Life Satisfaction and the Human Development Index Across the World[*]

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Abstract

We use annual data on over 150 countries between 2005 and 2018 to look at the relationship between subjective well-being (both cognitive and affective) and the Human Development Index (HDI). The HDI appears to be more closely related to cognitive than affective well-being. We also consider the relationships between the three HDI components (the Income, Health and Education Indices) and well-being, and find that, on average, the Income Index has the strongest predictive power. Importantly, we find that the three HDI components only matter equally in Western and rich countries. Our analysis contributes to the discussion about cultural sensitivity in paradigms of societal development in two ways. We first show that differences in preferences towards development aims exist. Second, we propose a weighting procedure for a culturally-sensitive version of the HDI.

Keywords: Human Development Index, Subjective Well-being, Gallup World Poll, Country Groups.

1. Introduction

How can we measure progress in society? Despite the warnings of Kuznets (1934), Gross Domestic Product (GDP) has occupied centre stage as the measure of national prosperity, progress and well-being for over half a century since its creation following the end of World War II. There are, however, many criticisms of GDP, starting in the 1960s and 1970s: the Social Indicators Movement and Richard Easterlin's celebrated work (Easterlin, 1974) are two examples. The Human Development Index (HDI), created by the United Nations Development Program (UNDP) in 1990, can be seen as one of the first well-established indices whose objective was to go beyond GDP in order to measure human development and well-being (Stanton, 2007).

From its inception in 1990 up to 2009, the HDI was calculated as the arithmetic mean of three components: the Income Index (the log of GDP per capita in Purchasing Power Parity), the Health Index (life expectancy at birth) and the Education Index (composed of the adult literacy rate and the gross enrolment ratio). We call this $HDI_0 = \frac{x_1 + x_2 + x_3}{3}$, with the x's referring to the three indices. All of the x's are rescaled to lie on a 0-1 scale, and therefore so does the summary arithmetic mean HDI_0 figure.

One criticism of this original formulation of the HDI was that it was possible to obtain a reasonable summary score while neglecting one of the components, say health or education, as the index is additively separable. To penalise poor performance in any of the HDI dimensions, the UNDP in 2010 switched from an arithmetic to a geometric mean of the income, health and education indices (UNDP, 2010), $HDI_1 = (x_1 \times x_2 \times x_3)^{\frac{1}{3}}$. This geometric mean is also on the 0-1 scale. The rationale for this change was that with a geometric mean it was no longer possible to exhibit poor performance in one dimension but still obtain a decent overall score (although this change came with its own problems, as discussed in Ravallion,

2012). The Income and Education Indices also changed somewhat in 2010, with the former now being based on Gross National Income (GNI) per capita in PPP and the latter on the mean and expected years of schooling. However, one HDI feature that has remained unchanged since its inception is the equal weight that is given to each of the three components. This choice of equal weighting is normatively justified by the absence of any *a priori* opinion on which of the dimensions should matter more, and the belief that the three components are equally important in constructing human capabilities (for a complete review of the arguments, see Hirai, 2017).

Seen through the lens of the Economics of Happiness, the HDI components are arguably pertinent. While it continues to be debated whether economic growth is correlated with higher subjective well-being (Easterlin, 1974; Clark *et al*., 2008; Stevenson and Wolfers, 2008), people who live in richer countries very often report higher levels of subjective well-being (Di Tella *et al*., 2003; see also the country rankings in the annual World Happiness Report). Income is also associated with higher well-being at the individual level, both in cross-section (Graham and Pettinato, 2002; Blanchflower and Oswald, 2004; D'Ambrosio *et al*., 2020) and panel analyses (Apouey and Clark, 2015; Frijters *et al*., 2004; Gardner and Oswald, 2007). Regarding the other two components, a large body of literature has concluded that health is one of the most important factors lying behind well-being (Powdthavee and van den Berg, 2011). However, the evidence on the relationship between education and well-being is less consensual: while education is often positively correlated with well-being, there are doubts about whether this correlation is causal, or rather reflects certain types of people being more likely to choose to become educated. Both Oreopoulos (2007) and Powdthavee *et al*. (2015) address this issue, and argue that education does raise life satisfaction, while Clark and Jung (2017) find no such effect in UK data. Considering all three of the HDI variables together, Layard *et al*. (2014) and Clark *et al*. (2018) conclude that health exhibits the largest

correlations with adult life satisfaction, with income and education playing more moderate roles. This conclusion comes from linear regression analysis. Gentile *et al.* (2021) apply machine-learning techniques to the data used in Layard *et al.* (2014): the same hierarchy is found.

Although the conclusions from the Economics of Happiness literature normatively confirm that all of the HDI dimensions are relevant for well-being, preferences towards development aims might well vary between societies and cultures. As it applies the same components and weighting procedure to every country in the world, the HDI concept is culture-blind. As discussed in Krys *et al.* (2020), the HDI could take cultural sensitivity into account by the rescaling of its dimensions to reflect the actual preferences of each society over the realms of health, education and income.

In practice, the weighting of development aims by cultural preferences is a challenge. We here propose to combine the objective and subjective well-being literatures at the aggregate level by exploring the relationship between the HDI and its components, on the one hand, and national summary measures of subjective well-being on the other. In the spirit of Kroll (2015) and Yang (2018), our objective is to establish empirically whether the normative choice of equality between the three dimensions of the HDI also holds statistically (in that they contribute equally to individuals' reports of their subjective well-being). We will run these analyses separately across different regions of the world in order to account for differences in preferences towards development aims. The implicit assumption that we are making here is that subjective well-being measures can be seen as a culturally-sensitive proxy for societal progress. Although Sen (1987) is critical about the use of subjective measures, as preferences may be adaptive, subjective well-being is being increasingly used in practice in economic and social policy discussions. See, for example, the OECD (www.oecd.org/statistics/measuring-well-being-and-progress.htm), and the "Green Book"

from the UK Treasury used for Appraisal and Evaluation (assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/9 38046/The_Green_Book_2020.pdf).

Using combined data from the UNDP, the World Bank (WB) and the Gallup World Poll covering more than 150 countries over a 14-year period, we first show that the HDI is positively (negatively) correlated with various national measures of subjective well-being (ill-being). These correlations are not affected by the method of HDI calculation (*i.e.,* the switch from the arithmetic to the geometric mean). The HDI is more strongly related to the Cantril Ladder, a cognitive measure of subjective well-being, than it is to various measures of affective well-being. Second, we show that the normative assumption of equal importance is not confirmed statistically: of the three HDI components, it is the Income Index that is the most-strongly correlated with national reported well-being. Last, we show that our results are context-dependent: there are substantial differences in the relationships between HDI and subjective well-being between different world regions. The HDI assumption that all of the three dimensions (Income, Health and Education) are of equal importance for well-being holds only in English-speaking countries and Catholic Europe, and high-income countries.

Our analysis contributes to the extant literature in a number of key ways. It can first be seen as an extension of Hall (2013), as we use more measures of national subjective well-being, a larger and more-recent dataset, and take into account both the relative importance of the three components and the calculation method in looking at the relationship between HDI and well-being. Our work also adds to the discussion of the relationship between objective and subjective indicators of well-being (two examples are Michalos, 2014, and Oswald and Wu, 2010).

We also contribute to a number of the issues raised by the Social Indicators Movement (Land and Michalos, 2018; Shek and Wu, 2018), such as taking into account multiple

domains of societal progress and, as suggested by Solomon *et al.* (1980), we underline the importance of cross-cultural comparisons by exploring different sources of cross-country heterogeneity. More importantly, our results confirm that the normative approach advocating equal weighting of the HDI components does not account for differences in preferences towards development aims. In other words, the HDI is culture-blind (as argued in Krys *et al.*, 2020). Our method can also be considered as a framework to help promote a culturally-sensitive HDI by using as weights for its components their estimated coefficients in well-being regressions.

The remainder of the paper is organised as follows. Section 2 presents the data and the empirical strategy. Section 3 then shows the main results, and Section 4 the heterogeneity analysis across different regions of the world. Last, Section 5 concludes.

2. Data and Empirical Strategy
2.1. Data

We use the online database of the United Nations (UN) to obtain yearly national measures of the HDI and its components from 1990 to 2018 (http://hdr.undp.org/en/data). This database lists the HDI figure that corresponds to the geometric mean of the income index (rescaled log Gross National Income per capita), the health index (rescaled life expectancy at birth) and the education index (rescaled expected years and mean years of schooling), calculated using the method introduced by the UN in 2010; it also supplies the values of the three indices themselves. We obtain a number of time series of variables over the same time period from a World Bank database (https://data.worldbank.org/indicator): country GDP per capita (in 2017 international Dollars in PPP terms), population size, the population percentage of women, and median population age.

We wish to relate the objective index of country well-being given by the HDI to a number of different measures of subjective well-being reported by that country's inhabitants

in that year. The first of these is the average Cantril Ladder figure from the Gallup World Poll (as presented, for example, in the World Happiness Report, 2020). The Cantril Ladder question is as follows: *"Please imagine a ladder with steps numbered from zero at the bottom to 10 at the top. The top of the ladder represents the best possible life for you and the bottom of the ladder represents the worst possible life for you. On which step of the ladder would you say you personally feel you stand at this time?"*. This figure is available almost every year from 2005 to 2018 for over 150 countries. The Cantril Ladder is a common cognitive measure of subjective well-being (Clark, 2016; Flèche *et al.*, 2020). We will also consider a second cognitive-evaluative measure, national average life-satisfaction scores from the World Values Surveys, although this data is available for a smaller number of countries and years.

Evaluative measures of well-being may be subject to recall and cognitive biases as they refer to longer time periods and do not have a direct connection to daily-life activities (Kahneman *et al.,* 2004; Kahneman and Krueger, 2006; Dolan and Kahneman, 2008; Krueger and Mueller, 2012; Stone *et al.*, 2018), and/or reflect expectations rather than actual life experiences (Schwarz, 1999). This is why we also consider country-level affective well-being indices from the Gallup World Poll. The general form of the Affect questions is: *"Did you experience the following feelings during a lot of the day yesterday?"*. Valid answers to these questions are on a simple Yes/No scale. We use the answers to these questions to construct Positive and Negative Affect indices. Positive Affect is the average "Yes" response to the previous-day questions regarding feelings of happiness, laughter and enjoyment; the Negative Affect index is constructed analogously for the questions on feelings of worry, sadness and anger.

While cognitive and affective measures of subjective well-being are often highly correlated (Clark, 2016), Kahneman and Deaton (2010) argue that their determinants might differ substantially. For example, in Knabe *et al*. (2010) unemployment significantly reduces

cognitive measures of well-being, while at the same time the unemployed and employed report similar levels of affective well-being.

2.2. Empirical Strategy and Estimation Sample

We first want to see whether the way in which the HDI is calculated (as first an arithmetic and then a geometric mean) affects its correlation with national subjective well-being. We therefore estimate the following two equations via ordinary least squares regressions:

$$WB_{it} = \beta_0 HDI_{0it} + \lambda_t + \epsilon_{it}, \tag{1}$$

$$WB_{it} = \beta_1 HDI_{1it} + \lambda_t + \epsilon_{it}. \tag{2}$$

Here WB_{it} will successively be the Cantril Ladder, Positive Affect and Negative Affect scores of country i in year t. In line with Diener (1984) and Diener and Biswas-Diener (2002), we study positive and negative affect separately. We do so because positive and negative affect do not share the same set of determinants and because in our estimation sample, as revealed in Table A1, the raw correlation between the two types of affect is relatively low. We have also considered Affect Balance, as in Brulé and Veenhoven (2015) and find similar conclusions. These Affect Balance results are available upon request. HDI_{0it} and HDI_{1it} are respectively the arithmetic and geometric means of the Income, Health and Education indices from the UN (see the description above). We control for year fixed effects, λ_t, weight the observations by the size of the population (we find similar results in unweighted analyses, and if we exclude the largest countries - China and India - from our estimation sample), and cluster standard errors at the country level. We can compare β_0 and β_1 directly, as both HDI measures are on a 0-1 scale: if there is a statistically-significant difference between the partial correlation coefficients in Equations (1) and (2), β_0 and β_1,

then subjective well-being is differently associated with the arithmetic and the geometric HDI measures.

We will estimate two versions of equations (1) and (2). The first includes the controls listed above, while the second will add a set of time-varying national characteristics, X_{it} (median population age and its square, and the population percentage of women) and a set of cultural fixed effects θ_c. Note that X_{it} does not include any measures of income, education or health, as these are already present in the three index variables making up the HDI. We include cultural fixed effects as we are interested in whether the relationship between objective and subjective well-being varies across different cultures. We here use the grouping and terminology of Inglehart and Welzel (2010) to construct the following five culture groups: "English-speaking countries and Catholic Europe", "Protestant Europe, Orthodox and Baltic countries", "Latin America", "African-Islamic countries" and "Confucian and South Asia" (see Figure A1 for more details). This second specification asks whether the difference between countries reflects the characteristics of their populations. We obtain very similar results if we use continent rather than cultural fixed effects. Note that we cannot use country fixed effects in these analyses due to the only limited within-country variance in the independent and dependent variables.

We then decompose the HDI into its three constituent indices in order to see how these are separately correlated with national subjective well-being:

$$WB_{it} = \gamma_1 \, Inc. \, Index_{it} + \gamma_2 Health \, Index_{it} + \gamma_3 \, Educ. \, Index_{it} + \lambda_t + \epsilon_{it}. \quad (3)$$

As in Equations (1) and (2) above, we will estimate Equation (3) first as it appears above and then controlling for the X_{it} and θ_c variables.

Before estimating Equation (3), we follow a beauty-contest approach where we separately control for each of the three indices and then control for all of them simultaneously. Any significant differences in the estimated γ_1, γ_2 and γ_3 coefficients in

Equation (3) would show that the three HDI dimensions are not equally important in terms of their correlation with subjective well-being. This matters, as the implicit assumption behind the HDI is that all three domains are equally important from a normative perspective. We do not believe that this question has ever been explicitly analysed using cross-country (and over-time) aggregate subjective well-being data. In Equation (3), this amounts to testing $\gamma_1 = \gamma_2 = \gamma_3$.

Equation (3) provides a potential framework that can be used to build a culturally-sensitive version of the HDI. Under the assumption that all of the estimated coefficients are unbiased, the estimation of Equation (3) in different cultural groups would produce a set of $(\gamma_1, \gamma_2, \gamma_3)$ coefficients that would accurately reflect differences in preferences towards development aims, and could be used as weights in a culturally-sensitive HDI (as proposed in Krys *et al.*, 2020).

The estimation of Equations (1), (2) and (3) requires a dataset with valid information on subjective well-being, the HDI and its components, and the aggregate control variables in X_{it}. The combination of the Gallup World Poll, UN and World Bank datasets yields 1623 country-year observations, corresponding to 155 countries that are observed an average of 10.47 times over the 14-year period between 2005 and 2018. Appendix Figure A2 lists the countries in this estimation sample, as well as the number of times each country is observed. Figure A3 displays the distribution of the dependent variables, while Table A2 reports the descriptive statistics of all of the variables that we will analyse.

3. Main Results

Table A3 shows the estimated coefficients from regressions of our three subjective well-being variables from the Gallup World Poll on the UN's Human Development Index. The results here correspond to Equations (1) and (2) without any control variables other than

year dummies. All of the well-being and HDI variables are standardised for ease of comparison. Column (1) shows that one standard-deviation (SD) higher HDI, when this is an arithmetic mean, is associated with a 0.78 SD-point higher average Cantril-Ladder score. Column (2) repeats this exercise, substituting the geometric for the arithmetic mean: this produces exactly the same estimated coefficient. The relationship between the Cantril Ladder and the HDI is then not sensitive to the way in which the latter is calculated. Columns (3) to (6) carry out analogous analyses for first Positive and then Negative Affect. The estimated coefficients on the HDI measures in the Affect regressions are smaller than those for the Cantril Ladder (but remain significant at all conventional levels). A one-SD higher arithmetic HDI is associated with 0.31 SD-point higher Positive Affect and 0.18 SD-point lower Negative Affect. These coefficients are again almost identical for the two HDI calculation methods. The lack of any significant difference by calculation method is not surprising: the two HDI measures are highly correlated (Table A5), and the country HDI ranks in our estimation sample are almost identical when using geometric or arithmetic HDI. This suggests that the penalisation for poor performance in one HDI dimension introduced in the geometric HDI had only minor effects in practice.

The Adjusted-R^2 figures at the foot of Table A3 reveal that the predictive power of the HDI is far larger for cognitive well-being than for either Affect measure. This is in line with research at the individual level that has shown that cognitive measures of well-being are relatively more responsive to variations in life circumstances (Kapteyn *et al.*, 2015), and that Affect measures may exhibit somewhat less international variation (Helliwell and Wang, 2013; Kahneman and Deaton, 2010). The theory of happiness of Veenhoven (2009) can also be mobilised here: although the HDI and its components were meant to represent the gratification of *universal needs* (proxied by affective measures), the difference in predictive

power across measures of subjective well-being suggests that they are more likely to reflect *cultural wants* (proxied by cognitive measures).

Columns (1) and (2) of Table 1 display the same estimates as in Table A3, but add controls for median population age and its square (to allow for a potential U-shaped relationship between subjective well-being and age, as is commonly found in the literature), the population percentage of women, and the cultural fixed effects discussed in Section 2.2 above. The estimated coefficients in columns (1) and (2) of the top panel for the Cantril Ladder in Table 1 are somewhat higher than their counterparts in Table A3; again, there is very little difference by HDI calculation method. The same pattern is found for the Affect measures in the other panels: the results are the same across HDI calculation methods and introducing controls raises the correlations between HDI and subjective well-being measures (and significantly so for Positive Affect). This movement towards a more positive correlation renders the estimated coefficients for Negative Affect insignificant in the bottom panel, although again the difference in the estimated coefficients between Tables A3 and 1 is not significant.

Columns (3) to (6) of Table 1 show the estimation results from Equation (3), where the first three columns introduce the three HDI components separately (the Income, Health and Education indices) and the last column takes a beauty-contest approach and includes all three HDI dimensions at the same time. Introducing all HDI indices simultaneously may well change the estimated coefficients found in the columns (3) to (5), as Income, Education and Health are correlated with each other (see Kovacevic, 2010). Table A6 presents the same regressions without controls.

In the top panel, the Income, Health and Education indices are all positively and significantly correlated with the Cantril Ladder, either when introduced separately or with all three indices at the same time. In the middle panel, the introduction of controls renders the

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correlation between the Health index and Positive Affect insignificant. Last, in the bottom panel, when each index is introduced separately, Education is the only index that is significantly correlated with Negative Affect. As the different HDI components are highly correlated (see Table A5), we calculated variance inflation factors (VIF) for the independent variables in all of our regressions. None of these is over the rule-of-thumb figure of 10, which is considered as the threshold for multicollinearity requiring correction.

4. Accounting for Cultural Sensitivity: Differences across World Regions

The numbers in Tables A6 and 1 refer to the average effects of the different dimensions of the HDI across 150+ countries. The implicit assumption is that the Income, Health and Education Indices correlate with well-being in the same way over all of these countries. As such, our analysis so far has been culture-blind. We now relax this assumption and re-estimate Equation (3) separately for the five cultural groups presented in Inglehart and Welzel (2010) and described in Sub-section 2.2 ("English-speaking countries and Catholic Europe", "Protestant Europe, Orthodox and Baltic countries", "Latin America", "African-Islamic countries" and "Confucian and South Asia"). These different groups are depicted graphically in the map in Figure A1.

Table 2 reproduces the specification in column (6) of Table 1 separately for these five groups. The top panel refers to the Cantril Ladder. The Income Index is positively correlated with subjective well-being in all regions, with the largest coefficient in English-speaking countries and Catholic Europe and the smallest in African and Islamic countries. The Health and Education Indices are both associated with higher Cantril-Ladder scores only in English-speaking countries and Catholic Europe in column (1). This is also the only region in which the three HDI dimensions are statistically significant and where we cannot reject that they are statistically equal to each other (in other words, this is the only region in which the equal-weighting assumption underlying the HDI as a measure of well-being seems to hold). The

Health Index attracts a positive significant coefficient in Latin America. The estimated coefficient on the Education Index is in general weak outside of column (1). Overall, these results underline that there are significant regional differences in preferences towards development aims, and that the single weighting procedure for the HDI across the world neglects substantial cultural sensitivity. They also confirm that the HDI components seem to correspond to Western wants more than universal needs.

The middle panel of Table 2 carries out the same exercise for Positive Affect. The results here are similar to those for the Cantril Ladder in the top panel in columns (1) to (3). However, contrary to the top panel, the estimated coefficient on the income index is insignificant in columns (4) and (5). Last, there are only few significant estimates and differences across groups of countries in the analysis of Negative Affect in the bottom panel. Income significantly reduces Negative Affect only in Latin America, while the results for Education there are somewhat surprising: education increases the level of Negative Affect. One potential explanation is that education raises expectations. However, if expectations are not accompanied by better outcomes, education widens the gap between expectations and realisations and, consequently, reduces well-being. Using different groupings of countries (such as that used by the Gallup World Poll, or by Continent) produces similar results: the three indices of the HDI attract significant estimates in Western and Developed countries only, and are always statistically equal to each other.

The definition of culture in Inglehart and Welzel (2010) is based on differences in traditional *vs.* secular-rational values and survival *vs.* self-expression values. However, the descriptive statistics by region in Table A7 reveal large differences within each of these groups in terms of subjective well-being, the HDI and objective country characteristics. As such, Table 3 may not capture all of the heterogeneity across world regions. As an alternative, we construct three groups of countries that are more homogeneous in terms of income, based

on the terciles of the most recent country GDP-per-capita figures from the World Bank. The income-based map of the world appears in Figure A4, and the descriptive statistics in Table A8 confirm that there is now less heterogeneity within groups than there was for the cultural groups in Table A7.

The estimated coefficients from the re-estimation of Equation (3) separately for Low-, Middle- and High-income countries are listed in Table 3. There is no significant difference in the Income coefficient across country groups for the Cantril ladder in the top panel (even though the estimated coefficient seems to rise in size as income rises from left to right), while Health Index is significant only in Middle- and High-income countries. Last, Education is important only in High-income countries. In High-income countries, none of the estimated coefficients on the three HDI components are statistically different from each other (and all are significant). Again, this suggests that it is only in High-income countries that the equal weighting of the three HDI dimensions accurately reflects societal progress.

As was the case for Inglehart and Welzel's culture-based groups, the results differ for affective measures of subjective well-being. While the Income coefficient in the middle panel of Table 3 is significant only in Low-income countries, the size of the standard errors mean that it is not statistically different from that in the other two country groups. The only significant estimated Health coefficient is in high-income countries, although again the coefficients for the Health Index are statistically equal to each other due to the large standard errors. Last, Education is only significantly correlated with Positive Affect in high-income countries. The bottom panel looks at Negative Affect. As in Tables A6, Health is associated with greater Negative Affect, but only in Middle- and High-income countries, suggesting that this might reflect issues related to rich ageing societies. Along these lines, if we control for the percentage of the population aged 65 or over, the estimated health-index coefficient becomes smaller in size, and is no longer significant in middle-income countries.

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5. Conclusion

We here used data from the UN, the World Bank and the Gallup World Poll for more than 150 countries over a 14-year period to consider the relationship between the HDI, a measure of composite objective well-being, and the subjective well-being that individuals report. We first show that the HDI is more-closely related to cognitive than affective measures of subjective well-being, and that its calculation method (arithmetic *vs.* geometric mean) has no impact on its estimated relationship with subjective well-being. The HDI is then a reasonable short-cut proxy for subjective well-being for those who believe that national well-being is cognitive-evaluative, but not those who think that it should be given by the population's average mood.

Splitting the HDI into its three components, the Income Index explains subjective well-being better than do the Health or Education indices. Over the whole world, the HDI supposition that the three components are of equal importance does not hold. However, these broad conclusions no longer apply when we split the world up into different regions using either cultural values or GDP per capita to account for cultural sensitivity. The HDI assumption of equally-important and significant Income, Health and Education indices holds only in English-speaking countries and Catholic Europe, and in high-income countries. Other countries, accounting for the majority of the World's population, have different preferences towards development aims

These results are of importance for a number of reasons. They first underline that the determinants of well-being are context-dependent. While indices like the HDI allow easy cross-country comparisons via their harmonised construction, these comparisons are of only limited validity if the conception of subjective well-being is not universal. While one of the main objectives of the HDI was to extend the measure of a country's progress beyond GDP, we find that income is the only HDI component that is consistently correlated with the Cantril

ladder across different country groups in terms of cultural values or GDP per capita, except in Middle-income countries where the correlation is not significant at conventional levels (the situation with respect to Affect is more mixed, where in general the correlations are weaker). The choice of the HDI components is therefore not entirely reflected in individuals' evaluations of the lives that they live in some regions of the world. These components were chosen as they are argued to represent equally-important basic capabilities at the core of human development (for a discussion, see Anand and Sen, 1994).

We believe that the method and results we present here are potentially useful for the construction of culturally-sensitive indices of progress. Were the data detailed enough, the estimated coefficients on the Income, Health and Education indices in subjective well-being regressions could serve as weights for culturally-sensitive HDI measures that would more accurately reflect the preferences towards development aims of different groups (by country, religion, age, gender etc.).

Our analysis does have limitations. First, data-driven weightings are not necessarily to be preferred to normative weightings in that they can be biased (as argued by Decancq and Lugo, 2013, and Hirai, 2017); in our case the estimates are not necessarily causal. Exploiting exogenous changes in the HDI components would of course be useful, but very difficult to isolate given the world-wide scope of our analysis here. These endogeneity issues should be carefully addressed in future research to help construct unbiased weights for culturally-sensitive indices of societal progress. Second, our analysis of subjective well-being has focussed on cognitive-evaluative measures (the Cantril Ladder and life satisfaction) and Positive and Negative Affect. There are alternative well-being measures, such as Eudaimonia (which picks up aspects of life like meaning and mastery); however, these are not currently as widely-available in terms of country and year coverage. Third, we have focussed only on the HDI, as it is the best-known social indicator. This is only one of many indicators, and a useful

research programme would be to establish the degree to which other innovative objective indices are correlated with various national measures of subjective well-being. Last, it would be of great interest to examine the interplay between economic development and preferences towards development aims.

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Table 1: Subjective Well-being and the HDI Components: OLS Results with Controls

	Cantril Ladder					
	(1)	(2)	(3)	(4)	(5)	(6)
HDI (Arithmetic mean)	0.98*** (0.11)					
HDI (Geometric mean)		0.96*** (0.11)				
Income Index			0.76*** (0.10)			0.60*** (0.10)
Health Index				0.43*** (0.10)		0.21*** (0.07)
Education Index					0.54*** (0.09)	0.21** (0.08)
Adjusted R^2	0.69	0.69	0.70	0.62	0.64	0.71
Observations	1623	1623	1623	1623	1623	1623
	Positive Affect					
	(1)	(2)	(3)	(4)	(5)	(6)
HDI (Arithmetic mean)	0.75*** (0.19)					
HDI (Geometric mean)		0.74*** (0.19)				
Income Index			0.58*** (0.16)			0.44*** (0.16)
Health Index				0.22 (0.16)		0.03 (0.14)
Education Index					0.50*** (0.13)	0.28** (0.14)
Adjusted R^2	0.34	0.34	0.36	0.30	0.34	0.37
Observations	1623	1623	1623	1623	1623	1623
	Negative Affect					
	(1)	(2)	(3)	(4)	(5)	(6)
HDI (Arithmetic mean)	-0.26 (0.19)					
HDI (Geometric mean)		-0.24 (0.19)				
Income Index			-0.13 (0.18)			0.02 (0.20)
Health Index				0.11 (0.14)		0.19 (0.13)
Education Index					-0.38*** (0.14)	-0.43** (0.17)
Adjusted R^2	0.12	0.12	0.13	0.13	0.15	0.16
Observations	1623	1623	1623	1623	1623	1623

Notes: These figures refer to our estimation sample of 1623 observations (155 countries observed on average 10.47 times between 2005 and 2018). Standard errors, clustered at the country level, appear in parentheses. All regressions include year dummies and the observations are weighted by population size. The controls are median age, the median-age squared, the population percentage of women, and culture fixed effects (see Inglehart and Welzel, 2010, for more details). The dependent and HDI variables are standardised. $^* p < 0.1$, $^{**} p < 0.05$, $^{***} p < 0.01$.

Table 2: Subjective Well-being and the HDI Components by Cultural Groups: OLS Results with Controls

	English-speaking countries and Catholic Europe	Protestant Europe, Orthodox and Baltic countries	Latin America	African and Islamic countries	Confucian and South Asia
			Cantril Ladder		
	(1)	(2)	(3)	(4)	(5)
Income Index	1.29***	0.97***	0.79***	0.26**	0.64**
	(0.33)	(0.30)	(0.25)	(0.10)	(0.29)
Health Index	0.64**	0.11	0.61**	0.01	0.41
	(0.28)	(0.46)	(0.27)	(0.07)	(0.37)
Education Index	0.64***	0.58	-0.25	0.15*	-0.37
	(0.18)	(0.42)	(0.32)	(0.08)	(0.26)
Adjusted R^2	0.79	0.75	0.57	0.56	0.52
Observations	268	278	258	657	162
			Positive Affect		
	(1)	(2)	(3)	(4)	(5)
Income Index	1.33***	0.94***	0.62***	0.01	0.42
	(0.22)	(0.32)	(0.21)	(0.19)	(0.55)
Health Index	0.87***	0.36	0.94***	-0.24	-0.80
	(0.27)	(0.28)	(0.18)	(0.18)	(0.87)
Education Index	0.83***	0.54*	0.03	0.31*	-0.28
	(0.19)	(0.30)	(0.16)	(0.16)	(0.66)
Adjusted R^2	0.65	0.77	0.59	0.05	0.02
Observations	268	278	258	657	162
			Negative Affect		
	(1)	(2)	(3)	(4)	(5)
Income Index	-1.08	-0.52	-1.07***	0.44	0.36
	(0.70)	(0.39)	(0.33)	(0.27)	(0.29)
Health Index	0.18	1.14*	-0.05	0.19	0.75
	(0.60)	(0.63)	(0.31)	(0.20)	(0.56)
Education Index	-0.94***	-1.16***	0.80*	-0.40**	-0.41
	(0.33)	(0.40)	(0.43)	(0.19)	(0.37)
Adjusted R^2	0.43	0.50	0.31	0.18	0.45
Observations	268	278	258	657	162

Notes: The sample-splits are based on the cultural groups of Inglehart and Welzel (2010). Standard errors, clustered at the country level, appear in parentheses. All regressions include year dummies and the observations are weighted by population size. The controls are median age, the median-age squared and the population percentage of women. The dependent and HDI variables are standardised. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: Subjective Well-being and the HDI Components by Income Groups: OLS Results with Controls

	Low-income Countries	Middle-income Countries	High-income Countries
	Cantril Ladder		
	(1)	(2)	(3)
Income Index	0.39***	0.47	0.79***
	(0.13)	(0.29)	(0.23)
Health Index	0.10	0.58***	0.56***
	(0.09)	(0.16)	(0.13)
Education Index	0.10	-0.22	0.82***
	(0.08)	(0.21)	(0.14)
Adjusted R^2	0.24	0.23	0.63
Observations	497	553	573
	Positive Affect		
	(1)	(2)	(3)
Income Index	0.45*	0.23	0.46
	(0.23)	(0.46)	(0.32)
Health Index	0.19	0.21	0.76***
	(0.19)	(0.33)	(0.28)
Education Index	0.02	-0.49	0.65**
	(0.16)	(0.40)	(0.30)
Adjusted R^2	0.10	0.16	0.34
Observations	497	553	573
	Negative Affect		
	(1)	(2)	(3)
Income Index	0.20	0.02	-1.26***
	(0.31)	(0.47)	(0.36)
Health Index	-0.14	0.50***	0.70**
	(0.19)	(0.17)	(0.27)
Education Index	-0.20	0.11	-0.69***
	(0.24)	(0.36)	(0.22)
Adjusted R^2	0.23	0.10	0.29
Observations	497	553	573

Notes: The sample-splits are based on the terciles of the most recent GDP per capita figures from the World Bank. Standard errors, clustered at the country level, appear in parentheses. All regressions include year dummies and the observations are weighted by population size. The controls are median age, the median-age squared and the population percentage of women. The dependent and HDI variables are standardised. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
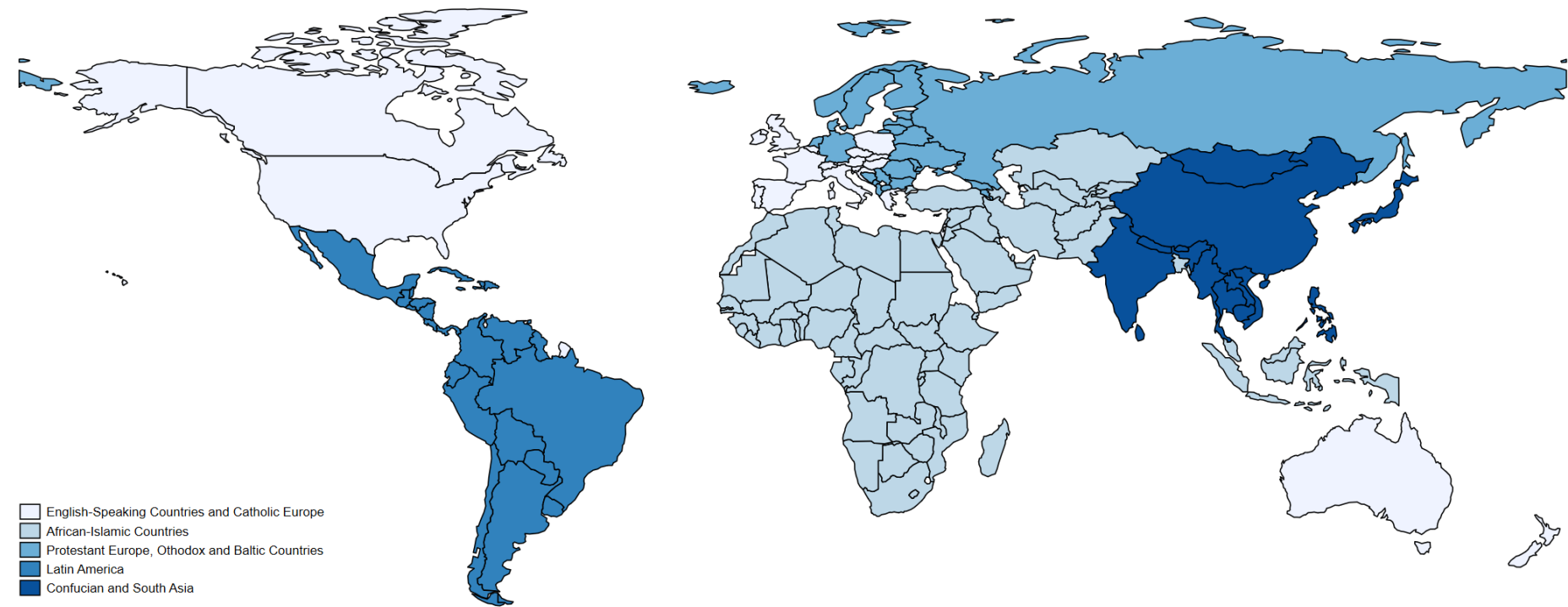
Supplementary Online Materials:

Figure A1: Culture-based Groups

Legend:
- English-Speaking Countries and Catholic Europe
- African-Islamic Countries
- Protestant Europe, Othodox and Baltic Countries
- Latin America
- Confucian and South Asia

Note: This heat map depicts the cultural groups presented in Inglehart and Welzel (2010).

Figure A2: Number of Annual Observations per Country

13 observations
12 observations
9 to 11 observations
6 to 8 observations
Fewer than 5 observations
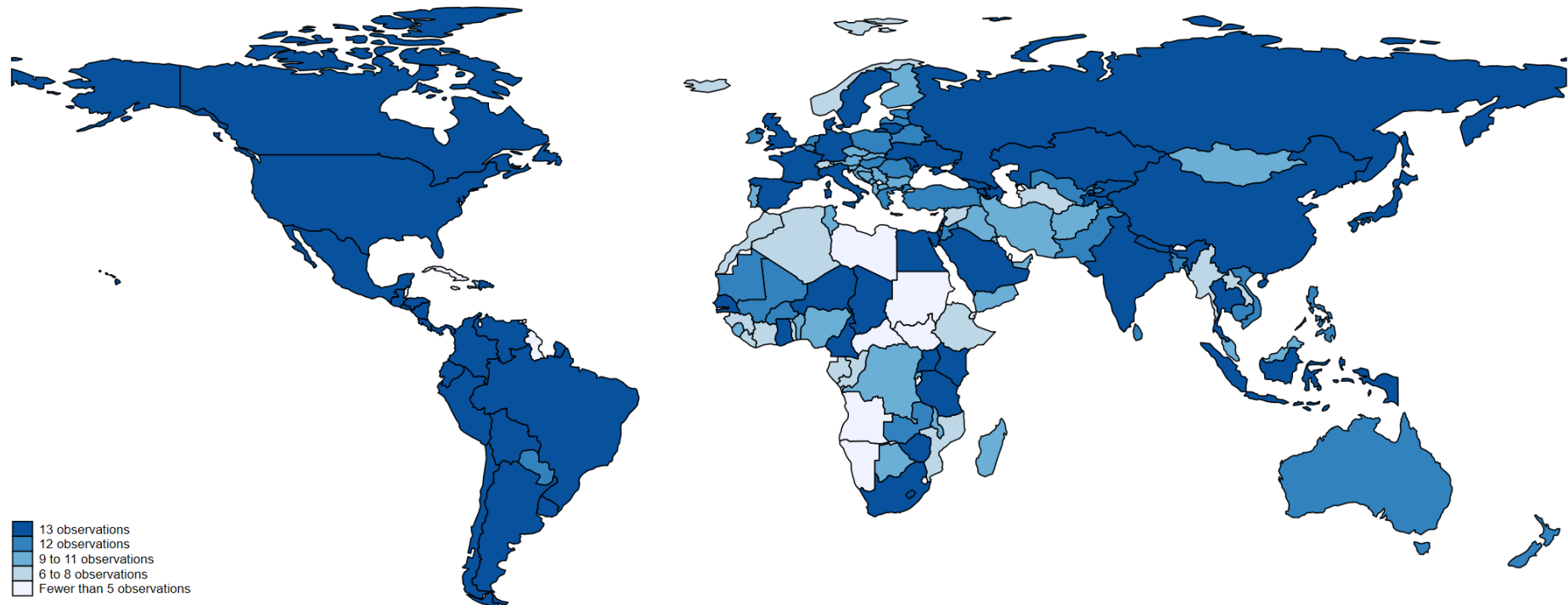
Note: This heat map shows the number of observations per country in our estimation sample of 1623 observations (155 countries observed on average 10.47 times between 2005 and 2018).

Figure A3: The Distribution of the Subjective Well-being Measures
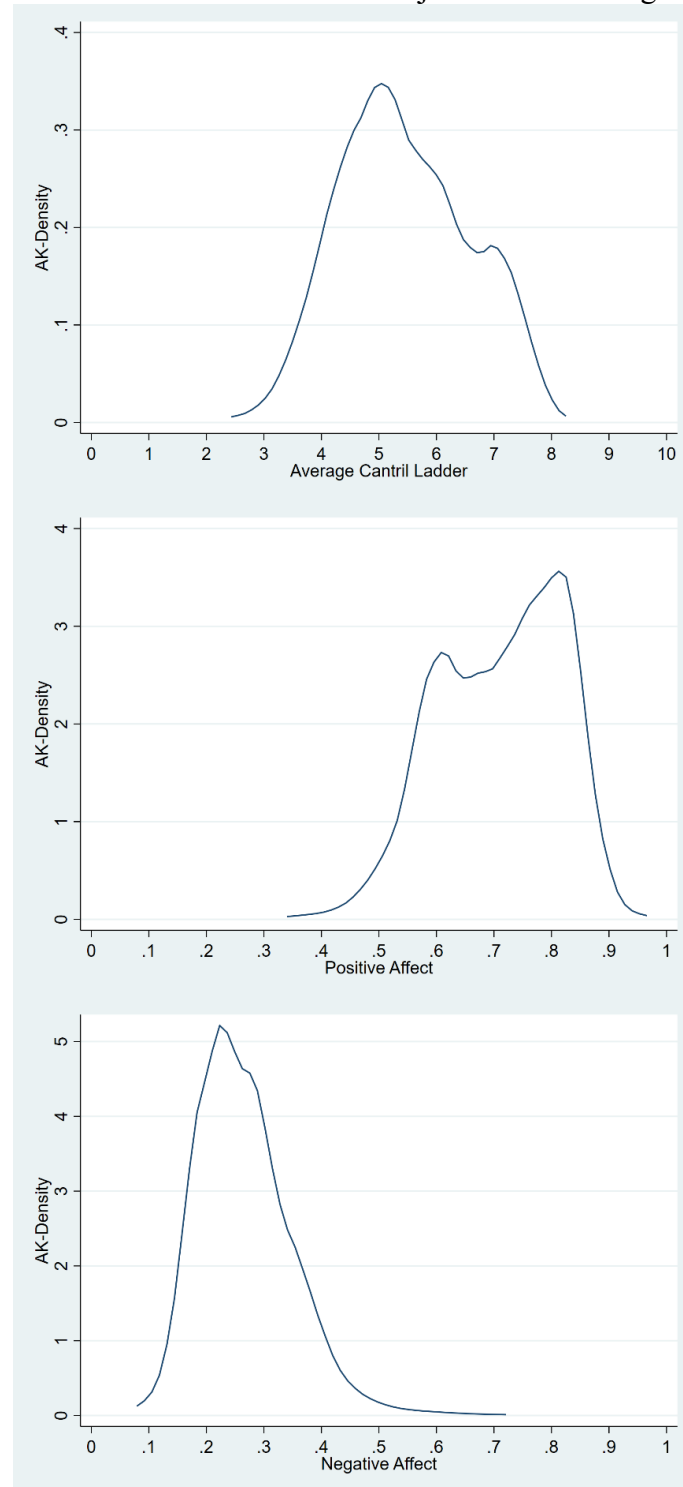
Notes: These figures refer to our estimation sample of 1623 observations (155 countries observed on average 10.47 times between 2005 and 2018). The densities are plotted using an adaptive kernel (see Van Kerm, 2003, for technical details). The graphs plot probability densities, which is the probability per unit, on the X-axis. As such, the total area under the curve integrates to one (note that the Cantril Ladder in the top panel is on a scale of 0 to 10, while the two Affect scores below take on values between 0 and 1).

Figure A4: Income-based Groups
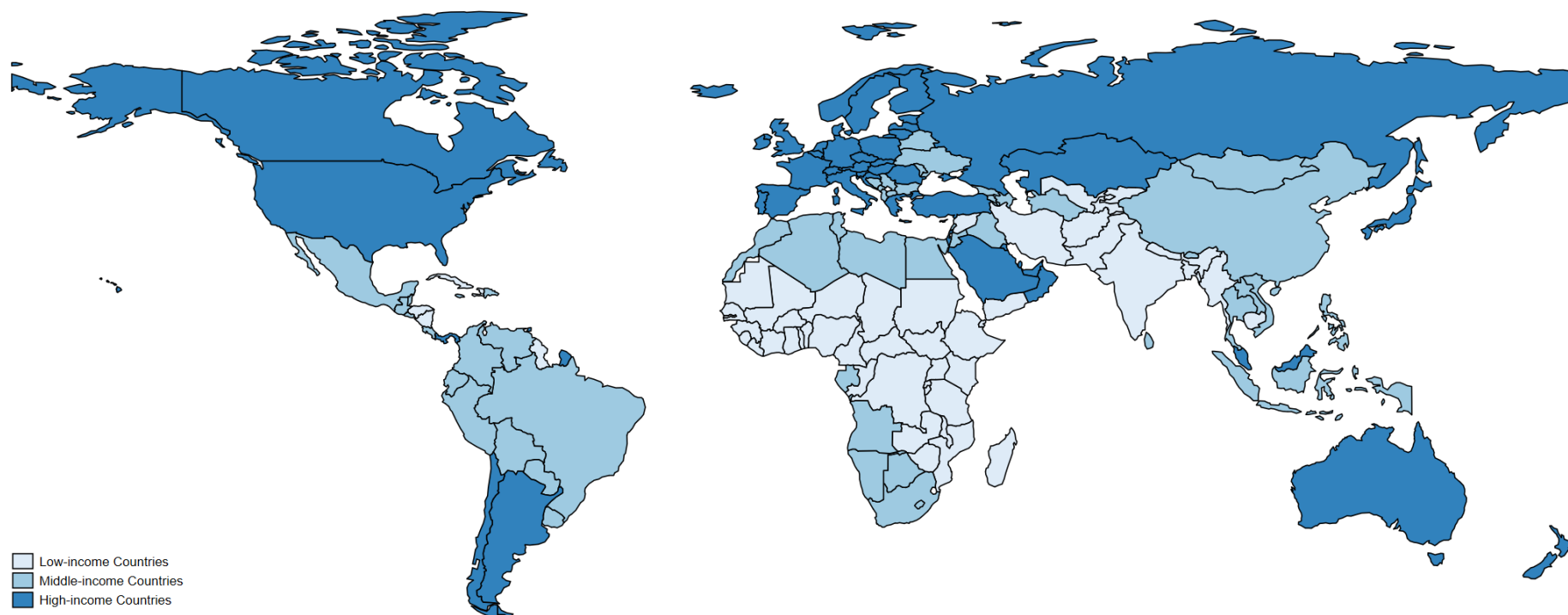
Note: This heat map shows the income groups based on the terciles of the most recent GDP per capita figures from the World Bank.

Table A1: Correlation Matrix – Subjective Well-being Measures

	Cantril Ladder	Positive Affect	Negative Affect
Cantril Ladder	1		
Positive Affect	0.55***	1	
Negative Affect	-0.27***	-0.36***	1

Notes: These figures refer to our estimation sample of 1623 observations (155 countries observed on average 10.47 times between 2005 and 2018). $^{*}\, p < 0.1$, $^{**}\, p < 0.05$, $^{***}\, p < 0.01$.

Table A2: Descriptive Statistics

	Mean	S.D.	Min	Max
Cantril Ladder (0-10)	5.43	1.14	2.66	8.02
Positive Affect (0-1)	0.71	0.11	0.36	0.94
Negative Affect (0-1)	0.27	0.08	0.10	0.70
HDI (Arithmetic mean)	0.71	0.15	0.33	0.95
HDI (Geometric mean)	0.71	0.16	0.29	0.95
Income Index	0.69	0.18	0.27	1.00
Health Index	0.79	0.13	0.37	0.99
Education Index	0.65	0.18	0.15	0.95
Median Age	29.37	8.98	14.90	47.60
Percentage of Women	50.28	2.68	23.29	54.56

Notes: These figures refer to our estimation sample of 1623 observations (155 countries observed on average 10.47 times between 2005 and 2018). Both HDI indices and their components are on a 0-1 scale.

Table A3: Subjective Well-being and the HDI: OLS Results

	Cantril Ladder		Positive Affect		Negative Affect	
	(1)	(2)	(3)	(4)	(5)	(6)
HDI (Arithmetic mean)	0.78***		0.31***		-0.18***	
	(0.04)		(0.06)		(0.06)	
HDI (Geometric mean)		0.78***		0.30***		-0.18***
		(0.04)		(0.06)		(0.06)
Adjusted R^2	0.62	0.61	0.09	0.09	0.08	0.08
Observations	1623	1623	1623	1623	1623	1623

Notes: These figures refer to our estimation sample of 1623 observations (155 countries observed on average 10.47 times between 2005 and 2018). Standard errors, clustered at the country level, appear in parentheses. All regressions include year dummies and the observations are weighted by population size. The dependent and HDI variables are standardised. $^*\,p < 0.1$, $^{**}\,p < 0.05$, $^{***}\,p < 0.01$.

Table A4 below reproduces this analysis with data from the World Values Survey (WVS) matched to the three HDI dimension indices calculated using the pre-2010 method for the Education and Income indices (http://hdr.undp.org/en/global-reports). Given the data availability of these pre-2010 dimensions, we can carry out this analysis for WVS waves 3 to 5 (1995-2009). We consider both the pre-2010 (arithmetic mean) and post-2010 (geometric mean) ways of combining these three dimension indices. The subjective well-being measure in the WVS is life satisfaction. Table A4 shows that the World Values Survey results are similar to those using the Cantril Ladder from the Gallup World Poll. Our results are therefore not sensitive to either the time period that is covered or the way in which cognitive well-being is measured.

Table A4: Average Life satisfaction, HDI and its Components: OLS Results with Controls using Data from the World Values Survey

	Life Satisfaction						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
HDI (Arithmetic mean)	0.48*** (0.09)						
HDI (Geometric mean)		0.53*** (0.10)					
Income Index			0.53*** (0.10)			0.50*** (0.18)	0.49*** (0.16)
Health Index				0.46*** (0.10)		0.13 (0.14)	0.19 (0.19)
Education Index					0.36*** (0.09)	-0.08 (0.15)	0.23 (0.15)
Observations	117	117	117	117	117	117	117
Adjusted R^2	0.36	0.33	0.39	0.30	0.25	0.39	0.59
Controls	No	No	No	No	No	No	Yes

Notes: These figures refer to an estimation sample of 117 observations from three waves of the World Values Surveys (1995-2009). Standard errors, clustered at the country level, appear in parentheses. All regressions include year dummies and the observations are weighted by population size. The controls in column (7) are median age and its square, the population percentage of women, and culture fixed effects (see Inglehart and Welzel, 2010, for more details). The dependent and HDI variables are standardised. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A5: Correlation Matrix – HDI and its Components

	HDI (Arithmetic mean)	HDI (Geometric mean)	Income Index	Health Index
HDI (Arithmetic mean)				
HDI (Geometric mean)	0.99***			
Income Index	0.96***	0.96***		
Health Index	0.92***	0.91***	0.84***	
Education Index	0.95***	0.96***	0.86***	0.81***

Notes: These figures refer to our estimation sample of 1623 observations (155 countries observed on average 10.47 times between 2005 and 2018). $^*\,p < 0.1$, $^{**}\,p < 0.05$, $^{***}\,p < 0.01$.

Table A6: Subjective Well-being and the HDI Components: OLS Results

	Cantril Ladder			
	(1)	(2)	(3)	(4)
Income Index	0.78***			0.53***
	(0.04)			(0.09)
Health Index		0.74***		0.25***
		(0.05)		(0.08)
Education Index			0.71***	0.04
			(0.05)	(0.09)
Controls	No	No	No	No
Adjusted R^2	0.62	0.55	0.51	0.64
Observations	1623	1623	1623	1623
	Positive Affect			
	(1)	(2)	(3)	(4)
Income Index	0.31***			0.28**
	(0.05)			(0.14)
Health Index		0.32***		0.24*
		(0.06)		(0.14)
Education Index			0.24***	-0.19
			(0.06)	(0.15)
Controls	No	No	No	No
Adjusted R^2	0.09	0.10	0.05	0.11
Observations	1623	1623	1623	1623
	Negative Affect			
	(1)	(2)	(3)	(4)
Income Index	-0.17***			-0.03
	(0.06)			(0.16)
Health Index		-0.12**		0.18*
		(0.06)		(0.10)
Education Index			-0.22***	-0.33**
			(0.06)	(0.14)
Controls	No	No	No	No
Adjusted R^2	0.07	0.06	0.09	0.10
Observations	1623	1623	1623	1623

Notes: These figures refer to our estimation sample of 1623 observations (155 countries observed on average 10.47 times between 2005 and 2018). Standard errors, clustered at the country level, appear in parentheses. All regressions include year dummies and the observations are weighted by population size. The dependent and HDI variables are standardised. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A7: Descriptive Statistics by Cultural Group

	English-speaking countries and Catholic Europe (268 observations)				Protestant Europe, Orthodox and Baltic countries (278 observations)				Latin America (258 observations)			
	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
Average Cantril Ladder	6.57	0.75	4.68	7.78	5.78	1.14	3.68	8.02	6.00	0.79	3.35	7.61
Positive Affect	0.75	0.08	0.58	0.89	0.66	0.12	0.43	0.90	0.81	0.06	0.54	0.94
Negative Affect	0.26	0.06	0.15	0.48	0.26	0.08	0.13	0.47	0.28	0.06	0.13	0.43
HDI (Arithmetic mean)	0.88	0.03	0.80	0.95	0.82	0.07	0.67	0.95	0.72	0.08	0.47	0.85
HDI (Geometric mean)	0.88	0.03	0.80	0.95	0.82	0.08	0.67	0.95	0.71	0.08	0.46	0.85
Income Index	0.88	0.04	0.78	0.98	0.80	0.10	0.58	0.98	0.69	0.10	0.41	0.86
Health Index	0.93	0.03	0.82	0.98	0.86	0.06	0.71	0.96	0.83	0.06	0.60	0.93
Education Index	0.84	0.05	0.68	0.93	0.81	0.08	0.61	0.95	0.63	0.10	0.38	0.84
Median Age	39.75	3.27	28.98	46.54	39.07	3.16	30.34	45.90	26.69	3.91	18.74	36.16
Population Percentage of Women	50.97	0.69	49.54	52.71	51.62	1.52	49.05	54.21	50.55	0.80	49.11	53.11

	African-Islamic countries (657 observations)				Confucian and South Asia (162 observations)			
	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
Average Cantril Ladder	4.68	0.86	2.66	7.27	5.14	0.76	3.57	7.06
Positive Affect	0.67	0.10	0.36	0.90	0.75	0.09	0.48	0.93
Negative Affect	0.28	0.10	0.10	0.70	0.23	0.08	0.11	0.48
HDI (Arithmetic mean)	0.59	0.13	0.33	0.87	0.71	0.12	0.50	0.94
HDI (Geometric mean)	0.58	0.14	0.29	0.87	0.70	0.13	0.48	0.94
Income Index	0.58	0.17	0.27	1.00	0.68	0.16	0.43	1.00
Health Index	0.69	0.12	0.37	0.91	0.82	0.09	0.65	0.99
Education Index	0.51	0.15	0.15	0.82	0.62	0.14	0.38	0.86
Median Age	21.74	5.01	14.90	36.74	30.73	7.59	19.42	47.60
Population Percentage of Women	49.31	3.71	23.29	52.45	50.37	1.63	47.24	54.56

Notes: These figures refer to our estimation sample of 1623 observations (155 countries observed on average 10.47 times between 2005 and 2018). The cultural groups are based on Inglehart and Welzel (2010).

Table A8: Descriptive Statistics by Income Group

	Low-income Countries (497 observations)				Middle-income Countries (553 observations)				High-income Countries (573 observations)			
	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max	Mean	S.D.	Min	Max
Average Cantril Ladder	4.36	0.67	2.66	6.48	5.35	0.81	3.46	7.61	6.45	0.78	4.67	8.02
Positive Affect	0.67	0.09	0.36	0.87	0.71	0.13	0.42	0.94	0.75	0.09	0.43	0.91
Negative Affect	0.28	0.10	0.11	0.70	0.28	0.08	0.10	0.59	0.24	0.06	0.10	0.51
HDI (Arithmetic mean)	0.52	0.08	0.33	0.80	0.72	0.05	0.52	0.82	0.87	0.05	0.72	0.95
HDI (Geometric mean)	0.51	0.09	0.29	0.80	0.72	0.05	0.51	0.82	0.86	0.05	0.71	0.95
Income Index	0.48	0.09	0.27	0.79	0.70	0.06	0.52	0.83	0.88	0.06	0.72	1.00
Health Index	0.65	0.10	0.37	0.89	0.81	0.07	0.50	0.93	0.90	0.06	0.70	0.99
Education Index	0.44	0.12	0.15	0.78	0.66	0.09	0.40	0.86	0.82	0.08	0.56	0.95
Population size (in log)	14.49	1.26	11.13	18.72	14.15	1.58	10.31	18.78	13.93	1.50	10.31	17.30
Median Age	19.61	3.27	14.90	36.16	29.27	6.12	16.40	44.12	37.93	5.20	23.70	47.60
Population Percentage of Women	50.22	0.99	46.62	54.56	50.61	1.20	47.24	53.84	50.02	4.24	23.29	54.21

Notes: These figures refer to our estimation sample of 1623 observations (155 countries observed on average 10.47 times between 2005 and 2018). The income groups are based on terciles of the most recent country GDP per capita figures from the World Bank.