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# THE WELFARE COSTS OF WELL-BEING INEQUALITY

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The Welfare Costs of Well-being Inequality
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**ABSTRACT**

If satisfaction with life (SWL) is used to measure individual wellbeing, the dispersion of its distribution offers a comprehensive measure of inequality that subsumes the many and various component forms of inequality in particular domains. The cross-country correlation between the level of SWL and its dispersion may thus offer a useful measure of the degree to which happiness differences are related to differences in inequality. A major concern, however, is spurious correlation due to the bounded scale on which SWL is reported. We examine this possibility, and show (i) that the correlation between SWL and its dispersion is only marginally attenuated when allowing for bounded scale reporting, including a purely ordinal measure of dispersion, (ii) that it is stronger in the subset of individuals who care most about inequality, and (iii) that it extends to contributors of SWL that are known to be affected by inequality, with SWL levels ruled out as a mediating variable. These findings allay the concern with spurious correlation, and support the use of the SWL dispersion as a comprehensive measure of inequality. Among rich countries, differences in the variance of SWL explain about as much of the difference in mean SWL as differences in GDP per capita.

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# 1 Introduction

Inequality is attracting a great deal of public attention. Inequality of income and wealth attracts the most attention (Piketty & Saez, 2003; Atkinson et al., 2011; Piketty, 2014; Saez & Zucman, 2016), but there is also substantial interest in inequality in other domains, such as health, education, the criminal justice system, marriage rates, and access to supportive social networks (Piketty, 2014; Neal & Rick, 2014; Wang & Parker, 2014; Case & Deaton, 2015).

Surveys of public attitudes towards inequality are unambiguous: most people believe they would be happier if inequality were lower (Wike et al., 2014). But to what extent is this belief justified? Different researchers may disagree about the best method of addressing this question, but they all need precise definitions of happiness and inequality that they can use in econometric analysis.

While happiness data is not without its problems, the situation is quite good. A number of established surveys ask participants about their satisfaction with life (SWL), and economists have been using the resulting data for some time.[1] We now have SWL data for about 150 countries going back to 2006, and for at least some countries we have data going back to the 1970s.

Because of its multi-dimensional nature, the measurement of inequality presents a greater challenge. The Gini coefficient of income is available for many countries, but there is little or no internationally comparable data for inequalities in wealth, health, education, social networks, and other domains.[2] Moreover, even if we had data on inequality in all these domains, it would be impractical to identify their separate relationship with well-being.

A promising alternative is to measure the overall level of inequality by the amount of dispersion in the distribution of individual welfare. The great advantage of this approach is that we already have an empirically useful measure of individual welfare, namely each person's satisfaction with his or her life. A person's SWL gives proper consideration to all the different aspects of life that person cares about with the weights that he or she ascribes to them.

[1] See Section 2.1.

[2] While the Gini coefficient of income is available for many countries, the definition of "income" varies significantly among those countries. There are also substantial differences in the availability of public services, making income inequality a problematic measure of consumption inequality.

Using this approach, the distribution of SWL in different countries or time periods provides a measure not only of welfare, but also of inequality. Average happiness is identified with the mean of the distribution, and the degree of inequality is identified with its standard deviation, or some other indicator of dispersion (Figure 1a).[3] If, for example, greater dispersion is associated with lower mean in some sample of countries (Figure 1b), we conclude that happiness is negatively correlated with inequality in that sample.[4]

A potential deal-breaker, however, is bias due to a mechanical relationship between the SWL mean and dispersion. The problem is that SWL is reported on a bounded scale, causing the SWL distribution in countries with relatively high SWL levels to be compressed against the upper bound of the scale (Figure 1c). Since the right tail of the distribution is censored, its dispersion is reduced through a purely mechanical effect that has nothing to do with the level of inequality. This mechanical effect could theoretically result in an entirely spurious negative correlation between happiness and inequality. More realistically, it biases our estimates of the true correlation, leading us to see the negative relationship between happiness and inequality as stronger than it really is.[5]

We thus have a powerful and convenient measure of inequality, but it comes with a potentially fatal weakness. Our goal in this paper is to evaluate this weakness: should it be a deal-breaker, or is it a practically minor issue? Should researchers ignore SWL dispersion, or should they adopt it as the most empirically useful measure of overall inequality?

There are at least a dozen papers on SWL dispersion, but relatively few have examined its relationship with happiness levels. All these studies (Delhey, 2004; Ott, 2005; Bolle et al., 2009; Quick, 2015) have reported a strong negative correlation between the two. For example, Ott (2005) studied a sample of 78 countries in the World Values Survey, and found a correlation of $r = -0.65$ between the mean and standard deviation of the SWL distribution. Ott considered the possibility that the correlation is purely mechanical, but dismissed it on the grounds that the correlation remained

[3]We discuss the measure of dispersion in Section 2.2.

[4]More generally, we can use the SWL mean and dispersion in any form of econometric analysis that requires precise definitions of happiness and of overall inequality.

[5]Measurement error is less of a concern in this case. In particular, suppose that individual SWL is measured with a normally distributed error. The effect would be to shift the standard deviation of the SWL distribution in each cluster upwards by the standard deviation of the noise, making no difference whatsoever to regression results.

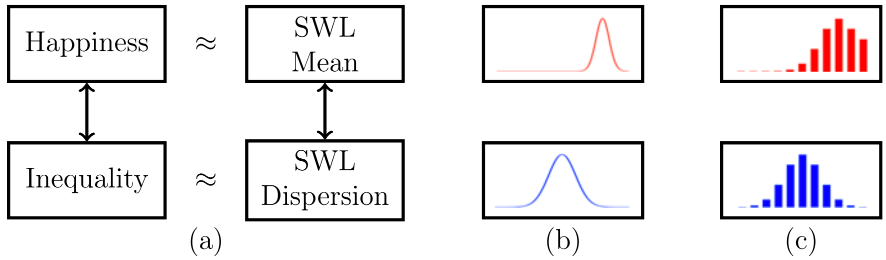


Figure 1: (a) The level of happiness in a country can be measured by the mean of the distribution of satisfaction with life (SWL), and the level of inequality by its dispersion. (b) A negative correlation between happiness and inequality would result in a negative correlation between the mean and dispersion of the SWL distribution. (c) The bounded scale on which SWL is reported is a potential source of bias: the distribution in high SWL countries is censored, reducing the dispersion through a purely mechanical channel that has nothing to do with the level of inequality.

negative ($r = -0.29$) in a sample of relatively poor countries with GDP per capita of less than \$10,000. Ott's argument was that the mean happiness in this group of countries was relatively distant from the bounds of the reporting scale, and that a mechanical relationship was therefore unlikely.[6] Quick (2015) also considered the mechanical correlation problem, and concluded that "a much deeper understanding of these issues will be required of well-being inequality is to be used robustly in the policy making process."

While the main contribution of this paper is to evaluate the possibility that the observed correlations are largely (or even entirely) mechanical, we start by establishing a baseline of correlations in a number of different surveys: the European Social Survey, the World Values Survey, the Gallup World Poll, and the Gallup-Healthways Well-Being Index (comparing U.S. states). Taken together, these surveys include over 160 countries and (for some of these countries) survey waves from 1990 to 2015.

We estimate individual level regressions in clusters defined by the com-

[6]"This negative correlation between level and inequality is, up to a point, a ceiling effect since it is inevitable that inequality, as measured by standard deviation, will diminish if higher average levels are reached. But this correlation is also visible in poor countries with lower average levels and this arithmetical necessity does not predict that it really happens!" (Ott, 2005)

bination of country/wave (state/wave in the Gallup-Healthways Well-Being Index), and controls for log GDP per capita (in PPP terms), region dummies, and personal variables: gender, age, education, employment, and marital status. Despite the inclusion of these controls, we replicate earlier findings of a strong and strongly statistically significant negative relationship between SWL levels and dispersion in all the surveys.

If SWL dispersion is a comprehensive measure of inequality, we would expect it to be more strongly correlated with SWL levels than income inequality is. We estimate corresponding regressions with income inequality replacing SWL dispersion, and confirm that this is indeed the case. Moreover, when we include both forms of inequality in the same regression, the coefficient on income inequality is substantially reduced in magnitude, but the coefficient on SWL dispersion is unchanged.

While our initial results are encouraging, they do not directly address the possibility of a mechanical correlation bias. We employ three tests using the standard deviation measure of SWL dispersion, and repeat the key regressions using an ordinal measure of dispersion. Our first test exploits questions—available in two of the surveys we use—that ask respondents whether they think income differences should be reduced. We take this question as a measure of aversion to inequality, and test whether the correlation between SWL levels and dispersion in subjects averse to inequality is stronger than the corresponding correlation in other subjects. We find that this difference is large and statistically significant. These results are hard to reconcile with a purely mechanical correlation—which should not differ between subjects who care about inequality and those who don't, and are exactly what we would expect if the correlation between SWL levels and dispersion measures the true relationship between happiness and inequality.

Our second test uses a partialling out logic to control directly for the mechanical correlation effect. We regress social trust on SWL inequality, and measure the change in the coefficient when we add mean SWL as an additional regressor. Social trust is important for both happiness (Helliwell & Putnam, 2004; Helliwell & Wang, 2011) and economic growth (Knack & Keefer, 1997), and is strongly correlated with income inequality (Bjørnskov, 2007; Rothstein & Uslaner, 2005). To the extent that SWL inequality measures overall inequality, we would expect it to be correlated with social trust, and the correlation coefficient should not significantly depend on whether mean SWL is a regressor. By contrast, the mechanical component of the correlation with SWL inequality is driven by mean SWL, and should disappear when these are included. The results are that the coefficient on SWL inequality is barely changed if mean SWL is added to the regression, consistent with the real correlation interpretation. In the Gallup World Poll we also examine other well-being determinants: recent feelings of worry and stress, and whether the respondent feels safe walking alone. Again we find strong correlations with SWL inequality in the expected direction (more worry, stress, and fear of walking alone), and only a small decline in the coefficient when mean SWL is added as a regressor. These results suggest that the correlations with SWL inequality are almost entirely due to real correlations with overall inequality, with only a very small role for a mechanical correlation effect.

Our third test is to model the function linking actual and reported SWL, and reestimate the correlations in actual SWL space. We assume that the distribution of actual SWL in each cluster is logistic and that each person reports his or her SWL using the closest integer within the bounds of the reporting scale. Using this assumption we find the maximum likelihood parameters of actual SWL distribution in each cluster, and measure the correlation between the mean and dispersion across clusters. This method would correct for the mechanical correlation bias if our distributional assumptions are justified, but would otherwise introduce a bias of its own. The observed SWL distributions are left skewed, and to the extent that this skew is real, our assumptions would lead us to overestimate the role of the mechanical correlation effect. Be that as it may, we find a reduction of about one third in the estimated correlation, suggesting that at least two thirds of the correlation is real.

Finally, as an alternative to modelling the SWL reporting function we reestimate our main regressions using the variation ratio, which is a purely ordinal measure of dispersion defined by the proportion of observations outside the mode. The variation ratio is obviously a weaker measure of dispersion than the standard deviation, and we can expect the correlation to be weaker. Nevertheless, we obtain qualitatively the same results, providing yet more evidence that the correlation between SWL levels and SWL dispersion is real.

We thus conclude that mechanical correlation plays only a small role in explaining the strong negative correlation between SWL levels and dispersion, and is by no means a deal-breaker. Most of the correlation is real, suggesting (i) that the degree of SWL dispersion is indeed a useful measure of overall inequality, and (ii) that the true cross-country correlation between happiness and overall inequality is large. Consider the magnitude of changes associated with a one point increase in SWL. While the exact coefficients vary between the surveys, a one point change in SWL on a 0–10 scale is associated either with a tripling of GDP per capita, or with a one point decrease in the standard deviation of SWL. As an example, New Zealand's GDP per capita is about 35% lower than in the United States, and the standard deviation of SWL is about 0.3 points less. According to our estimated coefficients, these two differences in wealth and inequality are associated with comparable differences in happiness. Indeed, according to the Gallup World Poll, the mean SWL in 2014 in the US was 7.28 and in New Zealand it was a nearly identical 7.35. Denmark—the country with the world's highest mean SWL level of 7.58—has about the same GDP per capita as the United States and about the same SWL dispersion as New Zealand.

# 2 Data

Section 2.1 provides a general discussion of satisfaction with life data, and the inter-personal comparability assumptions that are required in its analysis. Section 2.2 explains our use of the standard deviation to measure SWL dispersion. Section 2.3 describes the SWL surveys we use. Section 2.4 details our sources for supporting macro data.

## 2.1 Satisfaction with life

We use the term *satisfaction with life* (SWL) to refer to a person's overall evaluation of his or her life. A typical survey question is "All things considered, how satisfied are you with your life as a whole nowadays?" with answers given on a scale ranging from "extremely dissatisfied" to "extremely satisfied". Another commonly used question, the *Cantril Ladder*, asks respondents to rank their life between the worst and best possible life for them. Section 2.3 describes the questions that are available in the surveys we analyze.

SWL provides a measure of individual welfare that includes all the things a person cares about with the importance he or she assigns to them. The first well-known economics paper using SWL data as a proxy for welfare or utility is probably Easterlin (1974). The rate of publications has substantially increased around 2005, with such papers as Luttmer (2005), Van Praag and Baarsma (2005), Di Tella and MacCulloch (2006), Frey et al. (2007), Clark et al. (2008), and Layard et al. (2008). Deaton (2010) advocates its use in measuring international differences in poverty.

The use of SWL data raises two important concerns: interpersonal comparability and the linearity of the transformation between true utility and reported SWL. To appreciate these concerns, let $h_j$ denote the reported SWL of person $j$, and let $u_j$ denote her actual SWL or welfare. The interpersonal comparability problem is that different people could potentially use different transformations to report their utility: $h_j = f_j(u_j)$ and $h_k = f_k(u_k)$ with $f_j \neq f_k$. The linearity problem is that OLS regressions with $h_j$ as the dependent variable necessarily assume that equal differences in reported SWL correspond to equal differences in actual SWL, but that is only true if the reporting functions are linear.

There are two answers to these concerns. First, far from being a new and questionable requirement of SWL studies, interpersonal comparisons of well-being are a normal and unavoidable assumption in everyday life. As Harsanyi (1955) writes, "There is no doubt about the fact that people do make, or at least attempt to make, interpersonal comparisons of utility, both in the sense of comparing different persons' total satisfaction and in the sense of comparing increments and decrements in different persons' satisfaction." Second, research shows that SWL reports correlate as expected with other people's estimates, with neuropsychological measures, and with external factors that are expected to affect utility, and that they are in turn a good predictor of decisions, such as quitting and marital break-up (Clark et al., 2008).

In common with other SWL research, we take interpersonal comparability for granted. Most importantly, we assume that any individual differences in SWL reporting are uncorrelated with regressors: there is no systematic tendency for people in high inequality countries to report their SWL differently than people in low inequality countries. Most of the analysis assumes linearity: equal differences in reported SWL correspond to equal differences in actual SWL. Relaxing linearity requires strong distributional assumptions (Clark et al., 2008; Layard et al., 2008). Nevertheless, as a robustness check we test a non-linear model (Section 3.4.3) and an ordinal measure of SWL dispersion (Section 3.4.4).

## 2.2 Measuring inequality

We use the standard deviation of SWL as our primary indicator of SWL dispersion, and the Gini coefficient of income for income inequality. One of the key properties of the Gini coefficient is scale invariance: changing the units (or currency) in which income is measured makes no difference to the Gini coefficient. This is an important property, since it is difficult to ensure that income is measured in comparable units across clusters.

SWL is reported on the same scale in different countries, making scale-invariance irrelevant. The key property in a measure of SWL dispersion is invariance to additive shifts. Consider two clusters in which the distribution of SWL is the same except for an additive shift, so that the mean is higher in one cluster than in the other. We want our measure of dispersion to be the same in both clusters. This is the case for the variance or standard deviation, but not for the Gini coefficient or the coefficient of variation.[7] The choice between the standard deviation and the variance makes little practical difference. We follow the precedent in this literature (Kalmijn & Veenhoven, 2005), and measure SWL dispersion by the standard deviation of the distribution. In Appendix A we include results using the variation ratio, which is defined as the proportion of observations outside the mode. The variation ratio is more noisy measure of dispersion than the standard deviation, but as a purely ordinal measure of dispersion it provides a useful robustness test.

## 2.3 SWL surveys

We use data from four surveys: the World Values Survey (WVS), the European Social Survey (ESS), the Gallup World Poll (GWP), and the Gallup-Healthways Well-Being Index (GHWBI). Table 1 summarizes key statistics about these surveys. The sections below provide more details.

### European Social Survey

The European Social Survey[8] includes 36 European countries and Israel. We use waves 1-7 with data from 2006 to 2015 with a total of 303,385 individual SWL observations. The SWL variable is life satisfaction (`stflife`), which is recorded on a 0–10 scale, with end points labelled *Extremely dissatisfied* and *Extremely satisfied*. Clusters are defined by the combination of country

[7]These last two measures are reduced by a positive additive shift. Using these measures would therefore result in a mechanical negative correlation between happiness and inequality even if the reporting scale is unbounded!

[8]http://www.europeansocialsurvey.org

Table 1: The SWL surveys used in the paper.

| | ESS[a] | WVS[a] | GWP[a] | GHWBI[a] |
|---|---|---|---|---|
| Year range | 2002–2015 | 1989-2014 | 2006–2014 | 2008–2011 |
| Geographic Units | countries | countries | countries | states |
| No. geog. units | 36 | 93 | 164 | 50 |
| No. clusters | 166 | 222 | 1,120 | 200 |
| Individual obs. | 303,853 | 314,903 | 1,341,049 | 1,404,982 |
| SWL variable | Satisfaction with life | Satisfaction with life | Cantril Ladder | Cantril Ladder |
| SWL range | 0–10 | 1–10 | 0–10 | 0–10 |
| Mean SWL[b] | 4.22–8.58<br>$6.85 \pm 0.96$ | 3.94–8.49<br>$6.58 \pm 1.05$ | 2.69–8.02<br>$5.45 \pm 1.11$ | 6.28–7.48<br>$6.81 \pm 0.19$ |
| SWL inequality[b] | 1.39–3.08<br>$2.10 \pm 0.36$ | 1.33–3.00<br>$2.19 \pm 0.33$ | 0.86–3.22<br>$1.94 \pm 0.32$ | 1.68–2.39<br>$2.03 \pm 0.10$ |
| Income inequality[b] | 0.24–0.43<br>$0.32 \pm 0.04$ | 0.17–0.65<br>$0.39 \pm 0.10$ | 0.17–0.65<br>$0.38 \pm 0.08$ | 0.40–0.50<br>$0.46 \pm 0.02$ |
| Log GDP[b] | 8.89–11.40<br>$10.35 \pm 0.45$ | 6.75–11.75<br>$9.36 \pm 0.97$ | 6.42–11.81<br>$9.27 \pm 1.17$ | 10.24–11.06<br>$10.60 \pm 0.16$ |
| Social trust[c] | Yes | Yes | Partial | |
| View of inequality[c] | Yes | Yes | | |
| Emotions yesterday[c] | | | Yes | |

[a] Section 2.3 explains these acronyms.
[b] The columns report for each of the surveys the overall range, mean, and standard deviation of the variable in that row. The row variables correspond to $\mu_i$, $\sigma_i$, $g_i$, and $Y_i$ in the regression equations.
[c] Columns report whether the survey has the information in the row.

(`cntry`) and wave (`essround`). The interview year (`inwyye`, `inwyr`, `inwyys`, and `supqyr`) is used for matching with macro variables. Personal controls include gender (`gndr`), age (`age` and `agea`), education (`edulvla` and `eisced` values recoded into the `edulvla` range), marital status (`marital`, `marsts`, `maritala`, and `maritalb`), and unemployment (`unemp3m` and `unempla`). We use post-stratification weights (`pspwght`) for weighting, except in wave 7 when only design weights (`dweight`) are available. We use the variable `gincdif` as measuring a preference for equality. Subjects were asked to record their agreement or disagreement to the following statement: *"The government should take measures to reduce differences in income levels"*. Answers were originally on a 5 level scale ranging from *Agree strongly* to *Disagree strongly*, which we invert to a $-2$ to $+2$ range, with $+2$ denoting strong agreement. The trust variable `ppltrst` is a 0–10 variable with endpoints labelled *You can't be too careful* and *Most people can be trusted*.

### World Values Survey

The World Values Survey includes data from 98 countries. We use waves 1-6 with data from 1981 to 2014 with a total of 314,903 individual SWL observations.[9] The SWL variable we use is life satisfaction (`A170`) reported on a 1–10 scale with endpoints labelled *Dissatisfied* and *Satisfied*. Clusters are defined by the combination of country (`S003`) and wave (`S002`). The interview year (`S020`) is used for matching with macro variables. Personal controls include gender (`X001`), age (`X003`), education (`X025`) and marital status (`X007`). Weights are given by `S017`. The variable `E035` codes a preference for equality. Subjects were asked to report their view on a 1 to 10 scale with 1 labelled "Incomes should be made more equal" and 10 labelled "We need larger income differences as incentives for individual effort". We inverted this scale, so that higher values denote a preference for equality. Finally, the trust variable `A165` is a binary question, asking people whether "Most people can be trusted" or "you can't be too careful". We recode it so that a positive value denotes agreement with "Most people can be trusted".

[9] http://www.worldvaluessurvey.org. We exclude data from Egypt in 2001 and from India in 2001 and 2006, as these particular surveys did not use the full SWL range.

### Gallup World Poll

The Gallup World Poll[10] includes data from over 160 countries. We used the December 2014 version of the dataset, which includes data for every year from 2008 to 2014, and about 1.34 million individual observations. The SWL variable is the Cantril Ladder of Life (`WP16`) recorded on a 0–10 scale with end points labelled "Worst possible life for you" and "Best possible life for you". Clusters are defined by the combination of country code (`ccode`) and the interview year (`YEAR_CALENDAR`). Personal controls include gender (`WP1219`), age (`WP1220`), and marital status (`WP1223`). We use `wgt` for weighting observations. As in the World Values Survey, the trust variable `WP9039` is binary, asking whether "most people can be trusted" or "you have to be careful in dealing with people". We recoded answers so that a positive value denotes agreement with "most people can be trusted". The emotions data we use includes the following variables: `WP60` (well-rested), `WP67` (enjoyment), `WP69` (worry), `WP70` (sadness), `WP71` (stress), `WP74` (anger), and `WP6878` (happiness). These are all binary questions, asking whether the respondent experienced that particular emotion in the previous 24 hours.

### Gallup-Healthways Well-Being Index

Gallup-Healthways Well-Being Index[11] includes data from the United States with enough observations for useful statistics at the state level. We use the May 2012 version of the dataset, which includes data for every year from 2008 to 2011 and a total of 1.4 million individual SWL observations. The subjective well-being variable is the Cantril Ladder of Life recorded on a 0–10 scale. Clusters are defined by the combination of state (`zipstate`) and the interview year (obtained from the interview date, `int_date`). Personal controls include gender (`sc7`), age (`age`), marital status (`wp1223`) and education (`d4`). We use `weight` for weighting observations.

## 2.4 Macro data

We use the World Bank's World Development Indicators[12] as our primary source for GDP per capita and income inequality data in different countries.

[10] http://www.gallup.com/services/170945/world-poll.aspx
[11] http://www.well-beingindex.com
[12] http://data.worldbank.org/data-catalog/world-development-indicators

GDP per capita is in constant prices adjusted for purchasing power parity. Income inequality is measured by the Gini coefficient of income. When data is missing, we interpolate linearly using the nearest data points when we have both more recent and older data, and use the most recent data available when we only have older data. At the opposite end, the World Bank data we use starts at 1990, and some World Values Survey observations are for earlier years. We use GDP data from version 8.1 of the Penn World Tables to fill in the missing years.[13] For the Gallup-Healthways Well-Being Index we need US state level information. We use the U.S. Census Bureau's American Community Survey for Gini coefficients, and the Bureau of Economic Analysis for GDP.[14]

We use GDP per capita as an income control, since it is available in comparable form for all surveys. We have used household income data from the European Social Survey (ESS) and Gallup World Poll (GWP) for robustness checks against the possibility that the use of aggregate income might bias upwards our estimate of the effects of SWL inequality on average SWL. In the ESS sample our estimates of the effects of SWL inequality are actually higher using logs of household incomes, national means of the logs of household incomes, or logs of the national means of household incomes than they are using log GDP. The GWP results are more mixed, but for both surveys the sign and significance of the coefficients on SWL inequality as well as the results comparing SWL inequality and income inequality reported below are unchanged by using any of the alternative income measures.

# 3 Analysis

Section 3.1 discusses some general issues common to all our regressions. Section 3.2 describes the baseline regressions that establish the partial correlation between SWL levels and SWL dispersion. Section 3.3 describes the comparison with income inequality. Finally, Section 3.4 describes the tests for whether the correlation between SWL levels and dispersion is real.

[13]https://pwt.sas.upenn.edu. We use data from the earliest year in which we have GDP data from both sources (1990 for most countries) to normalize the Penn data that we use for years prior to 1990. This corrects for differences in the GDP, purchasing power, and population figures that the two datasets use, as well as for the across-the-board difference in the base year.

[14]https://www.census.gov/programs-surveys/acs and http://www.bea.gov.

## 3.1 Considerations common to all regressions

The correlations we are most interested in are between mean SWL and SWL dispersion—both of which are cluster level variables. This seems to suggest cluster level regressions, with one observation per cluster. Our data has individual level observations, however, including (in two of the surveys) information about the individual's own attitude towards inequality. In order to take advantage of this information, we estimate individual level regressions with standard errors corrected for clustering. SWL inequality, income inequality, and log GDP per capita are measured in clusters defined by the combination of geographic unit (country or state) and time (survey wave or year). Observations with ambiguous values ("no answer", "don't know") are treated as missing.

## 3.2 Baseline correlations in different surveys

Our baseline regression tests whether the correlations found in previous research (Delhey, 2004; Ott, 2005; Bolle et al., 2009) remain when we control for GDP per capita, as well as personal and region controls:

$$h_{ij} = \alpha + \beta_\sigma \sigma_i + \beta_Y Y_i + \sum_k \gamma_k x_{ijk} + \epsilon_{ij}, \tag{1}$$

where $h_{ij}$ denotes the reported SWL of person $j$ in cluster $i$, $\sigma_i$ denotes the standard deviation of SWL in this cluster, $Y_i$ is the logarithm of GDP per capita in PPP terms, and $x_{ijk}$ are personal controls for gender, age, education, employment, and marital status. In the World Values Survey and Gallup World Poll we also add region dummies in order to control for between-region differences in SWL levels.[15] Given previous research, the expectation is that $\beta_\sigma$ is negative. We also estimate a regression with geographic unit (country or state) dummies. This regression controls for any fixed differences in SWL levels between countries (including any fixed reporting biases), testing whether changes in SWL levels are correlated with changes in SWL dispersion.

[15] Regions include: (i) the West (Europe, North America, and Oceania), (ii) Latin America, (iii) Asia, (iv) Middle East and North Africa, and (v) Sub-Saharan Africa.

## 3.3 Comparing income inequality with SWL dispersion

If SWL dispersion is a comprehensive measure of inequality, its correlation with individual well-being should be stronger than the corresponding correlation for income inequality, or other less general measures of inequality. We estimate a variation of Equation 1 with the Gini coefficient of income, $g_i$ replacing $\sigma_i$:

$$h_{ij} = \alpha + \beta_g g_i + \beta_Y Y_i + \sum_k \gamma_k x_{ijk} + \epsilon_{ij}, \qquad (2)$$

and a combined regression with both measures of inequality:

$$h_{ij} = \alpha + \beta_\sigma \sigma_i + \beta_g g_i + \beta_Y Y_i + \sum_k \gamma_k x_{ijk} + \epsilon_{ij}. \qquad (3)$$

The hypotheses in Equation 3 are that the correlation with $\sigma_i$ remains significant: $\beta_\sigma < 0$, and is larger in magnitude than the corresponding correlation with income inequality: $|\beta_\sigma| > |\beta_g|$.

## 3.4 Testing for a mechanical correlation bias

### 3.4.1 Is the correlation stronger in subjects who care more about inequality?

Our first test exploits variation in the degree to which different people care about inequality. The World Values Survey and the European Social Survey ask respondents whether income differences should be reduced, with answers on a 5 level scale. The distribution of responses is far from uniform, with about three quarters of responders either agreeing or strongly disagreeing with this statement. Nevertheless, there is enough variation for a useful indicator of how much a given responder cares about inequality.

We estimate the following equation, where $e_{ij}$ denotes person's $i$ level of agreement that inequality should be reduced:

$$h_{ij} = \alpha + \beta_\sigma \sigma_i + \beta_g g_i + \beta_e e_{ij} + \beta_{e\sigma} e_{ij} \sigma_i + \beta_{eg} e_{ij} g_{i+} \beta_Y Y_i + \sum_k \gamma_k x_{ijk} + \epsilon_{ij}. \qquad (4)$$

Our interest is in the interaction term $\beta_{e\sigma}$. If the correlation between SWL levels and dispersion is real, we would expect $\beta_{e\sigma}$ to be negative (stronger correlation among responders who care more about inequality). If, however, the correlation is primarily a mechanical artifact of the way SWL is reported, $\beta_{e\sigma}$ should be insignificantly different from zero.

### 3.4.2 Partialling out the mechanical effect of mean SWL

Several of the datasets we use include measures of such SWL determinants as social trust and various emotions that are known to be correlated with the level of inequality. If SWL dispersion is a good measure of inequality, we would expect these variables to be correlated with SWL dispersion, and we would not expect this correlation to change significantly if we add SWL levels as a control. If, however, the correlation between SWL levels and SWL dispersion is mechanical, these variables should only be correlated with SWL dispersion through their correlation with SWL levels. In that case we would expect this correlation to be relatively small, and to disappear entirely if SWL levels are added as a control.

For a well-being determinant $w_{ij}$ we estimate the following two regressions:

$$w_{ij} = \alpha + \beta_\sigma \sigma_i + \beta_Y Y_i + \sum_k \gamma_k x_{ijk} + \epsilon_{ij}, \tag{5}$$

and

$$w_{ij} = \alpha' + \beta_\mu \mu_i + \beta'_\sigma \sigma_i + \beta'_Y Y_i + \sum_k \gamma'_k x_{ijk} + \epsilon'_{ij}, \tag{6}$$

where $\mu_i$ denotes the mean SWL level in cluster $i$. If SWL dispersion is a good measure of inequality, we would expect $\beta_\sigma$ in Equation 5 to be negative. Since $\mu_i$ is positively correlated with $w_{ij}$, we should not be surprised if the correlation is weakened when $\mu_i$ is added to the regression (Equation 6), but it should remain negative:

$$\beta_\sigma \leq \beta'_\sigma < 0. \tag{7}$$

Suppose, instead, that SWL dispersion has nothing to do with inequality, so that the correlation between SWL levels and SWL dispersion is purely mechanical (Figure 1). If that were the case, any correlation between $w_{ij}$ and $\sigma_i$ would be mediated by $\mu_i$, and should largely disappear when $\mu_i$ is added as a control in Equation 6:[16]

$$\beta_\sigma < \beta'_\sigma \approx 0. \tag{8}$$

The first well-being determinant we test is social trust. Survey questions on social trust have been validated by correlating answers on with cross-country differences in the frequency with which experimentally dropped wallets were returned (Knack & Keefer, 1997). Responses are available as a

[16] If the mechanical component of the correlation is a linear function of $\mu_i$ it should disappear entirely by the Frisch-Waugh-Lovell theorem.

0–10 numeric variable in the European Social Survey (ESS), and as a binary variable in the World Values Survey (WVS) and Gallup World Poll (GWP). There is no trust question in the Gallup-Healthways Well-Being Index. In ESS we estimate linear regressions, and in WVS and GWP we estimate a logit regression.

The other well-being determinants we use are yes/no questions on worry and stress in the previous day, and a question on whether the respondent fears walking alone. These questions are only available in the Gallup World Poll. As these are yes/no questions we use logit regressions. Since they are negatively related to well-being, they are predicted to increase in SWL inequality. The hypotheses in Equations 7 and 8 are therefore reversed, and $\beta_\sigma$ and $\beta'_\sigma$ are predicted to be positive.

#### 3.4.3 Modelling the SWL reporting function

Actual SWL may best be thought of as a continuous variable, but SWL reports are restricted to integers in a bounded range, such as 0–10. As we note in the introduction and in Figure 1, the truncation and quantization could, in principle, create a mechanical correlation between SWL levels and SWL dispersion that has nothing to do with the level of inequality. Our approach in this section is to model the reporting function and reestimate the regressions of Section 3.2 in actual SWL space.

This approach necessitates identifying assumptions on the distribution of actual SWL. We use maximum likelihood to estimate a model where the distribution of actual SWL in each cluster is logistic. After estimating the mean $\mu_i^*$ and standard deviation $\sigma_i^*$ in each cluster $i$, we estimate an analogue of Equation 1,

$$\bar{h}_{ij}^* = \alpha^* + \beta_\sigma^* \sigma_i^* + \beta_Y^* Y_i + \sum_k \gamma_k^* x_{ijk} + \epsilon_{ij}^*, \tag{9}$$

where $\bar{h}_{ij}^*$ is the expected value in the distribution of actual SWL values that are consistent with the SWL report $h_{ij}$.

The coefficient $\beta_\sigma^*$ in Equation 9 can then be compared with the corresponding coefficient $\beta_\sigma$ in Equation 1. If actual SWL is negatively correlated with inequality, $\beta_\sigma^*$ should be negative. If, however, $\beta_\sigma$ is only negative because of the non-linearity in the reporting function, we would expect $\beta_\sigma^*$ to be zero. If the correlation is partly real and partly mechanical, we may expect $\beta_\sigma^*$ to be negative, but smaller in magnitude than $\beta_\sigma$.

The estimates of the mechanical correlation component that are obtained using this method are driven by the difference between the distribution of reported SWL and our assumptions on the distribution of actual SWL. The distribution of reported SWL in most countries is left skewed. In a typical country, the mode may be at 7 on a 0-10 scale, with a large majority of respondents reporting a value of 6 or above, but some respondents reporting values as low as 0 or 1. Our assumption that actual SWL is symmetrically distributed explains this left skew as the result of non-linearities in the reporting function. There are, however, good reasons to expect the distribution of actual SWL to be left skewed. In particular, common mental health problems such as anxiety and depression can cause people to be far less happy with their lives, adding a left skew to what might otherwise be an approximately symmetric distribution. The absence of satiation in SWL regressions also argues against non-linearities in the reporting function (Stevenson & Wolfers, 2013). We should thus expect this estimation procedure to overestimate the mechanical component of the correlation between SWL and inequality, or equivalently, to underestimate the true correlation that we are interested in.

### 3.4.4 Ordinal measure of SWL dispersion

Finally, we repeat the regressions of Sections 3.2, 3.3 and 3.4.1 using the variation ratio measure of SWL dispersion (Section 2.2).

# 4 Results

Section 4.1 reports the results of all satisfaction with life regressions: the baseline regressions (Section 3.1), the corresponding regressions with income inequality (Section 3.3), and the regressions testing whether the correlation between the mean and dispersion of the SWL distribution is stronger among those responders who describe themselves as more concerned with inequality (Section 3.4.1). Section 4.2 turns to regressions of SWL components in which we partial out the effect of mean SWL (Section 3.4.2). Section 4.3 describes the results of modelling the SWL reporting function to estimate the correlation between the mean and dispersion of the SWL distribution in actual SWL space (Section 3.4.3). Appendix A reports results with the variation measure of SWL dispersion.

## 4.1 Satisfaction with life regressions

The results of the regressions are qualitatively similar in all four surveys: SWL dispersion is strongly negatively correlated with SWL despite the inclusion of GDP per capita and other controls; the corresponding correlation with income inequality is consistently weaker; the correlation is stronger among those particularly concerned with inequality, consistent with the hypothesis that this correlation is not mechanical, but real, capturing the true correlation between SWL and comprehensive inequality. The following sections describe the results for each survey in turn.

### European Social Survey

The results for the European Social Survey are in Table 2. The partial correlation between SWL levels and SWL dispersion is negative: $\hat{\beta}_\sigma = -0.21$ and is strongly statistically significant ($p \ll 0.001$). The corresponding correlation with the Gini coefficient of income (Column 2) is also statistically significant ($p < 0.001$), but the standardized beta coefficient is only a third in size: $\hat{\beta}_g = -0.07$ as compared with $\hat{\beta}_\sigma = -0.21$. When both measures of inequality are included in the same regression (Column 3), the Gini coefficient drops to insignificance, whereas the coefficient on SWL dispersion is hardly changed: $\hat{\beta}_\sigma = -0.20$. Column 4 adds the subjective importance of reducing inequality and its interaction with SWL and income inequality. As expected, the interaction term with SWL dispersion is negative: $\hat{\beta}_{e\sigma} = -0.22$ ($p < 0.001$), but the interaction term with income inequality is insignificant and of the wrong sign. The interaction term with SWL dispersion remains negative even when country dummies are included (Column 5). In summary, the correlation between SWL levels and SWL dispersion is consistently negative in both the cross-section and across time, is *more* negative than the correlation between SWL levels and income inequality, and is stronger among those who describe themselves as particularly averse to inequality.

### World Values Survey

The results for the World Value Survey (Table 3) are not as strong, but are otherwise similar to the European Social Survey results. The partial correlation with SWL dispersion is $\hat{\beta}_\sigma = -0.17$ ($p \ll 0.001$). The corresponding correlation with income inequality (Column 2) is also negative ($\hat{\beta}_g = -0.05$),

Table 2: SWL and inequality regressions in the European Social Survey with the standard deviation measure of SWL dispersion[a]

| | Dependent variable: life satisfaction (0–10) | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| SWL | -0.21*** | | -0.20*** | -0.16*** | -0.11*** |
| standard deviation[b] | (-9.82) | | (-8.77) | (-8.00) | (-4.35) |
| Income | | -0.07** | -0.02 | -0.02 | -0.04* |
| Gini coef.[b] | | (-3.33) | (-0.85) | (-1.17) | (-2.13) |
| GDP per capita | 0.18*** | 0.33*** | 0.18*** | 0.17*** | 0.29*** |
| in log terms[b] | (9.30) | (19.21) | (9.27) | (8.42) | (4.63) |
| Thinks inequality | | | | 0.08 | 0.09** |
| is too high[c] | | | | (1.29) | (2.75) |
| × SWL | | | | -0.22*** | -0.23*** |
| standard deviation | | | | (-4.73) | (-9.19) |
| × income | | | | 0.05 | 0.06 |
| | | | (0.93) | (1.39) | |
| Country dummies | | | | | Yes |
| No. of observations | 303853 | 301960 | 301960 | 301960 | 301960 |

[a] Standardized beta coefficients; $t$ statistics corrected for clustering in parentheses. Statistical significance indicators: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Clusters defined by country/wave combination.
[b] Cluster level variables: $\sigma_i$, $g_i$, and $Y_i$ in the text.
[c] 5 level variable indicating individual preference for equality ($e_{ij}$ in the text). Positive values indicate agreement and negative values disagreement.
[d] Gender, age, age squared, education (dummies), and marital status (dummies).

but is not statistically significant ($p < 0.268$). When both forms of inequality are included in the same regression (Column 3), the coefficient on SWL dispersion is virtually unchanged: $\hat{\beta}_\sigma = -0.17$ and the coefficient on income inequality remains insignificant. The interaction term with the importance of SWL dispersion (Column 4) is negative: $\hat{\beta}_{e\sigma} = -0.17$ ($p < 0.001$), and this remains the case when country dummies are added (Column 6) with $\hat{\beta}_{e\sigma} = -0.13$ ($p < 0.001$).

### Gallup World Poll

The correlations in the Gallup World Poll (Table 4) are mostly similar to those of the previous two surveys, though income inequality is more significant than in the other two surveys. The partial correlation between SWL levels with SWL dispersion is $\hat{\beta}_\sigma = -0.10$ ($p \ll 0.001$). The corresponding correlation with income inequality (Column 2) is also statistically significant, but weaker: $\hat{\beta}_g = -0.06$. When both inequality measures are included in the same regression (Column 3), $\hat{\beta}_g$ drops in magnitude to -0.04 ($p < 0.006$), while $\hat{\beta}_\sigma$ is unchanged: $\hat{\beta}_\sigma = -0.10$ ($p < 0.001$). When country dummies are added (Column 4) $\hat{\beta}_\sigma$ drops to $-0.05$ but remains strongly statistically significant ($p < 0.001$). Interestingly, the coefficient on income inequality becomes stronger: $\hat{\beta}_g = -0.09$.

### Gallup-Healthways Well-Being Index

Results in the Gallup-Healthways Well-Being Index (Table 5) are also qualitatively similar. The partial correlation with SWL dispersion is $\hat{\beta}_\sigma = -0.05$ ($p \ll 0.001$). Income inequality is not statistically significant (Column 2). When both forms of inequality are included (Column 3) the coefficient on SWL dispersion is unchanged: $\hat{\beta}_\sigma = -0.06$, while the coefficient on income inequality is statistically significant ($p < 0.005$) but with an unexpected positive sign ($\hat{\beta}_g = 0.02$). Adding state dummies (Column 4) causes a sharp reduction in the coefficient on SWL dispersion: $\hat{\beta}_\sigma = -0.13$, but it remains strongly statistically significant.

## 4.2 Partialling out the mechanical effect of mean SWL

This section reports the results of the partialling out analysis of Section 3.4.2. The results for social trust are in Table 6. The six columns are in pairs corre-

Table 3: SWL and inequality regressions in the World Values Survey with the standard deviation measure of SWL dispersion[a]

| | Dependent variable: life satisfaction (1–10) | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| SWL<br>standard deviation[b] | -0.17***<br>(-5.87) | | -0.17***<br>(-6.01) | -0.18***<br>(-6.53) | -0.11**<br>(-2.85) |
| Income<br>Gini coef.[b] | | -0.05<br>(-1.11) | -0.01<br>(-0.18) | -0.01<br>(-0.17) | -0.24**<br>(-2.99) |
| GDP per capita<br>in log terms[b] | 0.18***<br>(5.60) | 0.28***<br>(8.34) | 0.21***<br>(5.81) | 0.21***<br>(6.03) | 0.23**<br>(2.84) |
| Thinks inequality<br>is too high[c] | | | | 0.08<br>(1.51) | 0.01<br>(0.27) |
| × SWL<br>standard deviation | | | | -0.17***<br>(-3.57) | -0.13**<br>(-3.04) |
| × income<br>gini | | | | 0.03<br>(0.84) | 0.04<br>(1.28) |
| Region dummies | Yes | Yes | Yes | Yes | |
| Country dummies | | | | | Yes |
| No. of observations | 271667 | 243875 | 243875 | 235587 | 235587 |

[a] Standardized beta coefficients; $t$ statistics corrected for clustering in parentheses. Statistical significance indicators: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Clusters defined by country/wave combination.
[b] Cluster level variables: $\sigma_i$, $g_i$, and $Y_i$ in the text.
[c] 1-5 variable indicating individual preference for equality: $e_{ij}$ in the text.
[d] Gender, age, age squared, education (dummies), and marital status (dummies).

Table 4: SWL and inequality regressions in the Gallup World Poll with the standard deviation measure of SWL dispersion[a]

| | Dependent variable: Cantril ladder (0–10) | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| SWL standard deviation[b] | -0.10*** (-9.49) | | -0.10*** (-8.81) | -0.05*** (-4.15) |
| Income Gini coef.[b] | | -0.06*** (-3.72) | -0.04** (-2.76) | -0.09** (-3.03) |
| GDP per capita in log terms[b] | 0.38*** (31.69) | 0.39*** (26.33) | 0.39*** (27.23) | 0.45*** (4.87) |
| Region dummies | Yes | Yes | Yes | |
| Country dummies | | | | Yes |
| No. of observations | 1256817 | 1133621 | 1133621 | 1133621 |

[a] Standardized beta coefficients; $t$ statistics corrected for clustering in parentheses. Statistical significance indicators: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Clusters defined by country/wave combination.

[b] Cluster level variables: $\sigma_i$, $\sigma_i$, and $Y_i$ in the text.

[c] Gender, age, age squared, education (dummies), and marital status (dummies).

Table 5: SWL and inequality regressions in the Gallup-Healthways Well-Being Index with the standard deviation measure of SWL dispersion[a]

| | Dependent variable: Cantril ladder (0–10) | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| SWL standard deviation[b] | -0.05*** (-8.38) | | -0.06*** (-9.46) | -0.13*** (-29.22) |
| Income Gini coef.[b] | | 0.01 (1.12) | 0.02** (2.87) | -0.01 (-1.50) |
| GDP per capita in log terms[b] | -0.00 (-0.31) | -0.00 (-0.36) | -0.00 (-0.29) | -0.02 (-1.21) |
| State dummies | | | | Yes |
| No. of observations | 1363274 | 1363274 | 1363274 | 1363274 |

[a] Standardized beta coefficients; $t$ statistics corrected for clustering in parentheses. Statistical significance indicators: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Clusters defined by state/wave combination.

[b] Cluster level variables: $\sigma_i$, $g_i$, and $Y_i$ in the text.

[c] Gender, age, age squared, education (dummies), and marital status (dummies).

sponding to the three surveys that include social trust questions: the European Social Survey (ESS), the World Values Survey (WVS), and the Gallup World Poll (GWP). Consistent with our hypotheses, social trust is strongly negatively correlated with SWL dispersion in all three surveys (Columns 1, 3, and 5). Income inequality, by contrast, is borderline statistically significant in the ESS and WVS, and completely insignificant in the GWP. When mean SWL in the cluster is added to the equation (Columns 2, 4, and 6) the coefficient on SWL dispersion is completely unchanged in the WVS, and only marginally reduced in size in the other two surveys: from $-0.25$ to $-0.21$ in the ESS, and from $-0.25$ to $-0.22$ in the GWP. In all three cases the coefficient remains strongly significant ($p < 0.001$ in ESS and GWP, and $p < 0.01$ in WVS). Table 7 reports the results for worry, stress, and fear walking alone. As expected, SWL dispersion is positively correlated with worry, stress, and fear of walking alone (Columns 1, 3 and 5). As with social trust (Table 6) the magnitude of the correlation remains strongly statistically significant ($p < 0.001$) when mean SWL is added to the regressions, and is barely changed in size (Columns 2, 4, and 6).

The results in this section are consistent: a small to non-existent change in the magnitude of the correlation with SWL dispersion with mean SWL is added to the regression. It follows that only a small component of the correlation is mediated by mean SWL, and that the bulk of the correlation captures the true correlation with comprehensive inequality, rather than any mechanical correlation effect.

### 4.3 Modelling the SWL reporting function

Table 8 compares the results of the logistic distribution model of Section 3.4.3 with the corresponding linear model. The distribution of SWL is a little wider in the logistic model in all the surveys, both across and within clusters (the latter resulting in a higher level of SWL dispersion). This result is consistent with some systematic distortion due to the truncation inherent in SWL reports. Consequently, it is not surprising that the regression coefficient on SWL dispersion is smaller in size in the logistic model, though it remains strongly statistically significant in all the surveys. The greatest decrease is in World Values Survey, with the regression coefficient decreasing in size from $\hat{\beta}_\sigma = -0.17$ to $\hat{\beta}^*_\sigma = -0.10$.

These results suggest that up to a third of the correlation between SWL and SWL dispersion may be an artifact of the reporting function. As argued

Table 6: Social trust and SWL dispersion regressions in the European Social Survey (ESS), the World Values Survey (WVS), and the Gallup World Poll (GWP).[a]

| | Dependent variable: social trust | | | | | |
|---|---|---|---|---|---|---|
| | ESS | | WVS | | GWP | |
| Mean SWL[b] | | 0.09** (2.94) | | 0.01 (0.10) | | 0.15 (1.43) |
| SWL dispersion[b] | −0.25*** (−11.64) | −0.21*** (−7.73) | −0.18** (−3.24) | −0.18** (−2.62) | −0.25*** (−3.71) | −0.22*** (−3.29) |
| Income inequality[b] | −0.03 (−1.88) | −0.03 (−1.97) | −0.20* (−2.10) | −0.20* (−2.09) | −0.20* (−0.50) | −0.20* (−0.32) |
| Log GDP per capita[b] | 0.07*** (3.55) | 0.02 (0.95) | 0.21*** (3.96) | 0.21** (3.03) | 0.29** (3.17) | 0.18 (1.38) |
| Observations | 302317 | | 232580 | | 173006 | |

[a] Standardized beta coefficients; $t$ statistics corrected for clustering in parentheses. Statistical significance indicators: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Clusters defined by country/wave combination. All regressions include personal controls (gender, age, age squared, education dummies, and marital status dummies).

[b] Cluster level variables: $\mu_i$, $\sigma_i$, $g_i$, and $Y_i$ in the text.

Table 7: Logit regressions relating worry, stress, and fear of walking alone to SWL dispersion in the Gallup World Poll.[a]

| | Dependent variable | | | | | |
|---|---|---|---|---|---|---|
| | Worry | | Stress | | Fear | |
| Mean SWL[b] | | $-0.19^{***}$ (−7.06) | | 0.01 (0.14) | | $-0.20^{***}$ (6.00) |
| SWL dispersion[b] | $0.16^{***}$ (−11.64) | $0.12^{***}$ (−7.73) | $0.19^{***}$ (−3.71) | $0.20^{***}$ (−3.29) | $0.12^{***}$ (−3.24) | $0.09^{***}$ (−2.62) |
| Log GDP per capita[b] | $-0.04^{*}$ (−2.15) | $0.10^{***}$ (3.57) | $0.22^{***}$ (9.98) | $0.22^{***}$ (6.39) | $-0.11^{**}$ (3.16) | 0.03 (−0.72) |
| Observations | 1189093 | | 1092930 | | 1102859 | |

[a] Standardized beta coefficients; $t$ statistics corrected for clustering in parentheses. Statistical significance indicators: $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$. Clusters defined by country/wave combination. All regressions also include regional dummies and personal controls (gender, age, age squared, education dummies, and marital status dummies).

[b] Cluster level variables: $\mu_i$, $\sigma_i$, and $Y_i$ in the text.

Table 8: Comparison of the logistic and linear models in the distribution of mean SWL in different clusters, SWL dispersion in those clusters, and the coefficient in a regression of SWL on SWL dispersion.

| | ESS[a] | WVS[a] | GWP[a] | GHWBI[a] |
|---|---|---|---|---|
| **Linear model** | | | | |
| Mean SWL[b] | $6.85 \pm 0.96$ | $6.58 \pm 1.05$ | $5.45 \pm 1.11$ | $6.81 \pm 0.19$ |
| SWL dispersion[b] | $2.10 \pm 0.36$ | $2.19 \pm 0.33$ | $1.94 \pm 0.32$ | $2.03 \pm 0.10$ |
| Regression coefficient $(\hat{\beta}_\sigma)^c$ | -0.21*** (-9.82) | -0.17*** (-5.87) | -0.10*** (-9.49) | -0.05*** (-8.38) |
| **Logistic model** | | | | |
| Mean SWL[b] | $6.88 \pm 1.04$ | $6.71 \pm 1.19$ | $5.52 \pm 1.12$ | $6.99 \pm 0.18$ |
| SWL dispersion[b] | $2.34 \pm 0.43$ | $2.49 \pm 0.53$ | $2.00 \pm 0.42$ | $2.09 \pm 0.11$ |
| Regression coefficient $(\hat{\beta}_\sigma)^c$ | -0.15*** (-5.25) | -0.10** (-3.01) | -0.08*** (-8.03) | -0.03*** (-5.36) |

[a] Section 2.3 explains these acronyms.
[b] The columns report for each of the surveys the mean and standard deviation of the variable in that row. The row variables correspond to $\mu_i$ and $\sigma_i$ in the regression equations.
[c] Standardized beta coefficients; $t$ statistics corrected for clustering in parentheses. Statistical significance indicators: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

in Section 3.4.3, this estimate should be seen as an upper bound. It is entirely possible that the left skew observed in the distribution of reported SWL is also a feature of actual SWL. If that's the case, there may be no distortion in mean SWL, and no mechanical component to the observed correlation between SWL and SWL dispersion.

# 5 Discussion

We set out in this paper to test the proposition that SWL dispersion offers a comprehensive measure of inequality—one that subsumes the many and various component forms of inequality in particular domains. We started our investigation by replicating and extending previous findings that countries with high mean SWL tend to have a substantially lower SWL dispersion, showing that these correlations remain strong when controlling for GDP per capita, and are much stronger and more robust than the corresponding correlations between SWL and income inequality. When both forms of inequality are included in the regression, the coefficient on SWL dispersion is little changed. These results all suggest that SWL dispersion adds to the information provided by income inequality in important ways.

While these results were encouraging, they do little to allay the concern that the correlation between the the mean and standard deviation of the SWL distribution may be a mechanical artifact—higher SWL levels causing a truncation of the reported SWL distribution, and hence a lower dispersion. We employed three different tests to address this concern. In the first, we found that the correlation is substantially stronger among respondents who claim to be particularly concerned with inequality—as should be the case if the correlation is real, but not if it is merely a mechanical artifact. In the second, we examined the correlation between SWL dispersion and subjective well-being determinants such as social trust that are known to be correlated with inequality. We found that this correlation is large, and that it remains nearly as large when mean SWL is added as a control. Since the purported mechanical correlation is caused by high mean SWL, this result demonstrates that the mechanical correlation can only explain a small part of the correlation between the mean and dispersion of the SWL distribution. In our third and final test, we modelled the mapping from actual to reported SWL, enabling us to estimate the distribution of actual SWL in different countries, and compute the correlation between the mean and dispersion of the SWL distribution in actual SWL space. Using this method we estimated that at least two thirds of the observed correlation between the mean and dispersion of reported SWL is real, and that no more than a third of the correlation could be mechanical. Finally, we repeated our main regressions using a purely ordinal measure of dispersion—the variation ratio—confirming that the correlation between SWL levels and SWL dispersion does not depend on the use of a cardinal measure of dispersion.

Our findings support the use of SWL dispersion as a comprehensive measure of inequality. The correlations with SWL levels are much stronger and more robust than the corresponding correlations with income inequality, and the mechanical component of the correlation is small. SWL dispersion provides two important advantages for empirical researchers: one conceptual and the other practical. The conceptual advantage is that it offers a comprehensive measure of inequality that includes much more than the inequality of income. The practical advantage is consistent measurement in different countries and different periods of time, making it possible to compare the level of inequality in any of the 150 or so countries covered by SWL surveys. We thus hope that our results would encourage other researchers to use SWL dispersion in studying the impact of inequality on subjective well-being.

We conclude by noting that alongside GDP per capita, SWL dispersion can explain a substantial portion of the variance in SWL levels among rich countries. The countries with the highest level of SWL, such as Denmark, are characterized by a high level of GDP per capita and a low SWL dispersion. At the opposite end, countries such as Portugal and Greece are characterized by a low level of GDP per capita and high SWL dispersion. The United States has a GDP per capita as high as Denmark, but a much higher level of SWL dispersion. Its mean SWL level is substantially lower than that of Denmark, and is a little lower than New Zealand—a country with a much lower GDP per capita, but also with a much lower level of SWL dispersion. Needless to say, correlation does not imply causation. But whatever econometric techniques researchers may wish to use, SWL dispersion deserves a place in their toolkit.

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# A The variation ratio measure of SWL dispersion

This appendix includes tables corresponding to those of Section 4.1, but with the ordinal variation ratio measure of SWL dispersion instead of the cardinal standard deviation used in Section 4.1. If the correlation between SWL levels and the standard deviation of SWL is an artifact of the reporting scale, we would expect the correlation to disappear when using an ordinal measure of dispersion, such as the variation ratio. Instead, we find essentially the same results as in Section 4.1. Of course, since the variation ratio is a more noisy measure of dispersion, we can expect the correlation between SWL levels and SWL dispersion to be somewhat weaker. Moreover, when both SWL dispersion and the Gini coefficient of income are included in the same regression, we can expect the correlation between SWL levels and the Gini coefficient of income to be stronger. This is exactly what we find.

Table 9: SWL and inequality regressions in the European Social Survey with the variation ratio measure of SWL dispersion[a]

| | Dependent variable: life satisfaction (0–10) | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| SWL variation ratio[b] | -0.16*** (-7.75) | | -0.14*** (-6.91) | -0.11*** (-5.71) | -0.04* (-2.37) |
| Income Gini coef.[b] | | -0.07** (-3.33) | -0.04 (-1.91) | -0.05** (-2.71) | -0.04* (-2.25) |
| GDP per capita in log terms[b] | 0.23*** (11.40) | 0.33*** (19.21) | 0.24*** (11.53) | 0.20*** (9.93) | 0.39*** (6.68) |
| Thinks inequality is too high[c] | | | | 0.12 (1.85) | 0.11** (3.18) |
| × SWL VR | | | | -0.37*** (-6.11) | -0.27*** (-9.52) |
| × income gini | | | | 0.15* (2.53) | 0.08 (1.84) |
| Country dummies | | | | | Yes |
| No. of observations | 303853 | 301960 | 301960 | 301960 | 301960 |

[a] Standardised beta coefficients; $t$ statistics corrected for clustering in parentheses. Statistical significance indicators: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Clusters defined by country/wave combination.
[b] Cluster level variables: $v_i$, $g_i$, and $Y_i$ in the text.
[c] 5 level variable indicating individual preference for equality ($e_{ij}$ in the text). Positive values indicate agreement and negative values disagreement.
[d] Gender, age, age squared, education (dummies), and marital status (dummies).

Table 10: SWL and inequality regressions in the World Values Survey with the variation ratio measure of SWL[a]

| | Dependent variable: life satisfaction (1–10) | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| SWL variation ratio[b] | -0.11*** | | -0.12*** | -0.11*** | 0.02 |
| | (-4.28) | | (-4.12) | (-4.18) | (0.63) |
| Income Gini coef.[b] | | -0.05 | -0.04 | -0.03 | -0.20* |
| | | (-1.11) | (-0.85) | (-0.82) | (-2.20) |
| GDP per capita in log terms[b] | 0.22*** | 0.28*** | 0.25*** | 0.25*** | 0.31*** |
| | (6.97) | (8.34) | (7.06) | (7.19) | (3.45) |
| Thinks inequality is too high[c] | | | | 0.22** | 0.18** |
| | | | | (2.87) | (2.77) |
| × SWL VR | | | | -0.29*** | -0.27*** |
| | | | | (-4.14) | (-4.70) |
| × income gini | | | | 0.00 | 0.02 |
| | | | | (0.06) | (0.61) |
| Region dummies | Yes | Yes | Yes | Yes | |
| Country dummies | | | | | Yes |
| No. of observations | 271667 | 243875 | 243875 | 235587 | 235587 |

[a] Standardised beta coefficients; $t$ statistics corrected for clustering in parentheses. Statistical significance indicators: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Clusters defined by country/wave combination.
[b] Cluster level variables: $\sigma_i$, $v_i$, and $Y_i$ in the text.
[c] 1-5 variable indicating individual preference for equality: $e_{ij}$ in the text.
[d] Gender, age, age squared, education (dummies), and marital status (dummies).

Table 11: SWL and inequality regressions in the Gallup World Poll with the variation ratio of SWL dispersion[a]

| | Dependent variable: Cantril Ladder (0–10) | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| SWL variation ratio[b] | -0.05*** (-4.96) | | -0.05*** (-5.19) | -0.01 (-1.24) |
| Income Gini coef.[b] | | -0.06*** (-3.72) | -0.06*** (-3.79) | -0.10** (-3.18) |
| GDP per capita in log terms[b] | 0.40*** (30.49) | 0.39*** (26.33) | 0.40*** (26.52) | 0.36*** (4.15) |
| Region dummies | Yes | Yes | Yes | |
| Country dummies | | | | Yes |
| No. of observations | 1256817 | 1133621 | 1133621 | 1133621 |

[a] Standardised beta coefficients; $t$ statistics corrected for clustering in parentheses. Statistical significance indicators: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Clusters defined by country/wave combination.
[b] Cluster level variables: $\sigma_i$, $v_i$, and $Y_i$ in the text.
[c] Gender, age, age squared, education (dummies), and marital status (dummies).

Table 12: SWL and inequality regressions in the Gallup-Healthways Well-Being Index with the variation ratio measure of SWL dispersion[a]

| | Dependent variable: Cantril ladder (0–10) | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| SWL variation ratio[b] | -0.08*** | | -0.08*** | -0.09*** |
| | (-18.31) | | (-19.65) | (-35.85) |
| Income Gini coef.[b] | | 0.01 | 0.02*** | 0.03*** |
| | | (1.12) | (4.57) | (3.43) |
| GDP per capita in log terms[b] | -0.00 | -0.00 | -0.00 | -0.00 |
| | (-0.53) | (-0.36) | (-0.53) | (-0.11) |
| State dummies | | | | Yes |
| No. of observations | 1363274 | 1363274 | 1363274 | 1363274 |

[a] Standardised beta coefficients; $t$ statistics corrected for clustering in parentheses. Statistical significance indicators: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Clusters defined by state/wave combination.
[b] Cluster level variables: $\sigma_i$, $v_i$, and $Y_i$ in the text.
[c] Gender, age, age squared, education (dummies), and marital status (dummies).