Subjective Well-Being across Countries: What is the Aggregate?*

Cristina Sechel†
Department of Economics and Related Studies
University of York

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Abstract. Despite widespread interest in Subjective Well-Being (SWB), the economic literature has been largely limited to one single measure of national SWB, namely the mean. This paper draws attention to the shortcomings of focusing on mean aggregates of SWB and introduces an alternative headcount-based aggregate, defined as the '*proportion of the population that is satisfied with life'*. This measure is used to test the empirical relationships between national SWB and standard objective measures of well-being. A Beta-regression approach is employed to account for the special distributional properties of the proportion measure. The findings reveal significantly different relationships between the proportion of satisfied individuals and objective measures of development compared to the standard mean satisfaction measure, casting doubt over conventional development policies which are heavily focused on income growth and education.

Keywords. Subjective Well-Being; Development; Beta-regression; Welfare Economics

JEL classifications: O1, I3, H1.

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† Department of Economics and Related Studies, University of York, York, YO10 5DD, United Kingdom. E-mail: cs998@york.ac.uk. Tel: +44 (0)7807 119180.

1 Introduction

Subjective measures of well-being have recently gained much attention as potential measures of national development. Although initially marginalised precisely because of their subjectivity, mounting evidence suggests that Subjective Well-Being (SWB) data are reliable and valid sources of well-being information (Diener, 1994; Kesebir and Diener, 2008). More importantly, SWB appears to contain supplementary information to that obtained from the standard objective indicators (Frey and Stutzer, 2013; Graham, 2008). Several recent studies highlight the benefits of constructing and maintaining national accounts of SWB for use in conjunction with objective measures (Bruni et al., 2008; Diener and Seligman, 2004; Diener and Suh, 1997; Fleurbaey, 2009; Stiglitz et al., 2010), while some go as far as to advocate the use of SWB as the one single overarching measure of progress (Layard, 2009). There are several attempts to build fundamental guidelines for potential measures of national SWB (Cummins et al., 2003; Diener, 2006).

Despite such widespread interest, SWB literature within the economics discipline has been largely limited to one single measure of national SWB, namely the mean. This paper draws attention to the shortcomings of focusing on mean aggregates of SWB and introduces an alternative headcount-based aggregate measure, defined as the 'proportion of the population that is satisfied with life'. The advantage of a headcount measure of national SWB is that it is better suited to the arbitrary and bounded nature of individual SWB responses, especially when the data are based on wide-ranging scales such as the life satisfaction scales that are commonly used in the national SWB literature.

Econometric analysis is used to parallel existing happiness literature that relies on mean measures of SWB (such as Deaton, 2008; Ovaska and Takashima, 2006; Stevenson and Wolfers, 2008), testing the empirical relationships between national SWB and standard objective measures of well-being using this alternative measure. The emphasis on *standard* objective indicators is deliberately chosen because of the strong influence they exert on how we view development. The concern is that these conventional accounts help create a shared view that may be very skewed and misguided if the measures it relies on do not adequately reflect overall well-being.

The paper is intended as a starting point for discussion about best methods of aggregating subjective information, and aims to show that different national measures of

SWB can tell very different stories about development and well-being. Choosing the appropriate aggregation method is therefore crucial for effective policy design.

We employ a Beta-regression model that is shown to be more appropriate given the distinct properties of SWB data, especially when considering the headcount aggregate. This contribution aims to improve on the baseline Ordinary Least Squares (OLS) approach generally used in studies of national SWB.

The paper is structured as follows: Section 2 describes the proposed alternative aggregate of SWB; Section 3 summarizes the relevant literature; Section 4 describes data sources and presents the cleaned dataset constructed for the analysis; Section 5 formulates baseline and preferred econometric models; Sections 6 and 7 presents results and robustness checks; Section 8 concludes.

2 A Headcount Aggregate of National Subjective Well-Being

Mean measures are not particularly appropriate for use with SWB data. To begin, using average measures of SWB to evaluate progress requires relatively precise interpersonal comparisons, but the discrete and arbitrary nature of reported SWB scales makes it difficult to compare answers across individuals. Bond and Lang (2014) show that cross-country comparisons of average SWB are virtually impossible when reported SWB scales are ordinal (without imposing strong assumptions about the underlying distributions of SWB). Furthermore, SWB scales are naturally bounded, which limits the growth of average SWB measures since individuals who have reached the highest level cannot improve further.

But perhaps more critical than considerations regarding data structure and interpretation, is that mean measures may capture a misguided social aim. The complex nature of SWB makes it is a somewhat unreasonable goal to expect perpetual increases in average SWB. Given that SWB depends on many life dimensions – some of which governments cannot or should not have control over – it is perhaps more appropriate for governing bodies to target some reasonable standard of SWB for all citizens, rather than seek to increase the well-being of all.

At the country/region level, a sufficientarian welfarist approach provides a fitting alternative to the utilitarianism underlying mean measures of SWB, and seems particularly well suited for use with SWB information. Sufficientarianism welfarism is a social judgement

view that is primarily concerned with providing a 'sufficient' level of welfare. More precisely, Crisp (2003) proposes that "compassion for any being B is appropriate up to the point at which B has a level of welfare such that B can live a life which is sufficiently good" (p. 762). In terms of subjective welfare, development can accordingly be viewed as a nation's ability to support such a sufficient level of SWB for its citizens (or as many of its citizens as possible).

Applying the sufficiency principle to SWB data translates to an aggregate measure that is based on a dichotomous reduction of self-reported well-being and can be expressed formally as follows:

$$SWB_{share} = \frac{1}{n}\sum_{i=1}^{n} I(s_i \geq z) \quad (1)$$

where s_i is individual *i*'s reported satisfaction level, z is a threshold level of satisfaction and *I(.)* is an indicator function that is 1 when individual *i*'s reported satisfaction is above the threshold level z and 0 otherwise. The threshold level, z, separates individuals who are reasonably satisfied from those who are not. SWB_{share} therefore represents the share (or proportion) of individuals who are sufficiently satisfied. The exact choice of z is discussed in Section 4 after the introduction of the relevant data.

SWB_{share} has limited sensitivity to small changes in life satisfaction as it is only affected by changes that cross the threshold level, so it addresses to some degree the problem of interpersonal comparisons. It is also suitable for use with bounded and ordinal scales.

The range of individuals' reported satisfaction, s_i, obviously depends on the particular survey question that is being considered. Several types of questions are currently in use in various surveys, broadly grouped into two general categories: life evaluations, and questions aimed at emotional states or moods. What is key for the construction of SWB_{share} is a focus on overarching SWB measures that are intended to capture broad evaluations about life in general. Questions regarding specific aspects of life (e.g. satisfaction with the freedom to choose how to live one's life, satisfaction with the educational system, satisfaction with the quality of air, etc.) do not adequate reflect life in general. Questions about levels of happiness are also inadequate because they tend to elicit more hedonic evaluations that depend heavily on current (or recent) mood. The general consensus is that life satisfaction measures are the better choice when dealing with questions of national development. Helliwell and Barrington-

Leigh (2010) conclude that life satisfaction measures "are more reflective of overall and continuing life circumstances and hence are more suited to capture long-term and international differences in policies and institutions" (p. 732).

Response scales vary widely, typically from 4-point scales to scales spanning 11 points. Although no universal standard exists, it is generally accepted that questions with higher response resolution are more likely to reflect the broad well-being information more relevant for studies of national development. The current paper focuses on reported life satisfaction recorded on a 10-point scale (the exact measure is defined in Section 4). For a more detailed summary of the various SWB questions and scales used in a variety of surveys see Diener (1994).

3 Relevant Literature

Initial studies of national SWB focused on the simple relationship between income and SWB (Easterlin, 1974). These were soon followed by a growing body of literature encompassing various objective accounts of well-being, including development measures beyond income-based indicators, such as life expectancy, educational attainment, health indicators, female labour participation, economic and political freedoms, to name a few (Blanchflower and Oswald, 2005; Deaton, 2008; Lawless and Lucas, 2011; Leigh and Wolfers, 2006; Ovaska and Takashima, 2006).

The literature outlined above is centred around mean measures of SWB. While (Easterlin, 1974) does take into account some distributional considerations[1], its main cross-country result is based on average happiness, as are subsequent studies concerned with national SWB, including Easterlin's more recent work on the happiness paradox (Easterlin et al., 2011) and Stevenson and Wolfers's treatment of Easterlin's findings (Stevenson and Wolfers, 2008).

Some notable exceptions are the 'happy life expectancy' measure proposed by Veenhoven (1996) and a measure of satisfaction with life that is not explained by personal characteristics (Di Tella et al., 2001). The former is defined as the product of standard life expectancy and average happiness (standardized on a 0-1 scale); the latter is the average of the residuals obtained by regressing individual-level life satisfaction on personal

[1] Summary statistics of the distribution of SWB are considered, but only for happiness questions with qualitative scales involving limited categories (e.g. 'very happy', 'fairly happy', 'not very happy')

characteristics. These measures show more sophisticated alternatives for aggregating self-reported well-being, but they nevertheless rely on average SWB and are utilitarian in nature.

The sole direct reference (to the best of this author's knowledge) to the use of a headcount measure of national SWB can be found in Helliwell and Huang (2008), which briefly mentions using "the share of respondents above or below particular cut-off points in the numerical distribution of responses" (p. 609). The aim of the paper is to assess the effect of the quality of government on national life satisfaction. As such, the share is used as a robustness check for differences in the shape of the distribution of satisfaction responses due to cultural differences. This differs in intent from the current study, which aims to explicitly consider the headcount measure as an indicator of aggregate SWB. Helliwell and Huang (2008) find no significant changes in the key findings when using the share measure, but the relevant results are not reported in the publication, and no specific cut-offs are discussed.

To reiterate, SWB literature relies heavily on simple average measures, lacking consideration for alternative non-utilitarian approaches to national SWB. Non-mean based aggregation procedures, such as the headcount measure of the share of satisfied individuals proposed in this paper, have only been used for simple descriptions of datasets (e.g. Oswald, 1997), but not as key measures of interest in international accounts of development.

4 Data

4.1 Sources

The analysis dataset used here has been composed using multiple sources since no single source contains the relevant measures. SWB data are self-reported life satisfaction information collected by the World Values Survey (WVS) and the European Values Survey (EVS). Respondents are asked "*All things considered, how satisfied are you with your life as a whole these days?*" and are instructed to choose a number between 1 to 10, where 1 is labeled "dissatisfied" and 10 is labeled "satisfied"[2]. The distribution of life satisfaction responses is shown in Table 1. The sample ranges from underdeveloped to fully industrialised economies, and represents all continents and major sub-regions. Two measures of national

[2] Except for wave 2005-2007 of the WVS in which 1 means "completely dissatisfied" and 10 means "completely satisfied".

SWB are calculated using the individual-level survey data: the commonly used mean satisfaction (SWB_{mean}), and the proposed alternative headcount measure (SWB_{share})[3].

Table 1. Distribution of life satisfaction responses

Overall Life Satisfaction	1999-2004		2005-2010	
1 - Dissatisfied	5,563	5.50%	4,888	3.31%
2	4,264	4.21%	3,369	2.28%
3	5,843	5.78%	6,712	4.54%
4	5,869	5.80%	7,629	5.16%
5	15,148	14.97%	17,958	12.15%
6	10,150	10.03%	15,037	10.17%
7	13,441	13.29%	22,655	15.33%
8	16,528	16.34%	31,336	21.20%
9	10,800	10.68%	17,454	11.81%
10 - Satisfied	12,479	12.33%	19,235	13.01%
no information	1,085	1.07%	1,535	1.04%

Source: WVS (2009), EVS (2011)

Note: sampling weights applied.

The key objective measures of development used are the individual components making up the current formulation of the Human Development Index (HDI): per capita Gross National Income (GNI), life expectancy, mean years of schooling, and expected years of schooling. The measures, defined in Table 2, are obtained from the online database maintained by the United Nations Development Programme (UNDP, 2013)[4].

Matching satisfaction to the objective measures of interest by specific year is not possible since the Values Surveys are conducted in waves that span multiple years. Additionally, yearly UNDP data are not available prior to 2005. However, it is possible to construct two waves of UNDP data corresponding to the two waves of available Values Surveys, as illustrated in Figure 1.

Values for each wave can be obtained by averaging across the five years in the relevant period, or by choosing one representative year. Period-averages of the objective indicators produce results that reflect a more long-term relationship with subjective measure (McGillivray, 2005). The current study is concerned mainly with international comparisons and therefore with fundamental differences in the economic organization of the countries,

[3] Detailed in Subsection 4.2.

[4] Available online at http://hdr.undp.org/en/statistics/data/ (accessed on Sept. 4, 2012). UNDP does not directly collect data; their database is constructed using various sources (list of sources available at http://hdr.undp.org/en/statistics/understanding/sources/).

which are by definition slow to change, so measures capturing a long-term trend are ideal. Yearly UNDP data are available for the 2005-2010 period so the second wave is constructed using averaged values. Prior to 2005, most measures obtained from UNDP's online database are available only for year 2000, so the first wave of matched data is constructed using year 2000 values for the objective indicators. The matching generates an unbalanced panel of 141 total country-wave observations including 90 countries. Summary statistics for the analysis dataset are presented in Table 3 – the data exhibit good variation, all measures cover a wide range and have a relatively strong deviation from the mean.

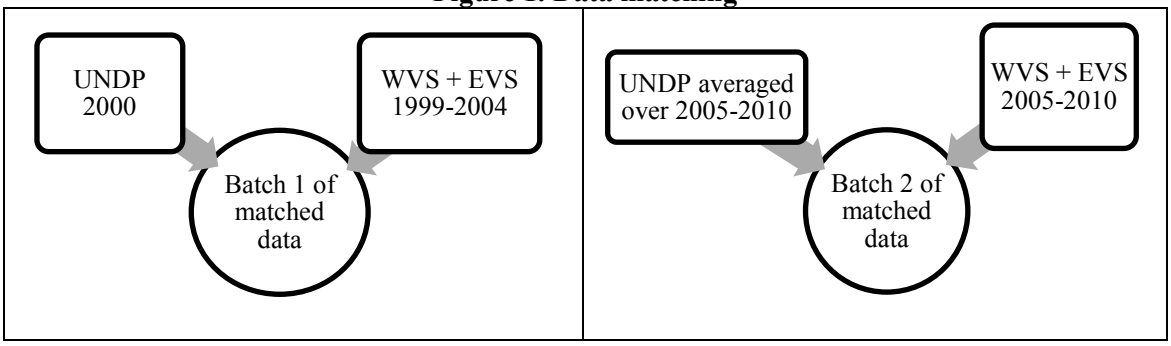
Table 2. United nations development indicators

Measure of Interest	Definition	Years of Coverage
GNI per capita	Aggregate income of an economy generated by its production and its ownership of factors of production, less the incomes paid for the use of factors of production owned by the rest of the world, converted to (constant 2005) international dollars using purchasing power parity (PPP) rates, divided by midyear population.	2000, 2005-2010
Life expectancy at birth	Number of years a newborn infant could expect to live if prevailing patterns of age-specific mortality rates at the time of birth stay the same throughout the infant's life.	2000, 2005-2010
Expected years of schooling	Number of years of schooling that a child of school entrance age can expect to receive if prevailing patterns of age-specific enrolment rates persist throughout the child's life	2000, 2005-2010
Mean years of schooling	Average number of years of education received by people ages 25 and older, converted from education attainment levels using official durations of each level.	2000, 2005-2010

Source: UNDP (2011)[5]

Note: Adult literacy rate and gross enrolment were used to calculate the education component of HDI until 2010; expected and mean years of schooling have been used since 2011.

Figure 1. Data matching



[5] The 2011 UNDP Human Development Report is available online at http://hdr.undp.org/en/media/HDR_2011_EN_Complete.pdf.

Table 3. Measures of interest, summary statistics

	mean	st. dev.	minimum	maximum	observations
mean satisfaction (ranges 1-10)					
1999-2004	6.49	1.13	3.87	8.24	63
2005-2010	6.86	0.90	4.46	8.36	78
total	**6.69**	**1.02**	**3.87**	**8.36**	**141**
transformed mean satisfaction (ranges 0-1)					
1999-2004	0.61	0.13	0.32	0.80	63
2005-2010	0.65	0.10	0.38	0.82	78
total	**0.63**	**0.11**	**0.32**	**0.82**	**141**
share of satisfied individuals (ranges 0-1)					
1999-2004	0.80	0.15	0.39	0.98	63
2005-2010	0.85	0.11	0.54	0.98	78
total	**0.83**	**0.13**	**0.39**	**0.98**	**141**
per capita GNI (PPP constant 2005 $)					
1999-2004	14,100	12,417	608	53,204	63
2005-2010	17,548	13,244	809	53,763	78
total	**16,454**	**12,894**	**608**	**53,763**	**141**
life expectancy (years)					
1999-2004	71.90	7.68	44.70	81.20	63
2005-2010	73.81	7.70	46.94	82.86	78
total	**72.95**	**7.72**	**44.70**	**82.86**	**141**
mean years of schooling					
1999-2004	8.38	2.43	3.30	13.00	63
2005-2010	9.04	2.70	1.30	12.66	78
total	**8.74**	**2.59**	**1.30**	**13.00**	**141**
expected years of schooling					
1999-2004	13.20	2.78	5.40	18.00	63
2005-2010	13.82	2.64	5.64	18.00	78
total	**13.54**	**2.72**	**5.40**	**18.00**	**141**

Source: WVS (2009), EVS (2011), UNDP (2013)

Note: satisfaction statistics computed using raw data with no sampling weights applied.

4.2 Controlling for Cultural Differences

Cultural norms and social systems vary widely across nations and they can be systematically and significantly related to individuals' assessment of their own life satisfaction. A concern is that many cultural dimensions tend to be highly correlated with the standard objective measures of well-being used in this study, especially with income (e.g. individualistic, democratic countries also tend to be the richest and most developed).

Cross-national studies usually attempt to control for cultural differences by setting apart countries or regions with particularly distinctive characteristics. Deaton (2008) includes separate indicator variables for eastern European and sub-Saharan countries. Ovaska and Takashima (2006) single-out Asian countries and also include religion controls for Islam and Christianity. However, these measures ignore a great deal of cultural variation likely to impact on the relationship between national SWB and objective measures of development.

A more comprehensive way to control for cultural difference can be obtained from the work of Inglehart and Welzel (2010), who have created a two-dimensional cultural map of the world using information from the WVS and EVS. Nations are scored along a traditional vs. secular-rational value scale, and also along a survival vs. self-expression value scale. Both scales revolve around zero so that cultures that emphasize traditional and survival values are assigned negative scores, while those with emphasis on secular-rational and self-expression values are given positive scores. Figure 2 shows the position of each country in the sample along these two cultural dimensions. Cultural profiles vary greatly across the nations in the sample, spreading across much of the bi-dimensional value plane.

Country scores are averages of the available scores from wave 1999-2004 and waves 2005-2010 (i.e. if scores are available for both waves, then the average is used, otherwise a single score value is used)[6]. This ensures that all countries in the sample are assigned one score (for each dimension) that does not change over time[7].

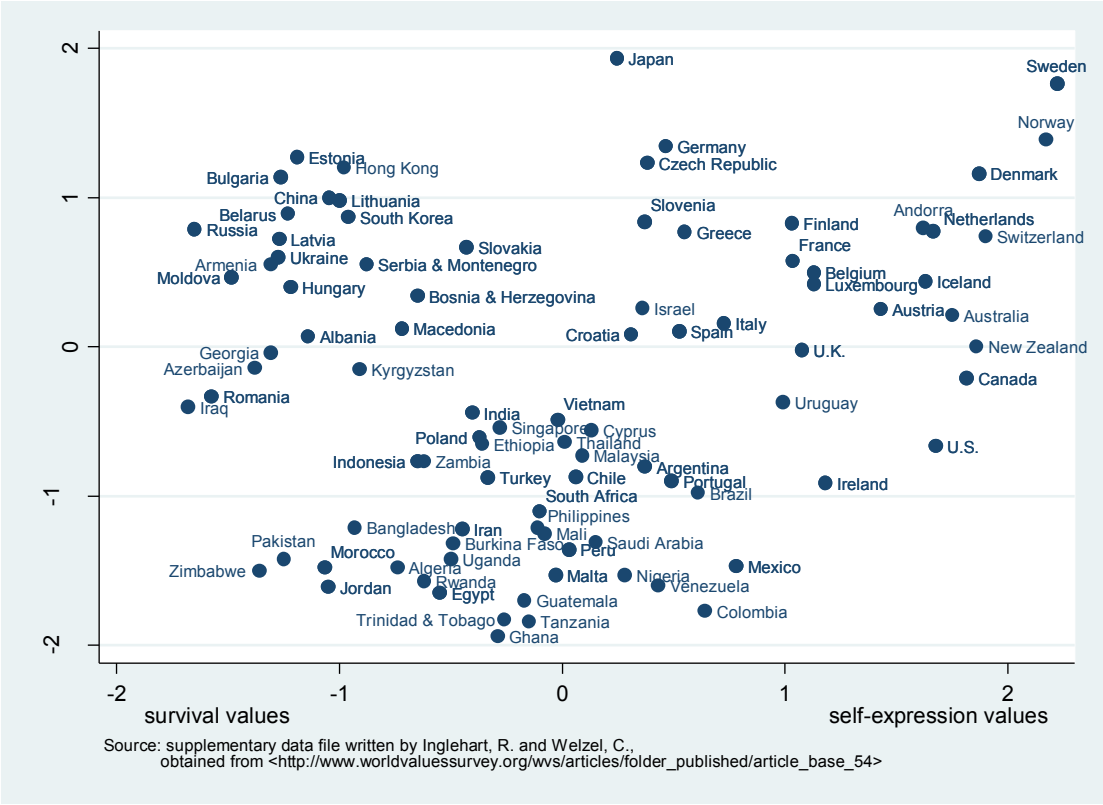
There are several advantages to using the Inglehart-Welzel indices to control for cultural effects. Firstly, they are directly relevant to the SWB data used here given they are themselves based on information collected by the WVS and the EVS. Secondly, they are systematically constructed using Factor Analysis of responses to questions explicitly designed to capture cross-national differences in value-systems and to gain a better understanding of cultural distinctions. Lastly, the two dimensions provide simple, reduced-form controls that capture wide-ranging aspects of values and beliefs.[8]

[6] Except for Armenia, Azerbaijan, Georgia, and Uganda, for which no score data are available between 1999-2010. Earlier information prior to 1999 is used for these countries.

[7] The decision to average across both time-periods for those countries for which both data points are available was made because few countries are given scores in both time periods and also to reduce bias stemming from large differences in cultural profiles for countries that significantly change their values and attitudes between wave 1 and 2.

[8] Detailed information regarding the variables used to construct the two dimensions and their correlations is available online as a supplementary material to Inglehart and Welzel (2010) at http://journals.cambridge.org/pps2010020.

Figure 2. Cultural map (1999-2010 average)



Source: supplementary data file written by Inglehart, R. and Welzel, C., obtained from <http://www.worldvaluessurvey.org/wvs/articles/folder_published/article_base_54>

4.3 Construction of SWB_{share}

The cut-off point, *z*, from Equation (1), which separates those who are satisfied from those who are not is motivated by dissonance theory (Akerlof and Dickens, 1982) using a data-driven approach. Dissonance occurs when our view of ourselves does not match reality. In the case of SWB, we would like to think of ourselves as being happy/satisfied, at least on some basic acceptable level. To uphold this view of oneself as satisfied in order to reduce any potential dissonance, there might be a strong resistance against admitting a less than acceptable level of satisfaction for those who experience very low levels of well-being. There is a clear break-point observed in the Values Surveys data that may be a manifestation of dissonance theory, separating those who are so below the acceptable threshold that they cannot overcome the instinct to deny that they are indeed not within the acceptable bound of happiness.

As shown in Table 1, satisfaction levels of 5 or higher are consistently more prevalent than levels below 5, suggesting a marked reluctance to report below 5. It is sensible to imagine that these individuals require special attention and could therefore be classified as

that group which is not sufficiently satisfied. Level 5 is interpreted as the lowest point at which people are sufficiently satisfied. The alternative share measure is therefore formally defined as:

$$SWB_{share} = \frac{1}{n}\sum_{i=1}^{n} \theta_i I(s_i \geq 5) \tag{2}$$

where s_i is individual i's life satisfaction response ranging from 1 to 10, $I(.)$ is an indicator function that takes on a value of 1 if individual i has indicated a satisfaction level of 5 or higher, and 0 otherwise, and θ_i is respondent i's sample weight that is included in order to obtain results representative of the whole population.

5 Econometric Model

5.1 Conventional Linear Baseline Model

The baseline econometric model that is commonly used to explore the relationship between objective and subjective indicators of well-being is expressed as:

$$SWB_i = \alpha + \beta X_i + \varepsilon_i, \quad i = 1, \dots, N \tag{3}$$

where SWB_i is usually average life satisfaction for country i, but can also be an alternative measure such as mean happiness or annual change in life satisfaction (Easterlin, 2013), and X is a vector of objective well-being measures[9].

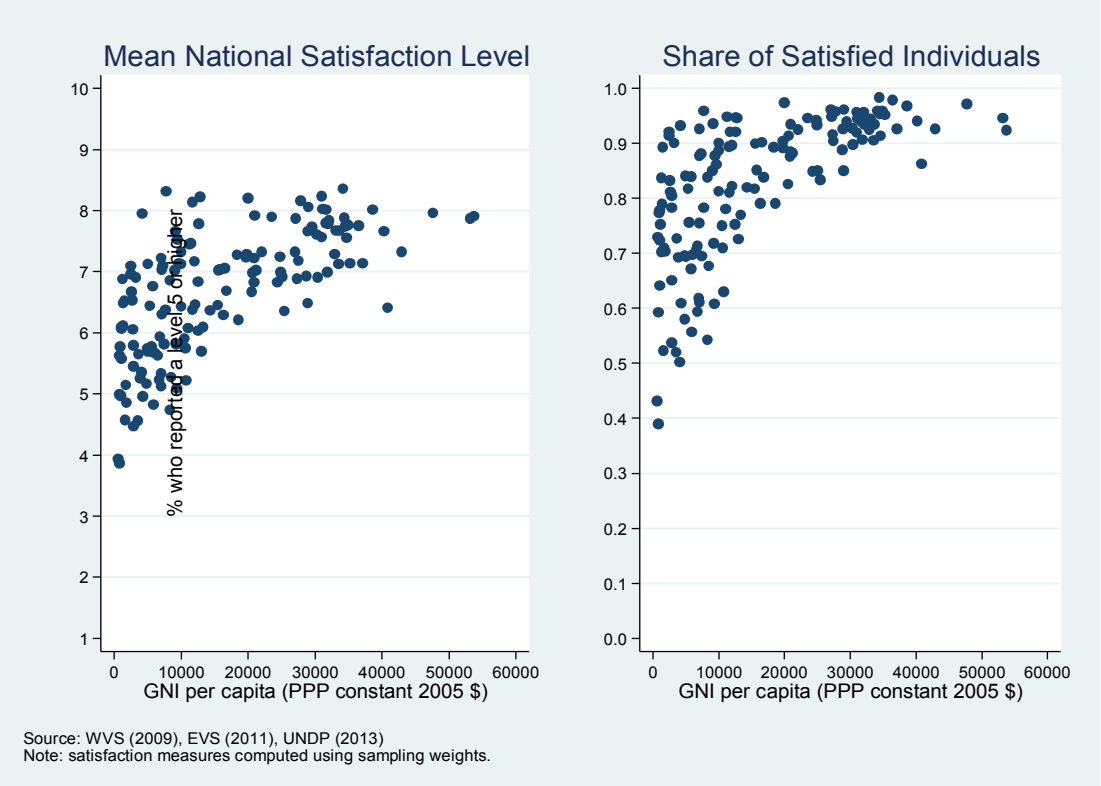
Using the data described in Section 4, the following baseline model can be estimated using Ordinary Least Square (OLS):

[9] Typically, this simple model is applied to cross-sectional data obtained from one single survey wave because of limited availability of historical data (e.g. Leigh and Wolfers, 2006); in some cases a cross-section is constructed by averaging across a number of waves to minimize seasonal deviations from the long-term trend (Ovaska and Takashima, 2006). One of the most sophisticated studies using this simple model is presented by Stevenson and Wolfers (2008), who use a wide range of data sources and waves to analyze both cross-section and panel datasets. See Table A1 in the Appendix for a summary of relevant econometric models and data used in previous studies.

$$SWB_{it} = \alpha + \beta_1 \ln(Y_{it}) + \beta_2 X_{it} + \beta_3 T + \beta_4 Z_i + \varepsilon_{it}, \quad i = 1, \dots, N, \quad t = 1, 2 \quad (4)$$

where SWB_{it} is aggregate life satisfaction (i.e. mean or headcount measure) in country i at time period t; Y is per capita GNI; X is the vector of HDI components, T is a time-trend indicator that equals 1 for observations in the second wave and 0 for observations in the first wave, and Z contains the Inglehart and Welzel cultural indices. Income is logarithmically transformed because it is generally accepted that the relationship between income and SWB is better captured by a logarithmic scale (Helliwell, 2003). Figure 3 demonstrates that the data used in the current analysis follow this pattern.

Figure 3. Aggregate satisfaction and per capita GNI, all countries (both waves combined)

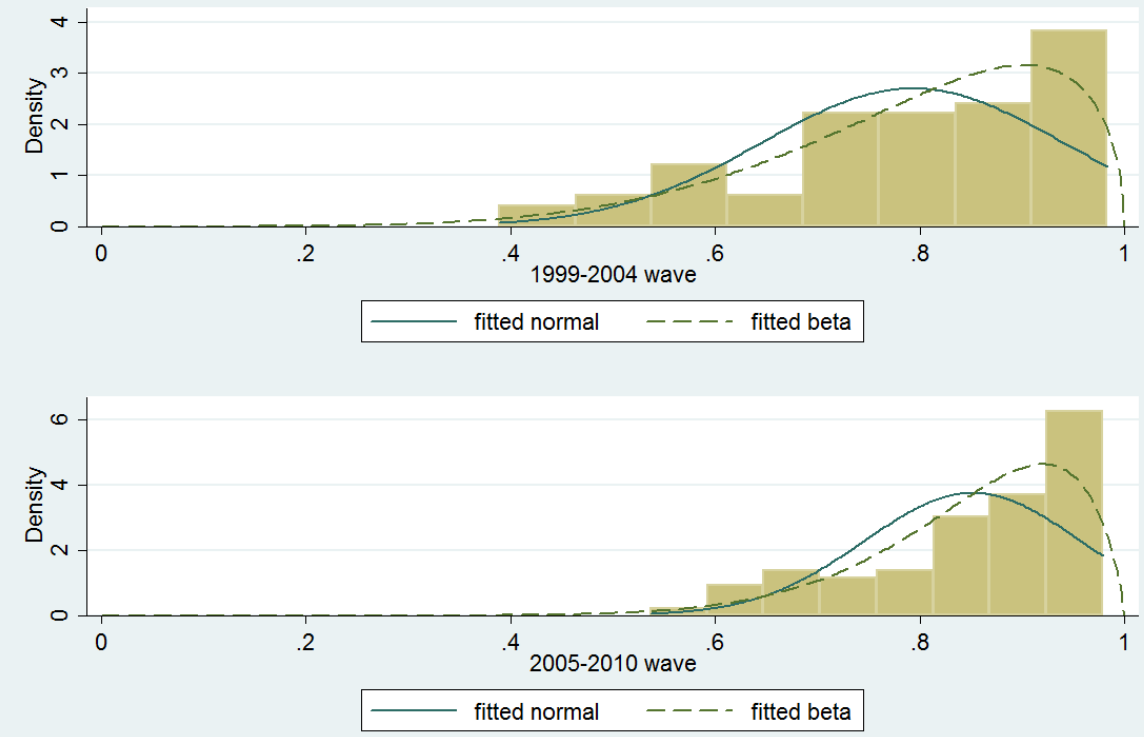


5.2 Beta-regression

However, the bounded structure of both SWB_{share} and SWB_{mean} means that OLS may not be the preferred method to estimate the relationship between national satisfaction and the objective indicators of interest because it can produce fitted values that are outside these bounds. Furthermore, looking at the distribution of the proportion of satisfied individuals in

Figure 4, we can see that it is left-skewed in each of the two waves, with most countries concentrated at the upper end of the distribution and long left tails – the fitted normal distribution (assumed in OLS regression) is not a good representation of the sample data.

Figure 4. Distribution characteristics of the proportion of satisfied individuals (by wave)



Source: WVS (2009), EVS (2011)
Note: measures computed using sampling weights.

Ferrari and Cribari-Neto (2004) and Smithson and Verkuilen (2006) independently propose a Beta-regression model with a Logit link function that is more appropriate for skewed, naturally bounded dependent variables. The Beta-regression model can be expressed as follows:

$$E(SWB|W) = \frac{e^{W\beta}}{1 + e^{W\beta}} \tag{5}$$

where $E(SWB|W)$ is the conditional mean of the relevant SWB measure, W is a matrix that includes all explanatory and control variables (denoted by Y, X, T, and Z in Equation (4)), and β is a matrix of parameter vectors (denoted by α, β_1, β_2, β_3, and β_4 in

Equation (4)). SWB is assumed to be Beta-distributed and estimated using Maximum Likelihood. The Beta function allows great flexibility in modelling asymmetric distributions, and Beta models perform well with small datasets (Kieschnick and McCullough, 2003), which is the case here. Panel-robust standard errors control both for heteroskedasticity and serial correlation within countries.[10]

Equation (5) requires the dependent variable to be continuous and constrained on (0, 1). While the share of satisfied individuals naturally falls in this interval, mean satisfaction does not and is instead defined on (1, 10). This can easily be corrected by a simple transformation. The transformed variable, SWB', is obtained thusly: $SWB' = (y - a)/(b - a)$, where a and b are the theoretical boundaries on (a, b), not the minimum and maximum observed in the sample, which in this case are (1, 10). The presentation and discussion of results focuses on this transformed measure of the mean, but equivalent estimates that are interpretable in terms of the original mean satisfaction scale are also provided in the Appendix (see Table A4).

5.3 Hypotheses

It is not meaningful to compare the magnitude of marginal effects between models using the share of satisfied individuals and models using mean satisfaction. Even if the two estimates are exactly the same, one might still be interested in the effect of income on the share of satisfied individuals, independently from the effect on mean satisfaction. An example may help to clarify this[11]. Let per capita GNI increase by $1,000 and let $\beta_1^{mean} = \beta_1^{share} = 0.05$. The estimated increase in mean satisfaction would be 0.45. The corresponding increase in the share of satisfied individuals would be 0.05. The change in mean satisfaction, though seemingly larger, does not necessarily capture any information regarding those individuals

[10] Given the panel structure of the data, a Fixed-Effects (FE) was considered. However, it is not clear that a FE approach would be appropriate in this context. While minimizing bias, it is inefficient, and especially so given the panel is unbalanced. Furthermore, it is difficult to obtain consistent FE estimates in non-linear specifications such as the Beta-regresssion model proposed here (Cameron and Trivedi, 2009, p. 232). Consistency is also problematic in short panels (Cameron and Trivedi, 2009, p. 231). This problem is amplified here due to the panel being unbalanced with a considerable portion of countries appearing only in one of the waves. Of the total 90 countries included in the analysis, 12 only appear in the 1999-2004 wave and 27 only appear in the 2005-2010 wave, which leaves only 51 countries with enough information to compute the average values necessary for the FE estimators. Lastly, FE models are not a good choice when within-unit variance is much smaller than between-unit variance (Cameron and Trivedi, 2009), which is the case here (see Table A2 in Appendix).

[11] For simplicity, this example assumes a linear model with constant point-estimates, but a similar argument applies to the variable estimates produces by the Beta-regression.

who are not sufficiently happy (driven by changes in the upper distribution of satisfaction responses), whereas the share of satisfied individuals does so directly. A parallel argument applies even if the estimated increase in mean satisfaction is exactly the same as the estimated increase in the share of satisfied individuals (i.e. β_1^{mean}= 0.0056 and β_1^{share} = 0.05). However, while comparisons of magnitude such as " β_1^{mean} is significantly different (or not) from β_1^{share} " are not meaningful, some comparisons can provide useful insights into the objective-subjective relationship. For example, if β_1^{share} is found to be statistically significant while β_1^{mean} is not, this can indicate an important contrast in the adoption of potential policies and initiative. Analysis relying on mean measures would likely prescribe no interventionist policies since they are estimated not to affect overall national well-being, while the adoption of the share measure would encourage initiatives aimed at raising per capita income. Discussion of the results in Section 6 will therefore not directly compare magnitudes of the estimates, but will note interesting differences in significance levels.

The emphasis will instead lie on the objective-subjective relationship as estimated using the proposed headcount measure of SWB. More precisely, the purpose is to assess the relevance of standard objective indicators of development in light of information contained within subjective indicators of development, and to do so with consideration for a suitable econometric model.

Expected school years and mean school years are both expected to be significantly associated with national satisfaction. In standard economic theory, education measures are positively linked to increased welfare because they lead to higher wages. However, this does not guarantee a positive relationship between education measures and national SWB. In Happiness Economics, welfare is not a direct outcome of income. In fact there is evidence of a negative relationship between SWB and education. Blanchflower and Oswald (2005) find a negative link between literacy rate and life satisfaction at the individual level, but only in Australia. Their full sample of 35 nations estimates a positive relationship. This suggests that there may be considerable variation in the way populations react to gains in knowledge. Overall, one would expect that access to basic public education is more important in countries where a large portion of the population is poor and unable to pay for education. Bjornskov et al. (2008) also suggests that the relationship between education and SWB is stronger in low-income countries.

As a metric of basic health, life expectancy should be seen to have a positive relationship with reported SWB. However, life expectancy is a crude measure and likely

captures many aspects of life outside basic health. If current SWB (i.e. at time of reporting) contains not only current and past SWB but also expected future SWB, then life expectancy may negatively affect reported SWB in circumstances when a long life is associated with low expected future SWB. This may cancel out the positive relationship between basic health and reported SWB. Previous evidence is contradictory – Ovaska and Takashima (2006) find a positive relationship between life expectancy and life satisfaction, while Deaton (2008) estimate a negative link.

6 Results

Table 5 contains Beta-regression results in Panel 1. OLS results are provided in Panel 2 for completeness. Within Panel 1, models using the share of satisfied individuals as the dependent variable are denoted by '1' , and models using mean satisfaction are denoted by '2'. Letter 'a' identifies the basic specification that includes only the key measures of interest and a wave indicator, and letter 'b' identifies models with cultural controls. Reported values for the Beta-regressions are the marginal effects of regressors evaluated at the sample means of the regressors (i.e. marginal effects at means).

Comparing the fit of the different specifications using the Bayesian Information Criterion (BIC)[12], it is clear that Beta regressions are superior at explaining the variation in the proportion of satisfied individuals than the equivalent OLS specifications, but little difference in BIC values is observed for models using mean satisfaction. For ease of comparison with the Beta-regression models preferred for the share of satisfied individuals, mean satisfaction models are also estimated using a Beta-regression.

[12] BIC is used because it allows for comparison across models with different dependent variables and different structural specifications, whereas R^2 alternatives would allow only comparison of nested models. Following Kass and Raftery (1995), differences in BIC values that are less than 2 points constitute "very little" evidence to support the use of the model with the lower BIC value, while differences between 2 and 6 points constitute "some positive" evidence, differences between 6 and 10 constitute "strong" evidence, and differences larger than 10 present "very strong" evidence.

Table 4. Regression Results

dependent variable:	Panel 1: Beta-Regression (marginal effects at averages)				Panel 2: OLS (coefficients)			
	share of satisfied individuals		*mean satisfaction* [1]		*share of satisfied individuals*		*mean satisfaction* [1]	
	(1a)	(1b)	(2a)	(2b)	(3a)	(3b)	(4a)	(4b)
ln(GNI)	0.06141 ***	0.01712	0.06273 ***	0.02219 **	0.06921 ***	0.03260 *	0.06279 ***	0.02468 **
	(0.01625)	(0.01235)	(0.01478)	(0.01125)	(0.01916)	(0.01669)	(0.01520)	(0.01185)
life expectancy	0.00311 *	0.00373 ***	0.00265	0.00324 **	0.00407 *	0.00449 **	0.00267	0.00323 **
	(0.00171)	(0.00117)	(0.00169)	(0.00128)	(0.00239)	(0.00200)	(0.00180)	(0.00140)
average years in school	-0.02365 ***	-0.00948 *	-0.02005 ***	-0.00434	-0.02490 ***	-0.01302 **	-0.01941 ***	-0.00506
	(0.00543)	(0.00532)	(0.00473)	(0.00468)	(0.00593)	(0.00570)	(0.00475)	(0.00460)
expected years in school	0.01438 ***	0.00848	0.01303 ***	0.00704	0.01340 **	0.00761	0.01249 ***	0.00672
	(0.00465)	(0.00555)	(0.00439)	(0.00466)	(0.00520)	(0.00535)	(0.00437)	(0.00442)
wave dummy	0.02842 **	0.03420 ***	0.02512 **	0.02683 ***	0.03634 ***	0.03696 ***	0.02547 **	0.02511 ***
	(0.01212)	(0.01067)	(0.01077)	(0.00921)	(0.01212)	(0.01117)	(0.01064)	(0.00917)
index of traditional/ secular-rational values	–	-0.00847	–	-0.02231 **	–	-0.01220	–	-0.02184 **
	–	(0.00944)	–	(0.00924)	–	(0.00948)	–	(0.00887)
index of survival/ self-expression values	–	0.06827 ***	–	0.05799 ***	–	0.05225 ***	–	0.05335 ***
	–	(0.00860)	–	(0.00702)	–	(0.00889)	–	(0.00676)
BIC	-322.5	-385.9	-305.6	-367.8	-274.3	-306.2	-305.3	-362.6
Adjusted R^2					0.571	0.676	0.494	0.723
Observations	141	141	141	141	141	141	141	141

*** p<0.01, ** p<0.05, * p<0.1, panel-robust standard errors in parentheses.

Source: WVS (2009), EVS (2011), UNDP (2013), Inglehart and Welzel (2010).

[1] Mean satisfaction is transformed to fit on (0, 1).

All regressions include a constant term (not shown here).

Satisfaction measures calculated using sampling weights.

Overall, mean satisfaction models have lower BIC values than models using the share of satisfied individuals, which suggests that the proposed headcount measure performs better in explaining the complicated relationships between subjective and objective measure of well-being. This is a noteworthy finding in the context of the current study. The improved model fit is a promising indication that the share of satisfied individuals is more suitable for understanding the observed link between national SWB and objective indicators of development than the mean measure.

The basic model (column (1a)) shows strong associations between the share of satisfied individuals and all objective measures of development. The marginal effects of per capita GNI, average school years, and expected school years are all significant at the 1% level, while life expectancy is significant at the 10% level. The marginal effects remain similarly significant when mean satisfaction is used (model (2a)), with the exception of life expectancy, which become non-significant at standard levels.

Including the Inglehart and Welzel indices (models (1b) and (2b)) changes the results substantially when considering either the share of satisfied individuals or mean satisfaction. The index of survival vs. self-expression values is particularly strongly associated with both dependent variables (significant at the 1% level). This relationship is positive so countries that value self-expression over survival have a higher level of national SWB regardless of which aggregate measure of satisfaction is used. The index of traditional vs. secular-rational values has no significant relationship with the share of satisfied individuals but is significantly and negatively related to mean satisfaction. Furthermore, the inclusion of cultural controls improves BIC values substantially. Models (1b) and (2b) are the preferred specifications and further discussion will focus on these specifications.

Notably, the share of satisfied individuals tells a unique story about the objective-subjective relationship that is critically different from analysis that uses mean satisfaction – as can be revealed by considering the findings regarding income, life expectancy, education measures, and the time-trend, individually.

Income

The prominent role of income-based measures of development, both within and without economic studies, makes GNI a particularly important key measure of well-being. The effect of income is commonly found to be large and positive in cross-country analysis. And indeed, the relationship between income and mean satisfaction is positive and statistically significant

(column 2b). So perhaps the most surprising finding of this study is the non-significant relationship between income and the share of satisfied individuals in the preferred specification (column 1b). This result offers valuable insights that are not obvious in previous findings that focus only on mean satisfaction. The income-satisfaction relationship can be judged to be very different when national satisfaction is constructed to directly reflect the perceptions of the unsatisfied. For instance, these finding suggest evidence against the existence of trickle-down benefits – if trickle-down effects are strong then we would expect to see the same strong relationship between income and the share of satisfied individuals as we observe between income and mean satisfaction, but we do not, implying that trickle-down effects are weaker than one might conclude from using only mean measures of SWB.

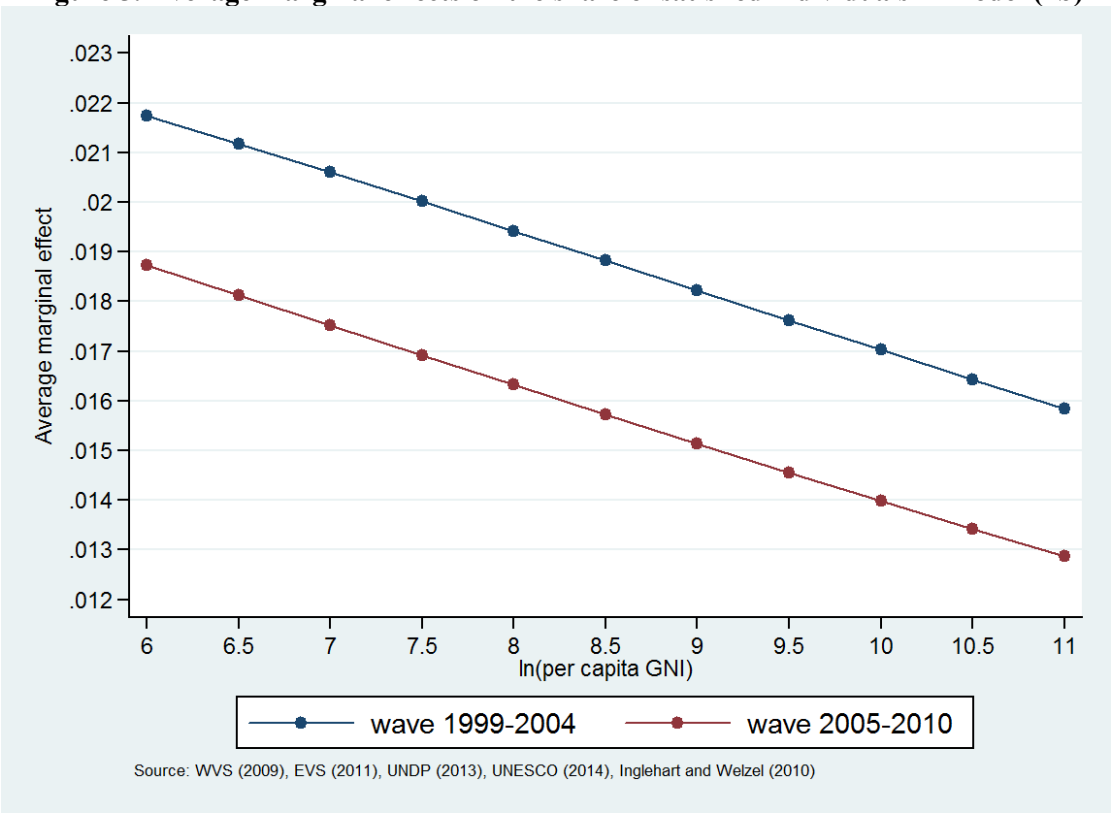
It is important to note that per capita GNI has been transformed by taking its natural log. The results are therefore not directly interpretable in terms of the level of income. Instead, the coefficient shows the effect of a one-percent increase in per capita GNI. For example, an increase of $1,000 from the sample mean per capita GNI of $16,454 corresponds to a very small increase of approximately 0.1% in the share of satisfied individuals. Aside from this effect not being statistically significant, it is also much below the marginal effect of a one year increase in life expectancy from the mean of 73 years, which is associated with a significant increase of 0.37% in the share of satisfied individuals.

A closer look at the marginal effects of income provides additional insights regarding the much discussed income satiation point theory. It has been proposed that there exists a threshold level of income such that additional income increases well-being below this level, but no relationship between income and well-being exists above this point. This threshold may be relatively low, representing the amount of money required to secure a 'decent' standard of living. Frey and Stutzer (2002) find evidence that a threshold level exists at $10,000, while Layard (2003) places it at $15,000, though he more recently proposes $20,000 (Layard, 2011).

It is possible to explore the non-linearity of the Beta-regression in order to investigate such claims. Although the marginal effect of income on the share of satisfied individuals is non-significant, tracing the marginal effects path is nonetheless a worthwhile exercise for understanding the underlying patterns. Figure 5 shows the path of average marginal effects of ln(GNI) on the share of satisfied individuals calculated using model (1b) in each wave separately. There is no indication of a satiation point, but the average marginal effect of income does decrease as income increases with no sign of levelling off. It is also interesting

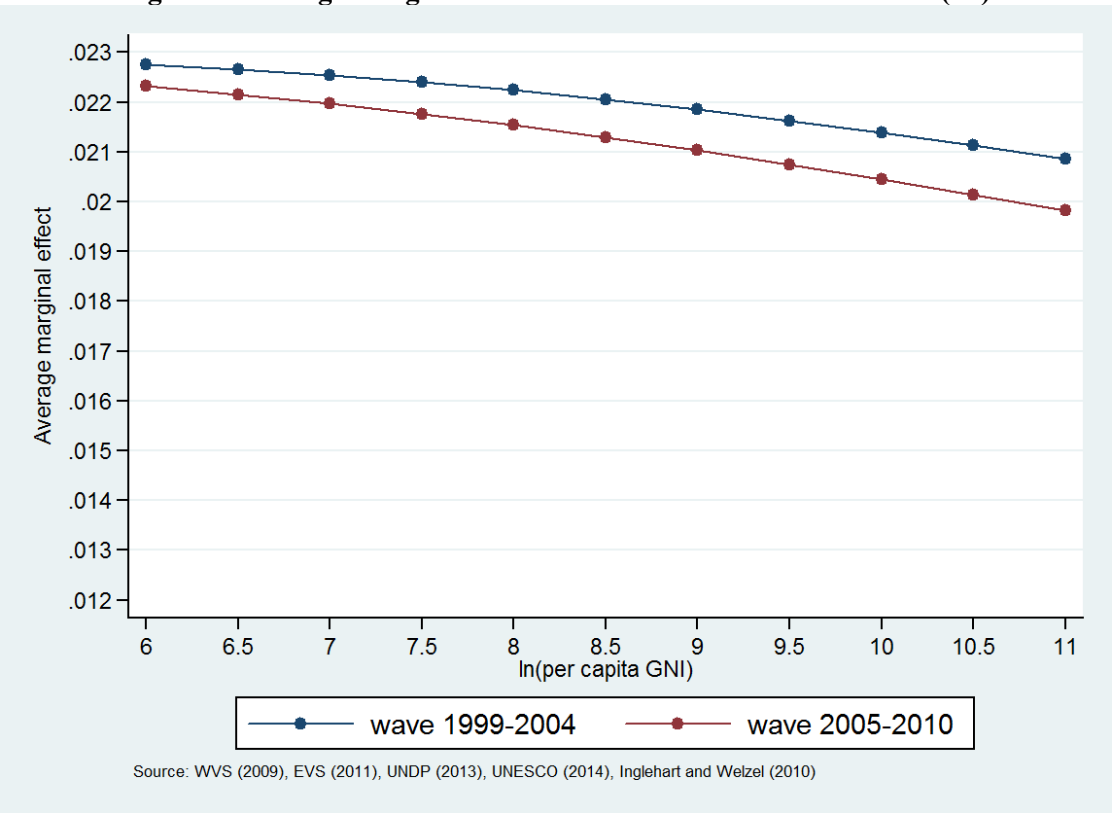
to note that the average marginal effect of income on the share of satisfied individuals is consistently lower in the second wave (2005-2010) compared to the first (1999-2004), suggesting that income is becoming a less important over time.

Figure 5. Average marginal effects on the share of satisfied individuals in model (1b)



The marginal effect of income also diminishes as income increases when mean satisfaction is used as the national measure of aggregate SWB (Figure 6). However, the decline is much less pronounced than that observed on the share of satisfied individuals (in both waves), indicating that the association of SWB and income is more sensitive to income levels than mean measures might suggest. As well, the path of the marginal effect on the share of satisfied individuals is consistently below that on mean satisfaction in both waves. Overall, mean measures tend to exaggerate the marginal effect of income on national satisfaction, especially for high income countries and to a lesser extent for low income countries.

Figure 6. Average marginal effects on mean satisfaction in model (1b)



Life Expectancy and Education Measures

Life expectancy is found to be positively associated with the share of satisfied individuals (which is significant at the 1% level) in Table 5. However, this is a relatively small effect with one additional year of life leading to a 0.37% increase in the share of satisfied individuals at the mean of the regressors (column (1b)). The magnitude of the effect is perhaps not surprising given that life expectancy is not a very good measure of health status. While the promise of a long life can improve satisfaction, the prospect of an old age full of hardship and health problems can dampen the positive effect. Life expectancy is also significantly positively associated with mean satisfaction (column (2b)).

Expected years in school has no significant effect either on the share of satisfied individuals, or mean satisfaction (columns (1b) and (2b)), but reducing average years in school by one year increases the share of satisfied individuals by approximately 0.95%. This is more than double the positive effect of life expectancy, but still relatively small considering that one year of schooling is a substantial increase in education when world mean is approximately 8.7 years and the highest level is 13 years of schooling. On the other hand, average years in schooling is not significantly associated with mean satisfaction, suggesting

that the relationship between education and SWB is relevant only at some crucial level of development (around the cut-off point), and much less so for very low or very high levels of development. In particular, the negative sign suggests that education may be detrimental when a certain level of development is achieved.

The negative relationship between mean years in school and the proportion of satisfied individuals raises questions about the role of education within a subjective well-being framework. It implies that adopting an account of progress based on SWB leads to policy conclusions that do not support investing in education. Objective accounts of well-being, on the other hand, tend to support improvements in access to education based on its positive influence on income, unemployment, health, etc. This discrepancy can be particularly detrimental for efforts to integrate SWB into accounts of well-being because it supports an unpopular development agenda that discourages education. However, there may be a more practical answer to this puzzle. These findings are consistent with rising expectations. A population that expects to achieve a high level of education is more likely to have increased expectations if people believe that better education will bring better opportunities. If opportunities are subsequently not available to fulfill these expectations, individuals are likely to feel less satisfied once they have achieved the higher level of education. This hypothesis resonates particularly well with the current economic conditions. A large portion of the educated youth of the more developed nations is underemployed and unhappy with their available employment prospects.

Including macro-level indicators as proxy measures for available opportunities supports the presence of an increased expectations effect. Table 6 shows Beta-regression results with added unemployment and inflation measures for both dependent measures[13]. The marginal effect of average years in school on the share of satisfied individuals is no longer significant, while unemployment and inflation are both significant and negatively associated with the share of satisfied individuals. These findings suggest that any potential benefits to education are closely linked to the availability of adequate post-education opportunities. However, unemployment and inflation are non-significant when using mean satisfaction as the dependent variable, indicating that mean measures of SWB overlook the importance of available opportunities.

[13] Both measures are obtained from the online World Bank Indicators database (WDI, 2014) and defined as : unemployed percentage of total labour force (national estimate), and GDP deflator (annual percentage).

Table 5. Beta-regression results (extended model)

dependent variable:	*share of satisfied individuals*		*mean satisfaction* [1]	
	(1)		(2)	
ln(GNI)	0.01564		0.02186	*
	(0.01193)		(0.01117)	
life expectancy	0.00332	***	0.00307	**
	(0.00126)		(0.00133)	
average years in school	-0.00886		-0.00415	
	(0.00564)		(0.00489)	
expected years in school	0.00972		0.00668	
	(0.00606)		(0.00489)	
wave dummy	0.03419	***	0.02852	***
	(0.01048)		(0.00943)	
index of traditional/ secular-rational values	-0.01150		-0.02242	**
	(0.00922)		(0.00932)	
index of survival/ self-expression values	0.06156	***	0.05783	***
	(0.00959)		(0.00767)	
unemployment	-0.00153	*	-0.00033	
	(0.00082)		(0.00096)	
inflation	-0.00142	**	-0.00041	
	(0.00056)		(0.00070)	
BIC	-373.4		-351.1	
Observations	138		138	

*** p<0.01, ** p<0.05, * p<0.1, panel-robust standard errors in parentheses.

Source: WVS (2009), EVS (2011), UNDP (2013), Inglehart and Welzel (2010), WDI (2014)

[1] Mean satisfaction is transformed to fit on (0, 1).

All regressions include a constant term (not shown here).

Satisfaction measures calculated using sampling weights.

Time-trend

It is interesting to note that the time trend dummy is strongly significant and relatively large in magnitude across all specifications. It is associated with a 3.4% increase in the share of satisfied individuals in the preferred specification (1b) and a 2.7% increase in mean satisfaction in specification (2b). The persistent positive time trend indicates that reported SWB is improving over time. This presents a somewhat optimistic outlook for the future of social progress. People seem to value their lives more, not just on average, but also there is a substantial upward shift in the lower end of the satisfaction distribution. While this does not help explain the process of improvement, it does suggest that we are moving toward a more developed world which is more valuable to individuals.

However, the wave coefficient may be biased due to the unbalanced structure of that data. If countries appearing only in the second wave are on average happier than countries appearing only in the first wave (all other regressors being held constant), β_3 will be biased upward. Both mean satisfaction and the share of satisfied individuals are on average higher for countries appearing only in the second wave, but so is average GNI, life expectancy, and all measures of education. It is difficult to assess the effect on β_3 by comparing means of the measures of interest.

Excluding the time-trend does not significantly change the point-estimates of the key measures of interest, which suggests that the positive relationship between income and national satisfaction is not driving this time-trend. As a further robustness check, regressions were repeated only for the subsample of countries that appear in both waves. The results support those obtained using the full sample (see Table A3 in the Appendix) – the time-trend remains very strongly significant and large for all equivalent specifications. The unbalanced structure of the panel does not appear to drive the strong positive time-trend.

7 Robustness Checks

Unbalanced Panel Issues

Unbalanced panels are common and can provide accurate estimates if the missing information is randomly distributed across the sample of relevant units. However, results can be skewed if missing observations are disproportionately associated with units that have distinctly different characteristics compared to the rest of the sample. Two common sources of unbalanced panels are attrition in respondents for surveys that follow the same individuals over a period of time, and shifting samples in rotating panel surveys. In this case, the missing information is not due to attrition (as macro-level panels do not rely on the retention of the same individuals, attrition is not generally applicable), and there is no clear intention from the part of the WVS and EVS for a systematic rotating panel design.

Although the time trend appears to be robust to the inclusion of the single-wave countries, missing observations can potentially bias the estimates of the key measures of interest. It is therefore important to further examine the characteristics of these 39 single-wave countries and how they behave relative to the rest of the sample. In general, the 12 countries appearing only in the first wave (call these group A) have on average lower values

of GNI, life expectancy, and education measures compared to the first wave observations of countries that appear in both waves (at 5% statistical significance). The same is observed for the 27 countries that appear only in the second wave (call these group B) when compared to the second wave observations of countries that appear in both waves. However, these differences are not necessarily problematic in this case because the countries are both lost and added to the sample[14]. As long as each separate wave contains a representative sample of countries, the random addition or loss of a group of countries should not skew the regression results. In other words, if group A is not significantly different from group B, the unbalanced structure of the dataset should not invalidate the results in Section 6.

T-tests reveal that all measures of interest are on average not significantly different between group A and B (at standard confidence levels), except for expected years of schooling (which is significant at the 10% level). This indicates that the addition and loss of countries across waves does not appear to change the sample properties (i.e. seemingly similar countries are lost and gained). However, countries in the two subsamples may still exhibit very different relationships between regressors and the satisfaction measures, which is enough to introduce bias in the estimates. Comparing the results of the full sample with those of the restricted subsample of countries that appear in both waves, as previously used to check the validity of the time-trend, is not particularly useful in this context. There is no doubt that groups A and B are different from countries that are surveyed in both waves, but this does not imply a skewed sample since the loss of group A can be offset by the addition of group B. The question is whether the addition of B is more or less equivalent to the loss of A. One way to test for this is to run separate regressions for each group and compare the resulting coefficients. While possible, the small sample sizes make it difficult to obtain consistent estimates. The future availability of additional waves will help settle this issue.

Data Comparability within Second Wave

There may be some concern about the general data comparability across the period covered by the second wave, as some countries are surveyed prior to 2008 by WVS, while others were surveyed after the onset of the recession by EVS. If SWB is affected by the recession, aggregate measures of SWB in countries surveyed before 2008 may not be comparable with measures for countries surveyed after.

[14] In a standard individual-level survey where attrition over time is the sole source of incomplete information, these differences would cause relatively more concern over the validity of results.

It is possible to explore the implications of this split sample using a subset of 20 countries surveyed by both initiatives in wave 2 using simple two-sample t-tests for the difference in the level of aggregate satisfaction between samples collected between 2005-2010 and those collected between 2008-2010. The results in Table 7 reveal that the share of satisfied individuals is significantly different between the EVS and WVS samples for 15 of the 20 nations, and mean satisfaction is significantly different for 13 nations, with both positive and negative differences. However, it is difficult to interpret these results as indicative of a recession effect because the changes observed by the t-tests may be caused by corresponding changes in other factors that are unaccounted for.

Table 6. T-tests for differences in aggregate SWB between EVS and WVS samples for countries surveyed under both initiatives in wave 2†

	difference in mean satisfaction			difference in share of satisfied individuals		
Bulgaria	0.611	(0.104)	***	0.073	(0.020)	***
Cyprus	-0.008	(0.097)		-0.017	(0.013)	
Finland	-0.115	(0.080)		-0.008	(0.011)	
France	0.172	(0.082)	**	-0.011	(0.013)	
Georgia	0.528	(0.088)	***	0.098	(0.016)	***
Germany	-0.028	(0.069)		-0.026	(0.011)	**
Great Britain	-0.101	(0.074)		-0.060	(0.010)	***
Italy	0.256	(0.080)	***	-0.034	(0.012)	***
Moldova	1.138	(0.097)	***	0.135	(0.018)	***
Metherlands	0.257	(0.054)	***	0.003	(0.005)	
Norway	0.149	(0.074)	**	-0.015	(0.008)	*
Poland	0.187	(0.087)	**	-0.008	(0.013)	
Romania	1.028	(0.090)	***	0.105	(0.015)	***
Russian Federation	0.429	(0.088)	***	0.036	(0.015)	**
Slovenia	0.301	(0.083)	***	-0.019	(0.010)	*
Spain	-0.005	(0.064)		-0.036	(0.009)	***
Sweden	-0.112	(0.084)		-0.055	(0.012)	***
Switzerland	0.002	(0.071)		-0.031	(0.009)	***
Turkey	-0.958	(0.087)	***	-0.137	(0.013)	***
Ukraine	0.410	(0.111)	***	0.070	(0.021)	***

† t-test conducted using sample weights (a positive point estimate indicates an increase in aggregate SWB from 2005-2007 (the WVS sample) to 2008-2010 (the EVS sample)

standard errors in parantheses

Source: WVS (2009), EVS (2011)

*** p<0.01, ** p<0.05, *p<0.1

To gain further insight, a Chow test is performed on the baseline OLS model to see how the estimates compare between the subsample of countries with WVS data and those surveyed only after the recession by EVS. The test reveals that the subsamples are significantly different at the 5% level (both when using mean satisfaction and share of satisfied individuals), which is consistent with the above t-test results.

This issue can be further addressed by regressing aggregate satisfaction on income and life expectancy[15] using only the subset of countries that are surveyed both by EVS and WVS in the second wave. The subsample dataset consists of 18 countries[16] which are surveyed both in 2005-2007 and 2008-2010, 15 of which are also surveyed in 1999-2004. The use of the three periods allows for the estimation of a time trend before and after the recession, which helps to give relative meaning to the changes in satisfaction observed after the onset of the recession.

Using countries that appear in all three time-periods, the data consist of a balanced panel with 45 country-period observations. Though this is a small subsample, it does help to get a more in-depth impression of the impact of the recession. Assuming that this is a sufficiently representative sample[17], these results imply that the data are reasonably comparable across the countries in wave 2.

Pooled OLS using mean satisfaction as the aggregate measure of SWB shows an overall positive time trend, but this effect is much more pronounced and significant (at the 1% level) when moving from 1999-2004 to 2005-2007 than the positive time effect moving from 2005-2007 to the post-recession period (which is much lower in magnitude and significant only at the 10% level). In contrast, a non-significant time-trend is observed when the share of satisfied individuals is used. These findings indicate the existence of a negative recession effect on mean satisfaction, but not on the share of satisfied individuals.

[15] Literacy rate and school enrolment rate are not used here because data are not available in all time-periods of interest. In most instances, literacy and enrolment information is only available for one or two years between 2005 and 2010, with no data either in the first half of this period or the latter half.

[16] Note that there are only 18 countries instead of the 20 used for the t-test analysis. This is because income and life expectancy data are not available for Cyprus and Great Britain as separate from Northern Cyprus and Northern Ireland.

[17] The subset contains countries that have been very much affected by the recession, as well as countries representing both developed, developing, and former communist economies. It is therefore reasonable to conclude that the working sample is representative.

8 Concluding Remarks

This paper follows previous cross-country studies using regression analysis to explore the link between national SWB and objective indicators of development. It aims to contribute to the better understanding of this relationship in order to help inform future development policy. It offers new insights into the measurement of SWB by introducing a new headcount measure, and adopting a Beta-regression approach. We find the headcount measure is an improvement over the commonly used mean measures of satisfaction.

A principal finding is that the proportion of satisfied individuals is not significantly associated with per capita GNI, in contrast to the strong positive relationship between mean satisfaction and income that is frequently established in cross-country studies of SWB. This finding does not invalidate the observed relationship between mean satisfaction and income, but reveals the importance of the aggregation approach used to measure national SWB and its implications for development policies. In light of this result, we should be skeptical about the benefits of raising per capita income without considering distributional issues and other more significant factors of SWB.

The Beta-regression model improves the goodness-of-fit over the standard OLS models when using the share of satisfied individuals due to the asymmetric density shape of satisfaction responses. An important advantage of using the non-linear Beta-regression model is that it can be used to assess non-constant links between SWB and objective measures, revealing crucial differences along the progression paths of key regressors of interest.

One concern regarding the use of threshold measures of SWB is their reliance on cut-off values. Since subjective scales are not based on a set, measurable standard, choosing appropriate cut-off values is challenging. We show that the data-driven approach motivated by dissonance theory provides a practical starting point, but further research can help establish the relevance of the chosen threshold by searching exploring the real-life meaning behind the data-driven threshold value. More generally, the analysis presented in this paper provides a starting point for research into a broader range of aggregate measures of SWB.

Bibliography

Akerlof, G. A. & Dickens, W. T. (1982). The Economic Consequences of Cognitive Dissonance. *American Economic Review,* 72**,** 307.

Bjornskov, C., Dreher, A. & Fischer, J. A. V. (2008). Cross-Country Determinants of Life Satisfaction: Exploring Different Determinants across Groups in Society. *Social Choice Welfare,* 30**,** 119-173.

Blanchflower, D. G. & Oswald, A. J. (2005). Happiness and the Human Development Index: The Paradox of Australia. *Australian Economic Review,* 38**,** 307-318.

Bond, T. N. & Lang, K. (2014). The Sad Truth About Happiness Scales. *NBER Working Paper Series No. 19950.* Cambridge, Massachusetts: National Bureau of Economic Research (NBER).

Bruni, L., Comim, F. & Pugno, M. (2008). *Capabilities and Happiness,* USA, Oxford University Press.

Cameron, A. C. & Trivedi, P. K. (2009). *Microeconometrics Using Stata,* Texas, Stata Press.

Crisp, R. (2003). Equality, Priority, and Compassion. *Ethics,* 113**,** 745-763.

Cummins, R. A., Eckersley, R., Pallant, J., Van Vugt, J. & Misajon, R. (2003). Developing a National Index of Subjective Wellbeing: The Australian Unity Wellbeing Index. *Social Indicators Research,* 64**,** 159-190.

Deaton, A. (2008). Income, Health, and Well-Being around the World: Evidence from the Gallup World Poll. *Journal of Economic Perspectives,* 22**,** 53-72.

Di Tella, R., MacCulloch, R. J. & Oswald, A. J. (2001). Preferences over Inflation and Unemployment: Evidence from Surveys of Happiness. *American Economic Review,* 91**,** 335-341.

Diener, E. (1994). Assessing Subjective Well-Being: Progress and Opportunities. *Social Indicators Research,* 31**,** 103-157.

Diener, E. (2006). Guidelines for National Indicators of Subjective Well-Being and Ill-Being. *Applied Research in Quality of Life,* 1**,** 151-157.

Diener, E. & Seligman, M. E. P. (2004). Beyond Money: Toward an Economy of Well-Being. *Psychological Science in the Public Interest,* 5**,** 1-31.

Diener, E. & Suh, E. (1997). Measuring Quality of Life: Economic, Social, and Subjective Indicators. *Social Indicators Research,* 40**,** 189-216.

Easterlin, R. A. (1974). Does Economic Growth Improve the Human Lot? Some Empirical Evidence. *In:* David, A. & Reder, M. W. (eds.) *Nations and Households in Economic Growth: Essays in Honour of Moses Abramovitz.* New York: Academic Press, Inc.

Easterlin, R. A. (2013). Happiness and Economic Growth: The Evidence. *Discussion Paper Series No. 7187.* Institue for the Study of Labor (IZA).

Easterlin, R. A., Angelescu McVey, L., Switek, M., Sawangfa, O. & Zweig, J. S. (2011). The Happiness-Income Paradox Revisited. *Discussion Paper No. 5799.* Institue for the Study of Labor (IZA).

Ferrari, S. & Cribari-Neto, F. (2004). Beta Regression for Modelling Rates and Proportions. *Journal of Applied Statistics,* 31**,** 799-815.

Fleurbaey, M. (2009). Beyond GDP: The Quest for a Measure of Social Welfare. *Journal of Economic Literature,* 47**,** 1029-1075.

Frey, B. S. & Stutzer, A. (2002). What Can Economists Learn from Happiness Research? *Journal of Economic Literature,* 40**,** 402-435.

Frey, B. S. & Stutzer, A. (2013). Economic Consequences of Mispredicting Utility. *Journal of Happiness Studies***,** 1-20.

Graham, C. (2008). Some Insights on Development from the Economics of Happiness. *In:* Bruni, L., Comim, F. & Pugno, M. (eds.) *Capabilities and Happiness.* New York: Oxford University Press.
Helliwell, J. F. (2003). How's Life? Combining Individual and National Variables to Explain Subjective Well-Being. *Economic Modelling,* 20**,** 331-360.
Helliwell, J. F. & Barrington-Leigh, C. P. (2010). Viewpoint: Measuring and Understanding Subjective Well-Being. *Canadian Journal of Economics-Revue Canadienne d Economique,* 43**,** 729-753.
Helliwell, J. F. & Huang, H. (2008). How's Your Goverment? International Evidence Linking Good Government and Well-Being. *British Journal of Political Science,* 38**,** 595-619.
Inglehart, R. & Welzel, C. (2010). Changing Mass Priorities: The Link between Modernization and Democracy. *Perspectives on Politics,* 9**,** 551-567.
Kass, R. E. & Raftery, A. E. (1995). Bayes Factors. *Journal of the American Statistical Association,* 90**,** 773-795.
Kesebir, P. & Diener, E. (2008). In Defense of Happiness: Why Policymakers Should Care About Subjective Well-Being. *In:* Bruni, L., Comim, F. & Pugno, M. (eds.) *Capabilities and Happiness.* New York: Oxford University Press.
Kieschnick, R. & McCullough, B. D. (2003). Regression Analysis of Variates Observed on (0, 1): Percentages, Proportions and Fractions. *Statistical Modelling,* 3**,** 193-213.
Lawless, N. M. & Lucas, R. E. (2011). Predictors of Regional Well-Being: A County Level Analysis. *Social Indicators Research,* 101**,** 341-357.
Layard, R. (2003). Happiness: Has Social Science a Clue? *Lionel Robbins Memorial Lectures 2002/03.* London School of Economics.
Layard, R. (2009). Why Subjective Well-Being Should Be the Measure of Progress. *OECD World Forum: Charting Progress, Building Visions, Improving Life.* Busan, Korea.
Layard, R. (2011). *Happiness : Lessons from a New Science,* London, Penguin Books.
Leigh, A. & Wolfers, J. (2006). Happiness and the Human Development Index: Australia Is Not a Paradox. *Australian Economic Review,* 39**,** 176-184.
McGillivray, M. (2005). Measuring Non-Economic Well-Being Achievement. *Review of Income and Wealth***,** 337-364.
Oswald, A. J. (1997). Happiness and Economic Performance. *The Economic Journal,* 107**,** 1815-1831.
Ovaska, T. & Takashima, R. (2006). Economic Policy and the Level of Self-Perceived Well-Being: An International Comparison. *Journal of Socio-Economics,* 35**,** 308-325.
Smithson, M. & Verkuilen, J. (2006). A Better Lemon Squeezer? Maximum-Likelihood Regression with Beta-Distributed Dependent Variables. *Psychological Methods,* 11**,** 54-71.
Stevenson, B. & Wolfers, J. (2008). Economic Growth and Subjective Well-Being: Reassessing the Easterlin Paradox. *Brookings Papers on Economic Activity,* 2008**,** 1-87.
Stiglitz, J. E., Sen, A. & Fitoussi, J.-P. (2010). *Report by the Commission on the Measurement of Economic Performance and Social Progress.*
UNDP (2011). *United Nations Development Programme (UNDP) Human Development Report.* Oxford University Press.
UNDP (2013). International Human Development Indicators Tables. *United Nations Development Programme (UNDP).*
Veenhoven, R. (1996). Happy Life-Expectancy. *Social Indicators Research,* 39**,** 1-58.
WDI (2014). World Development Indicators Database. *World Bank.*

Appendix

Table A1. Data and econometric models used in previous studies

	estimation	models	controls	data sources	data format	countries	periods	total obs.
Easterlin (1974)	No regressions, only tables and scatter diagrams analyzed			World Values Survey; Cantril	cross-section, time-series	14	1	14
Easterlin et al. (2011)	OLS	$FS_1 = \alpha + \beta Y_1$		Latinobaromete; WVS; Eurobarometer	cross-section	17	1	17
		$LS_1 = \alpha + \beta Y_1$			cross-section	37	1	37
		$FS_2 = \alpha + \beta Y_2$			panel	17	13	175
Deaton (2008)	OLS	$LS = \alpha + \beta_1 \ln Y + \beta_2 Y_1 + \beta_3 LE + \beta_4 \Delta LE + \beta_5 CH$	dummies for Eastern Europe, Sub-Saharan Africa, HIV prevalence; fraction of population in various age groups	Gallup World Poll	cross-section	123	1	123
Stevenson and Wolfers (2008)	OLS	$SWB_1 = \alpha + \beta \ln Y$		Gallup World Poll	cross-section	131	1	131
				WVS	cross-section and panel	79	4	166
				PEW Global Attitudes Survey	Cross-section	44	1	44
Leigh and Wolfers (2006)	OLS	$LS = \alpha + \beta HDI$ $H = \alpha + \beta HDI$ $LS = \alpha + \beta \ln Y$ $H = \alpha + \beta \ln Y$		WVS	cross-section	78	1	78
Ovaska and Takashima (2006)	OLS	$LS = \alpha + \beta_1 Social + \beta_2 Econ + \beta_3 Freedom$ $H = \alpha + \beta_1 Social + \beta_2 Econ + \beta_3 Freedom$		WVS + independent quality of life studies	cross-section	68	1	68
(Di Tella et al. (2001))	OLS	$SWB_2 = \alpha + \beta_1 \pi + \beta_2 u$	time and country effects	Eurobarometer	panel	12	17	150

current study	Beta-regression	$SWB_{share} = \alpha + \beta_1 \ln(Y^*) + \beta_2 LE + Social$	Time, cultural effects, unemployment, inflation, % aged 40-54, % females	WVS + EVS	panel	92	2	145

$FS_1 =$ annual change in average financial satisfaction
$LS_1 =$ annual change in average life satisfaction
$FS_2 =$ deviations from trend in average financial satisfaction
$LS =$ average life satisfaction
$Y =$ GDP per capita (Y^* = GNI per capita)
$Y_1 =$ growth rate of GDP per capita
$Y_2 =$ deviations from trend in log GDP per capita
$LE =$ life expectancy
$\Delta LE =$ change in life expectancy
$CH =$ level of confidence in healthcare (self-reported)
$SWB_1 =$ national index obtained from an individual-level ordered probit of SWB regressed on country (or country-year) fixed-effects; exact measure varies by survey
$HDI =$ HDI score (0-1)
$H =$ average happiness
$Social =$ life expectancy, population aging, educational attainment, government size, religion dummy, geographic location dummy, female labour participation rate (note: not all are used in the current study)
$Econ =$ GDP per capita, GDP per capita squared, GDP per capita of the neighbouring countries, GDP gorwth, unemployment, inflation, relative trade volume
$Freedom =$ economic freedom of the word (EFW) index, political freedom of the world (PFW) index
$SWB_2 =$ national index obtained from (1) regressing individual-level life satisfaction answers on a set of personal characteristics and socio-economic circumstances using OLS (2) Use the averaged residuals from the first step for each country as LS
$\pi =$ inflation
$u =$ unemployment

Table A2. Decomposed variance statistics for measures of interest

		Mean	St. Dev.
mean satisfaction			
	overall	0.633	0.114
	between		0.114
	within		0.033
share satisfied			
	overall	0.828	0.128
	between		0.129
	within		0.039
ln(GNI)			
	overall	9.263	1.098
	between		1.183
	within		0.129
life expectancy			
	overall	72.954	7.720
	between		8.612
	within		0.918
average yrs. of schooling			
	overall	8.744	2.593
	between		2.754
	within		0.391
expected yrs. of schooling			
	overall	13.542	2.716
	between		2.879
	within		0.500

Source: WVS (2009), EVS (2011), UNDP (2013)
total number of observations: 141

Table A3. Beta-regression results for subsample of countries appearing in both waves

dependent variable:	*share of satisfied individuals*		*mean satisfaction* [1]	
	(1a)	(1b)	(2a)	(2b)
ln(GNI)	0.06461 ***	0.00781	0.08021 ***	0.02362 *
	(0.01839)	(0.01579)	(0.01853)	(0.01356)
life expectancy	0.00510 **	0.00338 ***	0.00403	0.00214 *
	(0.00225)	(0.00090)	(0.00278)	(0.00111)
average years in school	-0.02628 ***	-0.00942 *	-0.02046 ***	-0.00186
	(0.00628)	(0.00540)	(0.00551)	(0.00537)
expected years in school	0.01506 **	0.00980 *	0.00772	0.00276
	(0.00644)	(0.00536)	(0.00634)	(0.00503)
wave dummy	0.02518 **	0.04070 ***	0.02206 **	0.03081 ***
	(0.01006)	(0.01114)	(0.01007)	(0.01031)
index of traditional/ secular-rational	—	-0.00540	—	-0.01858
	—	(0.01123)	—	(0.01170)
index of survival/ self-expression	—	0.07116 ***	—	0.06354 ***
	—	(0.01000)	—	(0.00907)
BIC	-243.5	-285.2	-229.0	-271.3
Observations	102	102	102	102

*** p<0.01, ** p<0.05, * p<0.1, panel-robust standard errors in parentheses

Source: WVS (2009), EVS (2011), UNDP (2013), Inglehart and Welzel (2010)

[1] Mean satisfaction is transformed to fit on (0, 1).

All regressions include a constant term (not shown here).

Satisfaction measures calculated using sampling weights.

Table A4. Beta-regression and OLS results using mean satisfaction as dependent variable (marginal effects on original satisfaction scale)

dependent variable:	*mean satisfaction (measured in original scale of 1-10)*			
	Beta-regression		OLS	
	(1a)	(1b)	(2a)	(2b)
ln(GNI)	0.56457 ***	0.19971 **	0.56511 ***	0.22212 **
life expectancy	0.02385	0.02916 **	0.02403	0.02907 **
average years in school	-0.18045 ***	-0.03906	-0.17469 ***	-0.04554
expected years in school	0.11727 ***	0.06336	0.11241 ***	0.06048
wave dummy	0.22608 **	0.24147 ***	0.22923 **	0.22599 ***
index of traditional/ secular-rational values	—	-0.20079 **	—	-0.19656 **
index of survival/ self-expression values	—	0.52191 ***	—	0.48015 ***
Observations	141	141	141	141

*** p<0.01, ** p<0.05, * p<0.1, panel-robust standard errors in parentheses

Source: WVS (2009), EVS (2011), UNDP (2013), Inglehart and Welzel (2010)

All regressions include a constant term (not shown here).

Satisfaction measures calculated using sampling weights.