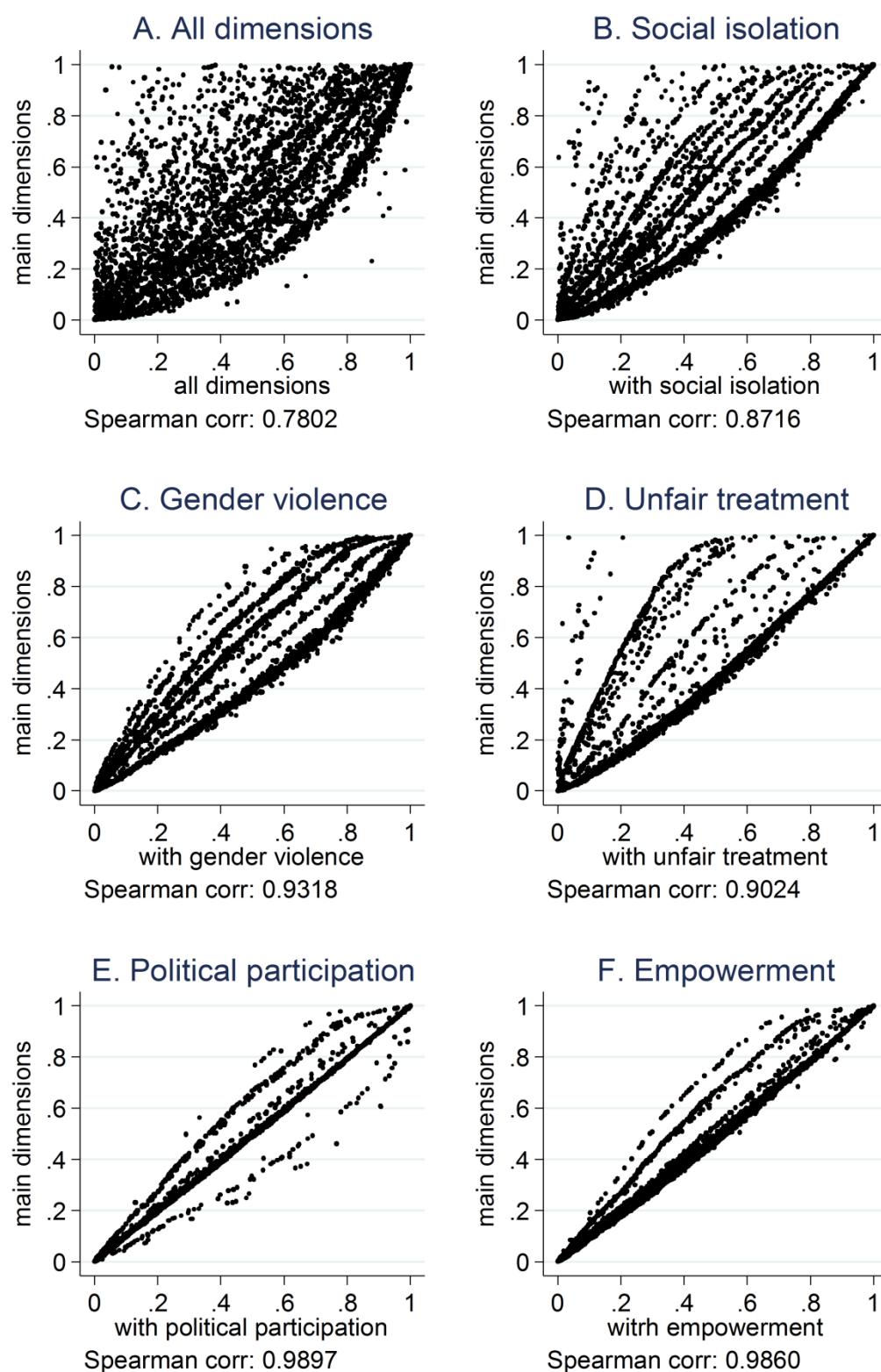
Figure 1. Reranking: basic dimensions versus all dimensions



Note: Graph based on bootstrapped preference parameters to generate confidence intervals for welfare ranks. Red dots indicate that welfare ranks are statistically different, black dots that they are not.
Source: Own calculations

To assess the effect of individual life dimensions on reranking, we plot equivalent income with the basic dimensions and that including each additional life dimension separately. The results are presented in Figure 2. The life dimension responsible for the largest degree of reranking is social isolation, which conveys a Spearman rank correlation of 0.87 when compared to the equivalent income including only the basic dimensions. Unfair treatment and gender-based violence also show an important contribution to reranking with Spearman correlations of 0.9 and 0.93, respectively. The effect of political participation and empowerment is, on the other hand, small.

Figure 2. Reranking: contribution of additional dimension



Source: Own calculations

4.3 The effect of missing dimensions and preference heterogeneity on well-being reranking

The previous section was focused on the comparison of the distribution of the reduced specification of equivalent income $I(L', A')$ and the extended specification $I(L, A)$. In our setting, differences in individual rankings based on equivalent incomes using the basic dimensions and those based on equivalent incomes including the missing dimensions stem from the interrelation between differences in the outcomes of life dimensions (e.g. inclusion of missing dimensions, outcome inequality and correlation between outcomes) and differences in preferences over life dimensions (e.g. changes in estimated preferences due to the inclusion of additional dimensions, preference heterogeneity over the new dimensions, correlation between outcomes and preferences). In this section, we follow Decancq et al. (2017) and calculate various counterfactual distributions with the aim of neutralizing the contribution of specific factors to well-being reranking. The contribution to reranking is assessed by comparing the rankings of equivalent incomes based on the basic dimensions, with the rankings of the counterfactual distributions.

More precisely, we construct five counterfactual distributions.

Fixed preference distribution $I(L, A')$. This counterfactual distribution is based on all dimensions of well-being but for the main dimensions of well-being it uses the preference parameters estimated from the regression including the only the basic dimensions. This distribution aims to isolate the effect of omitted variable bias in the estimated preference parameters of the basic dimensions.

Equalized preference distribution $I(L, \bar{A})$. We neutralize heterogeneity in preferences over the missing dimensions by averaging preference parameters over the sample of analysis and replacing individual preference parameters by this average.

Reshuffled preference distribution $I(L, \tilde{A})$. The counterfactual distribution is obtained by randomly assigning to each individual a new preference vector from the sample for the missing life dimensions. The counterfactual neutralizes the correlation between outcomes of missing dimensions and the preferences over these dimensions. Since the resulting reshuffled preference matrix is not unique, we generate 1000 reshuffled matrices.

Equalized outcomes distribution $I(\bar{L}, A)$. We neutralize heterogeneity (inequality) in outcomes of the missing dimensions by averaging outcomes of each missing dimension.

Reshuffled outcomes distribution $I(\tilde{L}, A)$. Correlation across outcomes of the missing dimensions is neutralized by randomly assigning to each individual an outcome from the sample, for each missing dimension. Since the resulting matrix is not unique, we generate 1000 reshuffled matrices.

Table 3 presents the Spearman rank correlation coefficient between the equivalent income based on the basic life dimensions and that of the counterfactual distributions, and the difference between this coefficient and the Spearman rank coefficient between the basic and the extended equivalent incomes.

The results show that the effect of omitted variable bias (first row in Table 3) in the estimated preference parameters from the regression based only on the basic well-being dimensions has a minor effect on reranking. The trade-offs between the basic dimensions of well-being are therefore only minimally affected by the introduction of the additional dimensions in the life satisfaction regression. The large degree of reranking must therefore be related to the introduction of the additional life dimensions into the measure of equivalent incomes, which at the same time is driven by the interaction between two components of the measure: the

outcomes of the additional dimensions and the preferences over these life dimensions. The remaining four rows of Table 3 attempt to isolate specific factors related to the interaction between these two components.

Table 3. Spearman rank correlation coefficient between the basic equivalent income and the counterfactual distributions

		Spearman correlation	Difference
Fixed preference distribution	$I(L', A')$ vs. $I(L, A')$	0.788	0.007
Equalized preference distribution	$I(L', A')$ vs. $I(L, \bar{A})$	0.806	0.026
Reshuffled preference distribution	$I(L', A')$ vs. $I(L, \tilde{A})$	0.782	0.002
Equalized outcomes distribution	$I(L', A')$ vs. $I(\bar{L}, A)$	0.968	0.187
Reshuffled outcomes distribution	$I(L', A')$ vs. $I(\tilde{L}, A)$	0.735	-0.045

Note: Difference refers to the difference between the Spearman correlation coefficient between the basic equivalent income and the counterfactual distributions, and that of the basic and extended equivalent income.

Source: Own calculations

The effect of preference heterogeneity on well-being reranking can be capture by the Spearman correlation between the basic equivalent income and that where preferences over the additional life dimensions have been equalized for all individuals in the data (second row in Table 3). Removing preference heterogeneity leads to a decrease in reranking, with a resulting Spearman correlation coefficient equal to 0.806 compared to 0.780 from the basic and extended distributions. The effect of reshuffling preference parameters of the additional dimensions (third row in Table 3) results in a Spearman correlation coefficient similar to that of comparing the basic and extended distributions (0.782 compared to 0.780) meaning that the correlation between outcomes and preferences has only a very minor effect on reranking.

The largest decrease in reranking is observed from equalizing outcomes of the additional dimensions (fourth row in Table 3). The Spearman correlation coefficient equals 0.968 compared to 0.780 from the basic and extended distributions. The difference in reranking is explained by the degree of inequality in outcomes across individuals in our sample. Finally, the effect of the correlation across outcomes is captured by the comparison of the basic distribution with that where outcome vectors have been reshuffled. In this case, the Spearman correlation coefficient is lower than that of from the comparison of the basic and extended distributions, meaning that the correlation across outcome dimensions mitigates the degree of wellbeing reranking. In the absence of correlation across dimensions, reranking would be higher (Spearman correlation coefficient equals 0.735 compared to 0.780).

5. Concluding remarks

The acknowledgement that individual well-being is a multidimensional concept comes along with the issue of how to aggregate different life dimensions into a single measure of wellbeing. Recent studies have suggested that individual preferences over different life dimensions should be taken into account in the aggregation. The equivalent income, defined as “the hypothetical income that, if combined with the best possible value on all non-income dimensions, would place individuals in a situation that they find equally good as their actual situation” (Decancq et al., 2016), has been proposed as a measure of well-being that respects individual preferences.

This paper analysed the extent to which “missing” life dimension, traditionally not available in the data, affect the calculation of equivalent incomes. In particular, based on a novel dataset collected in Ecuador, we first calculate equivalent incomes using a narrow set of life dimensions previously considered in the literature, namely income, health (sickness), unemployment and housing quality. Then, we calculate an extended measure of equivalent income including as additional dimensions objective indicators on five “missing” dimensions of well-being: social isolation, gender-based violence, unfair treatment, political participation and empowerment. We compare the reduced and the extended specifications of equivalent income and discuss the drivers of reranking between the two measures.

Our results show that social isolation, gender-based violence and unfair treatment are significant determinants of life satisfaction and play an important role in the calculation of equivalent income. In fact, an important degree of reranking is observed between the reduced and the extended specification of equivalent incomes, with a Spearman rank correlation coefficient of 0.78. Only 39 percent of individuals considered as the most deprived according to the extended specification are also considered as the most deprived according to the reduced specification. Inequality within outcomes of the additional dimensions appears to be the factor contributing the most to well-being re-ranking. In terms of life dimensions, the introduction of social isolation increases the degree of reranking.

The analysis highlights the importance of accounting for a wide range of life dimensions in the measurement of individual well-being. The divergence between our measure of equivalent income with and without additional life dimensions would have implications in the analysis of poverty and inequality based on these measures. This points to the need of collecting more and better information on well-being dimensions to provide additional input for policy analysis on multidimensional poverty and inequality.

In terms of data, it is, however, worth noting that our empirical work has some obvious shortcomings. The lack of panel data prevents us from properly controlling for unobserved individual heterogeneity, which may bias the estimated preference parameters. The approach taken here was to use information on a set of variables related with personality traits (reciprocity, trust, autonomy and life purpose) as a third best option to control for individual-specific time-invariant characteristics. However, in the context of “missing” well-being dimensions, one may wonder whether our controls might themselves also be considered to some extent as missing life dimensions.

The analysis of well-being over a broad range of life dimensions also raises interesting normative questions related to the principle of respecting individual preferences. In the context of a wide range of life dimensions, should individual preferences always be respected? Take for instance the case of gender-based violence, should we preferences of someone who favours gender-based violence be respected. The same could apply to a broader range of dimensions, such as environmental protection. Future work should focus on the normative treatment of different types of life dimensions for the calculation of well-being measures. This represents promising a promising area for future research.

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Appendix

Table A1. Descriptive statistics

	mean	standard deviation	min	max
Household disposable income per capita	264.80	533.98	0	20,119.8
Life satisfaction	3.01	0.72	1	4
Housing quality	0.70	0.17	0.04	1
Illness	0.06	0.25	0	1
Unemployed	0.01	0.10	0	1
Social isolation	0.67	0.83	0	4
Gender based violence	0.45	0.50	0	1
Unfair treatment	0.21	0.46	0	3
Political Participation	0.88	0.32	0	1
Empowerment	0.82	0.39	0	1
Female	0.24	0.43	0	1
Age < 30	0.15	0.36	0	1
Age 30-50	0.52	0.50	0	1
Age >50	0.33	0.47	0	1
Primary education or less	0.45	0.50	0	1
Secondary education	0.41	0.49	0	1
Post-secondary education	0.04	0.19	0	1
Tertiary education	0.11	0.31	0	1
Married	0.72	0.45	0	1
Ethnic minority	0.15	0.36	0	1
Rural area	0.57	0.50	0	1
Disabled	0.03	0.17	0	1
Pensioner	0.03	0.17	0	1
House work	0.03	0.17	0	1
Non-reciprocity	0.23	0.42	0	1
Distrust	0.79	0.40	0	1
Lack of life purpose	0.27	0.20	0	1
Lack of autonomy	0.27	0.20	0	1
Number of observations	5,508			

Table A2. Separate life satisfaction regressions for each missing dimension (ordered probit)

	(A)		(B)		(C)		(D)		(E)	
Disposable income (log)	0.0410*	(0.0213)	0.0444**	(0.0213)	0.0411*	(0.0213)	0.0380*	(0.0212)	0.0392*	(0.0212)
Housing quality	1.240***	(0.143)	1.238***	(0.142)	1.232***	(0.142)	1.229***	(0.145)	1.204***	(0.144)
Illness	-0.0439	(0.116)	-0.0204	(0.116)	-0.00559	(0.116)	-0.0321	(0.116)	-0.0249	(0.116)
Unemployment	-0.463*	(0.242)	-0.555**	(0.241)	-0.555**	(0.241)	-0.559**	(0.241)	-0.556**	(0.241)
Social isolation	-0.121***	(0.0281)	-	-	-	-	-	-	-	-
Gender violence	-	-	-0.125***	(0.0450)	-	-	-	-	-	-
Unfair treatment	-	-	-	-	-0.316***	(0.0494)	-	-	-	-
Political participation	-	-	-	-	-	-	0.0867	(0.0684)	-	-
Empowerment	-	-	-	-	-	-	-	-	0.0975*	(0.0553)
Housing x female	-0.471**	(0.223)	-0.425*	(0.219)	-0.423*	(0.219)	-0.399*	(0.219)	-0.388*	(0.219)
Housing x ethnicity	-0.0829	(0.239)	-0.0618	(0.237)	-0.0203	(0.237)	-0.0362	(0.237)	-0.0635	(0.238)
Housing x over 50	-0.0451	(0.0775)	0.0432	(0.0830)	-0.0177	(0.0759)	0.0221	(0.125)	0.0909	(0.112)
Housing x higher edu.	-0.466	(0.390)	-0.432	(0.385)	-0.415	(0.385)	-0.411	(0.385)	-0.399	(0.386)
Illness x female	-0.217	(0.134)	-0.247*	(0.134)	-0.233*	(0.134)	-0.230*	(0.134)	-0.226*	(0.134)
Illness x ethnicity	0.0395	(0.164)	0.0665	(0.164)	0.00387	(0.164)	0.0490	(0.163)	0.0469	(0.163)
Illness x over 50	-0.0187	(0.130)	-0.0236	(0.130)	-0.0443	(0.130)	-0.0283	(0.129)	-0.0359	(0.129)
Illness x higher edu.	0.483**	(0.230)	0.399*	(0.228)	0.401*	(0.227)	0.419*	(0.227)	0.420*	(0.227)
Unempl. x female	-0.192	(0.396)	-0.139	(0.394)	-0.125	(0.394)	-0.129	(0.393)	-0.112	(0.393)
Unempl. x ethnicity	1.034***	(0.374)	0.995***	(0.373)	1.003***	(0.373)	0.978***	(0.373)	0.990***	(0.373)
Unempl. x over 50	0.275	(0.336)	0.424	(0.335)	0.399	(0.335)	0.401	(0.335)	0.398	(0.334)
Unempl. x higher edu.	0.573	(0.458)	0.665	(0.455)	0.663	(0.456)	0.718	(0.456)	0.704	(0.454)
Isolation x female	-0.0374	(0.0413)	-	-	-	-	-	-	-	-
Isolation x ethnicity	-0.103**	(0.0475)	-	-	-	-	-	-	-	-
Isolation x age over 50	0.0579	(0.0380)	-	-	-	-	-	-	-	-
Isolation x higher edu.	-0.0817	(0.0669)	-	-	-	-	-	-	-	-
Gend. viol. x female	-	-	0.108	(0.0724)	-	-	-	-	-	-
Gend. viol. x ethnicity	-	-	-0.0902	(0.0861)	-	-	-	-	-	-
Gend. viol. x over 50	-	-	-0.0431	(0.0648)	-	-	-	-	-	-
Gend. viol. x higher edu.	-	-	-0.0514	(0.102)	-	-	-	-	-	-
Unfair treat x female	-	-	-	-	0.0601	(0.0784)	-	-	-	-
Unfair treat x ethnicity	-	-	-	-	0.0416	(0.0809)	-	-	-	-
Unfair treat x over 50	-	-	-	-	0.171**	(0.0692)	-	-	-	-
Unfair treat x higher edu.	-	-	-	-	0.0101	(0.127)	-	-	-	-
Pol. Part. x female	-	-	-	-	-	-	-0.0550	(0.111)	-	-
Pol. Part. x ethnicity	-	-	-	-	-	-	-0.182	(0.122)	-	-
Pol. Part. x age 50	-	-	-	-	-	-	-0.00992	(0.0886)	-	-
Pol. Part. x higher edu.	-	-	-	-	-	-	0.0490	(0.188)	-	-
Empower. x female	-	-	-	-	-	-	-	-	0.0483	(0.113)
Empower. x ethnicity	-	-	-	-	-	-	-	-	0.00136	(0.104)
Empower. x age 50	-	-	-	-	-	-	-	-	-0.0753	(0.0803)
Empower. x higher edu.	-	-	-	-	-	-	-	-	-0.0613	(0.132)
N. observations	5,508		5,508		5,508		5,508		5,508	
Pseudo R ²	0.0753		0.0722		0.0749		0.0706		0.0708	

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1