The costs of social and environmental degradation in affluent economies

Slater, Giulia and Sarracino, Francesco

STATEC Research

16 July 2025

The costs of social and environmental degradation in affluent economies

Giulia Slater and Francesco Sarracino

Abstract

Individuals' attempts to defend from the deterioration of common goods, such as natural and social capital, stimulate defensive growth, that is new economic activity driven by private solutions to collective problems. In this paper, we provide an estimate of the value of defensive expenditures - the individual consumption needed to protect subjective well-being against collective problems - using a compensating differentials approach; that is we estimate the monetary valuation of social and environmental disruption for which no market price exists. To do so, we conduct a regression analysis of life satisfaction on aggregate consumption levels and various social and environmental externalities (which we refer to as "bads"). Our estimates indicate that the consumption needed to defend against collective problems is worth nearly a quarter of actual individual consumption. In terms of national income, this is equivalent to nearly half Gross Domestic Product per capita in affluent economies. Defensive consumption stimulates economic growth, however, in so far as the equivalent of nearly half of growth is defensive, its expansion does not reflect true progress.

Keywords: subjective well-being, quality of life, defensive consumption, defensive growth, compensating differentials, shadow value, willingness to accept

JEL: I31, I10, P00, O10, Q50

Slater: Economics Researcher, Institut national de la statistique et des études économiques du Grand-Duché du Luxembourg (STATEC Research). Giulia.Slater@statec.etat.lu.

Sarracino (corresponding author): Senior Economist, Institut national de la statistique et des études économiques du Grand-Duché du Luxembourg (STATEC Research). GLO Fellow, Global Labor Organization. 12, Boulevard du Jazz, L-4370, Belvaux. +352 247 88469. Francesco.Sarracino@statec.etat.lu.

Acknowledgements: The authors would like to thank the colleagues at STATEC Research, and the participants of the BeWell Meeting 2025, 2° INTERNATIONAL CONFERENCE Renaissance in Economics Manifesto for New Economy, ISEE Degrowth 2025 conference, RSA Annual Conference 2025, and ISQOLS2025 for their valuable comments. The authors gratefully acknowledge the financial support of the Observatoire de la Compétitivité, Ministère de l'Economie, DG Compétitivité, Luxembourg, and STATEC. The authors gratefully acknowledge the funding from the European Union's Horizon 2022 research and innovation program under grant agreement No 101094546. Views and opinions expressed are however those of the authors only and do not necessarily reflect those of the European Union. Neither the European Union nor the granting authority can be held responsible from them. This article reflects the views of the authors and does not engage in any way STATEC, STATEC Research or funding partners.

1. Introduction

Economic growth is commonly regarded as a measure of progress, despite it being intended to simply measure the productive capacity of a country. Over the course of the twentieth century, it accompanied improvements in health, education, and living standards. However, environmental and social degradation coupled with the lack of long-run improvements in well-being, showed the limits of growth as a measure of progress (Easterlin and O'Connor, 2022; Jensen et al., 2024; Mikucka et al., 2017; Costanza et al., 2009; Fleurbaey, 2009).

Social comparisons and hedonic adaptation are two mechanisms that explain why economic growth and subjective well-being changes are decoupled in the long run (Easterlin, 1974; Clark et al., 2008; Clark, 2016). The idea is that individual well-being depends on previous achievements and on what others, the so-called reference group, have: if the expectations based on previous achievements are not met, subjective well-being does not grow even in presence of economic growth. Similarly, if individual income grows as much as or less than the one of others, subjective well-being will also decrease despite economic growth. The effects of social comparisons and adaptation for subjective well-being compound with those of defensive consumption, a third mechanism explaining why subjective well-being can stagnate in growing economies (Sarracino and O'Connor, 2023).

As Daly (1998; 1999) notes, growth becomes *uneconomic* when the environmental and social costs it generates exceed its benefits, so that further GDP expansion ultimately reduces net welfare rather than increasing it. These costs, however, are typically invisible to market prices and standard accounts of output. As environmental degradation and social fragmentation erode subjective well-being, individuals turn to private goods and services to defend themselves against this erosion - a phenomenon known as defensive expenditure (Hirsch, 1976; Daly, 1997) or defensive consumption (Bartolini and Bonatti, 2008). This response creates a feedback loop in which defensive consumption stimulates economic activity and resource use, perpetuating a cycle of growth that feeds on the very social and environmental disruption it helps produce (Antoci and Bartolini, 2004; Bartolini and Bonatti, 2008).

By pushing individuals to consume private goods and services to defend against the depletion of common goods, defensive consumption becomes an engine of economic growth. The depletion of natural and social capital opens the way to new business opportunities to address and buffer their impacts. Air filters and bottled water protect people from pollution; private security and insurance services shield from criminality; home entertainment offers companionship to the lonely; in these examples collective issues become fertile ground for new businesses and stimulate new economic activity which, however, offers an individual patch, without solving the collective problem. What is more, individuals need to work harder to afford the new defensive consumption. As degradation progresses, defensive consumption needs expand, setting people on a defensive treadmill where the protection they gain from their defensive consumption is lost as the erosion of common goods progresses. The economy thrives by offering market solutions to losses that are collectively endured, and thanks to the increased working efforts to afford the new expenditures. This is how defensive consumption explains why, in many affluent societies, declining ecological sustainability, rising stress and mental disorders, eroding social relations, increased loneliness, and flat well-being trends follow economic growth (Dixson-Decleve et al., 2022; Macchia, 2022; Sarracino and Mikucka, 2017).

The theoretical foundations of defensive growth are well established (Bartolini and Bonatti, 2003; Bartolini and Bonatti, 2008), and various studies provided evidence supporting its hypothesis and expectations. However, we still lack estimates of how much consumption and economic output is dedicated to defending well-being against social and environmental degradation. The information typically available in national accounts and social surveys is usually insufficient to distinguish defensive expenditures other forms of consumption.

We address this gap by leveraging the relationship between subjective well-being, aggregate consumption, and measurable societal "bads". Given the difficulty of observing actual consumption behaviour, we adopt a valuation approach based on compensating differentials. Specifically, we estimate the monetary value, in terms of consumption, that would be required to maintain well-being constant in face of increases in social or environmental degradation – what we will refer to in the following as compensating consumption. These estimates capture the shadow cost, akin to the economic concept of marginal rate of substitution, between consumption and public bads. These do not reflect behavioural expenditures, but rather the amount of consumption needed to sustain subjective well-being unchanged in response to increases in social or environmental disruption. As such, these estimates indicate the value of extra consumption that individuals would have to adopt to protect their subjective well-being in presence of social and environmental degradation, that is the value of defensive consumption. We emphasize that this is a theoretical amount, not the actual, observed, defensive consumption. In a second step, we compare compensating consumption valuations with the compensating income amounts we obtain using the same method, but switching aggregate consumption with aggregate income.

Our empirical strategy is based on a panel of high-income countries observed between 2009 to 2019. We combine subjective well-being data from the Gallup World Poll with macroeconomic indicators of consumption and a selection of social and environmental variables. These include income inequality, mistrust, distress, lack of prosocial behaviour, PM2.5 air pollution and temperature changes from greenhouse gas emissions. These variables are selected not only for their data availability in time, but because they also represent plausible externalities of economic activity with verifiable effects on well-being.

We contribute to the literature in various ways. First, we contribute to the valuation literature (which we discuss in section 5) by estimating shadow prices for both social and environmental degradation, thus providing an estimate of the value of defensive consumption. This is very different from what has been done in previous literature using compensating differentials.

Here, we recognize that the erosion of social and natural resources creates new business opportunities that contribute to "uneconomic" growth. However, such growth is undesirable as it does not benefit well-being, it creates new common degradation, and it establishes a self-reinforcing vicious cycle of growth, degradation and new growth. Our contribution is to provide a first estimate of the value of defensive consumption on total consumption. This is a first step towards the more ambitious goal of establishing how much is the share of the economy dedicated to defensive consumption. If we could eliminate defensive consumption, economic activity – and therefore growth – would be smaller, but it would be compatible with social and environmental sustainability, and with individuals' well-being.

The second value added of our work is that we apply the method of compensating differentials to the Gallup World Poll, an internationally harmonised yet underused dataset for well-being analysis. Third, we estimate compensating differentials with respect to consumption, as well as income, and discuss the implications of the different results we obtain.

Our work further adds to the literature on the limits of GDP as a measure of progress. Trying to establish whether a significant portion of economic activity is defensive would allow us to tell good, creative-led growth from the bad, defensive one, where only the former could contribute to real progress. Recognising this distinction invites us to rethink policy priorities: toward prevention rather than repair, and investing in public goods rather than inciting private coping. It also calls for a reconsideration of what economic indicators should measure: not merely the quantity of output, but the quality of life they enable and the sustainability with which it is achieved (Sarracino and Slater, 2025).

2. Data

The variables of interest for our analysis are subjective well-being (SWB), aggregate consumption per capita, and a number of social and environmental bads. We retrieved these variables from various datasets and merged them in a single, unbalanced panel dataset, covering high-income countries observed between 2009 and 2019. The choice of the period of analysis is dictated by the availability of individual level data on SWB and other socio-demographic controls which are sourced from the Gallup World Poll. We limit our analysis to 2019 to exclude the Covid-19 period during which the relationship between our variables of interest could have been affected in unpredictable ways.

Our dependent variable is the individual level Cantril ladder of life satisfaction, which asks "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?".

Aggregate consumption per capita is sourced from the Penn World Table and it measures real consumption at constant 2017 national prices (in million 2017 USD). Data on social and environmental degradation, which we also refer to as "bads", are derived from multiple datasets and are aggregated as follows:

- *Distress*, an index which we construct as the first principal component of three variables: the country-year share of people who feel pain, worry and stress. These are sourced from the Gallup World Poll, which asks respondents to report whether they felt any of the above feelings the day before (with a yes or no answer). We take the weighted average per country-year of the three variables, that is the share of people who answered "yes" to each of the questions, and we construct the index on the three shares.
- *Lack of pro-social behaviour* is the average of the shares of respondents in each country-year answering "no" to each of three variables sourced from the Gallup World Poll: donating money, volunteering, and helping strangers. Each component is assessed through responses to the question: "In the past month, have you done any of the following? A. Donated money to a charity; B. Volunteered your time to an organisation; C. Helped a stranger or someone you didn't know who needed help."
- *Mistrust* measures the share of people who state they do not think others around them can generally be trusted. The variable comes from the Survey Data Recycling (SDR) project, a harmonized dataset of a number of social surveys (Slomczynski et al., 2023). Mistrust is the variable for which we have the least observation, with the series starting in 2009 and ending in 2017. The observations are unbalanced across country-years as the trust question was not asked consistently in all social surveys that compose the SDR, and when asked it is possible it was in different years, with different intervals and in different countries at the time.
- *Gini index of income inequality* is sourced from the Standardized World Income Inequality Database and it measures the Gini of disposable income per country.
- *Temperature changes from GHG emissions:* sourced by Jones and co-authors (2023) this variable measures the temperature changes derived by Green House Gas emissions from anthropogenic activities[1].
- *PM2.5* is a measure of pollution expressed as mean annual exposure (micrograms per cubic meter). Population-weighted exposure to ambient PM2.5 pollution is defined as the average level of exposure of a nation's population to concentrations of suspended particles measuring less than 2.5 microns in aerodynamic diameter, which are capable of penetrating deep into the respiratory tract and causing severe health damage.

[1] Temperature changes from GHG emissions is measured as $\Delta T = k\, x \frac{1}{C} x\, E(GHG)$. Here, k is the conversion factor translating emissions into temperature, $E(GHG)$ is the cumulative emissions of GHG by country and year and C is a constant of conversion. This measure of temperature changes only pertains anthropogenic emissions, as all the green-house gases the authors include to estimate temperature changes are derived from economic activity and exclude land use and agriculture. For more details on the measure, please refer to the paper by Jones and co-authors (2023).

Exposure is calculated by weighting mean annual concentrations of PM2.5 by population in both urban and rural areas[2]. PM2.5 is observed from 2010 onwards.

The choice of these variables as measures of social and environmental bads is dictated by, firstly, availability of data with long enough time-series as well as geographical coverage; secondly, they are all plausibly related to economic activity, and have an adverse effect on subjective well-being.

3. Methods

To compute the monetary equivalent of social and environmental bads we use the method of compensatory differentials. A widespread literature has used the Wellbeing Approach (WA), or Life Satisfaction Approach (LSA), to derive monetary values of non-marketable goods[3]. This method uses subjective well-being measures to derive marginal rates of substitution between non-market goods or bads and measures of income, which can be used to measure the compensating (or equivalent) surplus (Fujiwara, 2013; Frey at al., 2009).

We estimate the compensating surplus in terms of willingness to accept the negative change: compensating surplus is the amount of money, paid or received, that will leave the individual in his initial welfare position following a change in the good (or bad) (Fujiwara, 2013). In our case, we are interested in how much people should consume to accept the negative change, that is, an increase in social and environmental disruption, to maintain their well-being unchanged. Essentially, by measuring the marginal disutility of social and environmental bads, as well as the marginal utility of consumption, we can determine the trade-off between consumption and the bads, and assign the bads a monetary value. Hence, this approach allows to compute the costs of social and environmental degradation, by monetizing the well-being losses caused by these bads.

To implement this method, we investigate the relationship between SWB, consumption and bads using Ordinary Least Squares (linear probability) to estimate the following equation:

$$SWB_{i,c,t} = \alpha + \beta_1\left(Bads_{c,t}\right) + \beta_{\mathbf{2}}\left(Log\ Consumption\ pc_{c,t}\right) + \beta_{\mathbf{3}}Controls_{i,c,t} + \beta_{\mathbf{4}}Controls_{c,t} + \lambda_t + u_{c,t} \quad (1)$$

[2] PM2.5 data were sourced in early 2024 from the World Development Indicators via the world bank function on STATA but has since been moved to the WDI archives.

[3] As examples, the wellbeing approach as a valuation technique has been applied to air pollution (Welsch 2002, 2006), aircraft noise (van Praag and Baarsma 2005), climate (Rehdanz and Maddison 2005), terrorism (Frey et al. 2009b), corruption (Welsch 2008), conflict (Welsch, 2008b), and fear of crime (Moore and Shepherd, 2006). For a thorough review of the method's critiques and comparison to hedonic pricing or contingent valuation methods to value public goods and bads please refer to the papers by Levinson (2012), Welsch (2006) and Frey et al. (2004).

where $SWB_{i,c,t}$ is the subjective well-being of each individual, measured with the Cantril ladder of Life satisfaction, in country c at time t, $\text{Log Consumption } pc_{c,t}$ is the natural logarithm of consumption per capita, and $Bads_{c,t}$ represents a matrix of the social and environmental variables mentioned above, measured as the level of bad in each country-year. λ_t are time dummies and $u_{c,t}$ are standard errors clustered at the country-year level. We further include a set of controls to account for socio-demographic and country characteristics that might affect the relationship between the bads and subjective well-being. In particular, we include a number of individual level controls sourced from the Gallup World Poll, and a number of country level controls. Individual level controls are: age categories (15 to 25, 26 to 45, 46 to 65, and 66+), whether the respondent is unemployed, educational attainment in categories, a dummy for female gender, household size, marital status in categories, income expressed in quintiles, and whether the respondet resides in a urban or rural area. Country level controls include the country's unemployment rate and inflation rate to account for the economy and lastly, we include latitude and macro-region dummies.

We regress individuals' SWB on all social bads (Gini, mistrust, lack of pro-social behaviour and distress) in one equation, and in a separate equation we regress SWB on the environmental variables (temperature changes from greenhouse gas and PM2.5). Indeed, when assessing the effect of each variable independently, bads in the same group (social or environmental) might be picking up some of the effects of the other variables. For instance, the effect of Gini on well-being might capture part of the effect of mistrust. However, we have no reason to believe that any of the social bads would be picking up any of the environmental bads' effects on well-being, and vice versa.

To compute the compensating differential, we set $\Delta SWB = 0$, where the Δ can be thought of as the difference between SWB in the "absence" of bad and SWB under an increase in the bad[4], and obtain the following formula for the compensating differential:

$$Compensating\ Differential = \boldsymbol{e}^{\left(\frac{-\boldsymbol{\beta_1}(\boldsymbol{SD_{bad}})}{\boldsymbol{\beta_2}} + \boldsymbol{Log}(\boldsymbol{Consumption})\right)} - \overline{Consumption} \quad (2)$$

This formula represents the *monetary equivalent value* of the bads, that is, the change (the extra dollars to be spent) in consumption necessary to offset a marginal change in any of the bads, accounting for the nonlinear relationship between consumption and SWB. It represents the *compensating consumption*, or the extra consumption necessary to hold well-being constant. In what follows, we represent the change in terms of a standard deviation of each bad, and we compute the monetary equivalent for each bad from the two estimated equations (one on social and one on environmental bads) as keeping the effect of each other

[4] Note here that for the sake of explaining the formula of the compensating differentials, we set the Δ to be difference between a situation with no bad to one with a bad. However, in our theoretical framework the bad exists and it increases with economic activity, as per the defensive growth model (Bartolini and Bonatti, 2008).

bad constant. In the appendix, we also report the results of the eight regressions of WSB on each bad independent of the other (table A4).

4. Results

How much should people consume to defend against social and environmental degradation? Table 1 reports the average compensating consumption amounts over the whole period, as well as the yearly equivalents. Our estimates suggest that compensating consumption ranges between 2061 US$ and 3170 US$ for social bads, and between 2688 US$ and 5035 US$ for environmental disruption. In particular, we estimate that societies would need to consume 3170 US$, on average over the 9-year period, to maintain their well-being levels unchanged in face of an increase in one standard deviation in the Gini of inequality. Per year, this means that an increase in Gini is compensated with 352 extra dollars of consumption. This is the highest compensating consumption estimate for the social bads. As for the other bads, among the social disruption variables, one standard deviation increase in distress is valued at 2061 US$ of extra consumption (229 US$ per year), the lowest compensating consumption according to our results. Among the environmental variables, our estimates suggest the lowest compensating consumption is for the temperature change from GHG, around 2688 US$, whereas the compensating amount for PM2.5, over the 10-year period is 5035 dollars. These compensating consumption values are obtained using the compensating differential formula for the willingness to accept a standard deviation increase in the bad, as expressed in equation (2). These computations are based on the coefficients of consumption and bads resulting from regression 1 and reported in table 2.

Table 1: Compensating Consumption value of each bad

	Compensating Consumption	CC x year	CC x unit
Gini	3170.91	352.32	66.17
Mistrust (share)	2944.85	327.2	21.73
Distress (share)	2061.94	229.1	35.67
No pro-social behaviour (share)	2323.76	258.19	21.53
Temperature changes from GHG	2688.15	268.81	6804.6
PM2.5	5035.09	503.5	33.37

Notes: Compensating consumption is computed as per equation (2). It represents the monetary value (in dollars) of increases in the bads, estimated as the marginal rate of substitution between the bad and log consumption per capita, multiplied by the SD of the bads. The CC per unit of bad in the third column are derived by dividing the compensating differential by the number of years and the standard deviation of each bad.

The signs of the coefficients illustrate that all the considered bads correlate negatively with SWB in a sizeable and statistically significant way (see Table 2). For instance, one standard deviation (SD) increase of the Gini index (around 5.32 points in our sample of high-income countries) correlates with a reduction in SWB of 0.199 points on a 0-10 point scale (-0.0377*5.3=-0.199). Similarly, one standard deviation increase in mistrust (15.05 percent) correlates to a decrease in SWB of around 0.18 points. As for the environmental bads, one SD increase in temperatures from GHG (0.039°C) reduces well-being by 0.18 points and one standard deviation increase in PM2.5 (15.08 micrograms per cubic meter) is associated to a well-being reduction of 0.34 points. Table A1 in the appendix reports the descriptive statistics of the two analytical samples, as well as the list of countries included in each.

Consumption per capita attracts high and statistically significant coefficients in both regressions. Partial correlations are 1.91 and 2.15 according to the specification. Thus, a 10% increase in consumption correlates to an increase in subjective well-being of 0.18 points on a 0-10 scale (=1.91*ln(1.10)) in the social bads specification, and by 0.23 points in the second specification, column 2 of table 2, with environmental bads.

Table 2: regression of subjective well-being on social and environmental bads

	Cantril ladder of life satisfaction			
	(1)		(2)	
Gini	-0.0377***	(0.00810)		
Mistrust (share)	-0.0124***	(0.00182)		
Distress (share)	-0.0207***	(0.00424)		
No pro-social behav. (share)	-0.0124***	(0.00216)		
Temp change from GHG (°C)			-4.806***	(0.431)
PM25			-0.0227***	(0.00207)
Log Consumption	1.914***	(0.145)	2.151***	(0.108)
Constant	-10.68***	(1.578)	-15.90***	(1.138)
Time dummies	Yes		Yes	
Controls	Yes		Yes	
N	258923		491286	
Countries	42		47	
R2	0.202		0.162	

Note: *** < 1%; ** < 5%; * < 10%. Standard errors are in parentheses. Individual level controls include age categories, unemployment and educational attainment, gender, household size, marital status, income in quintiles, whether urban or rural resident; Macro level controls include unemployment rate, inflation rate, latitude and macro-region dummies (Europe and Central Asia, Latin America and Caribbean, Middle East and North Africa, North America, Sub-Saharan Africa. East Asia and Pacific is the baseline). Year dummies are included, the period of observation is 2009-2017 in the first sample, and 2010-2019 in the second. Standard errors clustered by country and year are shown in parentheses. The sample is smaller in column 1 as Mistrust is not observed every year. Sample 1 includes 42 countries, sample 2 includes 47 countries. Sample descriptive statistics and country composition are reported in table A1 in the Appendix.

All control variables mentioned in the previous section are not shown for brevity, but can be found in table A2 in the appendix. In the first specification, shown in column 1 of table 2 in which we regress SWB on social bads, we find that the inflation rate attracts a negative albeit non-statistically significant coefficient, whereas the unemployment rate attracts a very small positive and statistically significant (at the lowest level) coefficient. All other individual level controls attract significant coefficients, with the expected signs. For instance, women are happier on average, being separated or widowed correlates to lower SWB, and unemployed respondents report on average lower SWB. In the specification from column 2, in which we regress SWB on the environmental bads, the unemployment rate shows a negative and statistically significant correlation with SWB, and all individual level controls attract similar coefficients to those in column 1.

4.1 Comparing compensating consumption and compensating income

Typically, compensating valuations are estimated using the marginal rate of substitution between the public good (or bad, as in our case) and income. Below we report the results of our previous estimation of equation (1) in which we regress SWB on the bads and on the logarithm of GDP per capita, rather than on consumption. The estimated coefficients are shown in table A3. As in table 2, estimated coefficients on both social and environmental bads are all negative and statistically significant. GDP per capita positively correlates to SWB as expected, with coefficients slightly lower than those of consumption. An increase of 10% in GDP per capita correlates to an increase in SWB of between 0.098 (=1.089*ln(1.10)) and 0.116 (=1.522*ln(1.10)) points according to the specification with the social or environmental bads respectively (see table A3 in the appendix).

Table 3 reports the compensating income values, estimated using equation 2 as before. We observe that compensating income is much larger than compensating consumption. In other words, the income equivalent - that is, the amount of income necessary to accept an increase in the bad - is larger than compensating consumption, the amount of consumption that people would need to spend to accept and defend themselves from the same increase in the bad. This is equivalent to saying that the consumption value of bads is lower than the income value of the bads.

This likely suggests that people have preferences over saving. Indeed, of what they value their compensating income to be, only part of it would they devote to consumption, whereas the rest is a valuation of their saving preferences. We emphasize that these are not behavioural responses, but rather valuations: it would be wrong to think about the exact difference between the compensating income and consumption as the actual savings. A possible explanation for this difference is that income buys, at least in part, hope (Pleeging et al., 2021). A higher disposable income allows to address collective problems and insures against the uncertainty of the future, thus buying hope.

Table 3: Compensating income value of each bad

	Compensating Income	CI x year	CI x unit
Gini	10554.8	1172.75	220
Mistrust (share)	8056.48	895.16	59.46
Distress (share)	6121.44	680.16	105.9
No pro-social behaviour (share)	7743.94	860.43	71.77
Temperature changes from GHG	3464.75	346.47	8770.44
PM2.5	21382.33	2138.23	141.75

Note: Compensating income is computed as per equation (2). It represents the monetary value (in dollars) of increases in the bads, estimated as the marginal rate of substitution between the bad and log GDP per capita, multiplied by the SD of the bads. The CI per unit of bad in the third column are derived by dividing the compensating income by the number of years and the standard deviation of each bad.

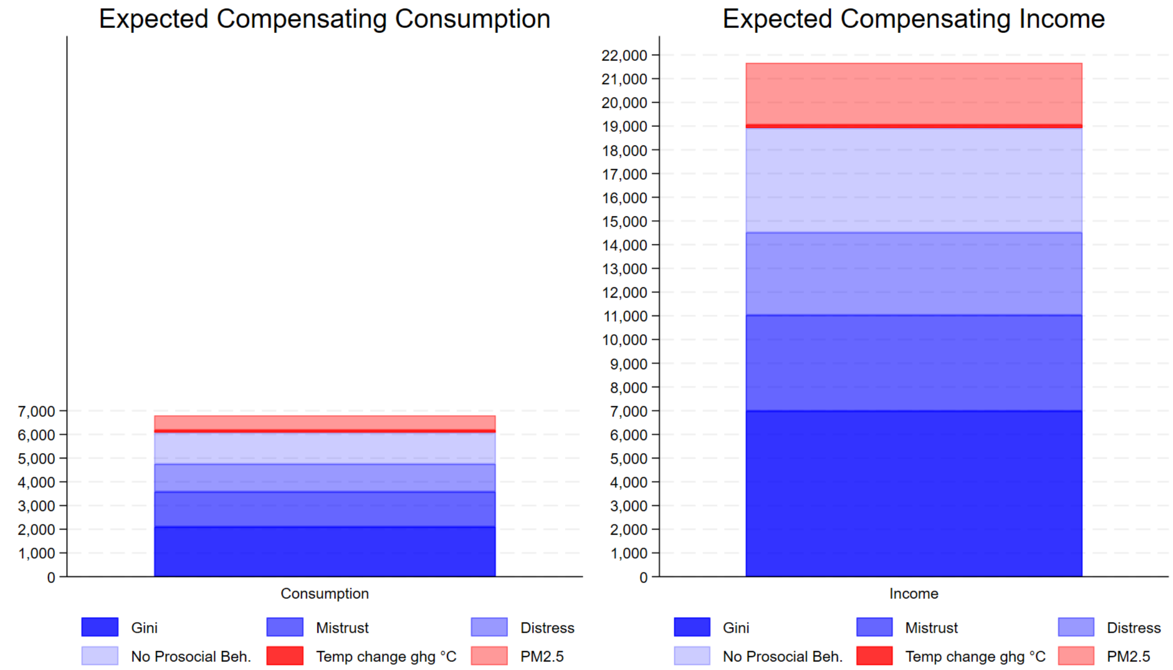
4.2 The expected defensive expenditures in affluent economies

How much are social and environmental disruption worth in affluent economies? To answer this question, we compute the compensating consumption and compensating income per unit of bad (column 3 of Tables 1 and 3) as the estimated compensating differentials divided by the number of years in which each bad is observed (9 or 10, depending on the bad) and by the standard deviation of the bad. Then, multiplying each bads' unit compensating consumption by its observed amount (i.e. the yearly average of each bad), we obtain an approximation of the *expected compensating consumption*, that is the cost of social and environmental disruption under the assumption that societies spend exactly what they value for each bad to maintain their well-being. Similarly, we multiply each bads' unit compensating income by the observed amount of bad to obtain the *expected compensating income*, that is the income necessary to compensate for increasing disruption.

Figure 1 shows the total expected compensatory amounts, in terms of consumption and income, from social and environmental bads. The bar on the left is the sum of each of the bads' expected compensating consumption amounts. We find that total expected compensating consumption is around 6500 dollars per capita. That is, if everyone spent exactly the value of each bad, and entirely defended themselves from each bad, they would spend around 5600 US$ on social bads, and 970 US$ on environmental bads, for a total of 6470 dollars per capita per year. This amounts to around 23% of observed average consumption in our sample, suggesting that a little less than one fourth of actual consumption arises from defensive needs.

Expected compensating income is much larger, as shown in the right column of figure 1, reflecting the higher importance that people place on income. Our estimates suggest that if people were to be fully compensated from the existing bads, expected compensating income would be 22000 dollars per capita, around 50% of observed GDP in our sample. Of these, 19000 US$ would be devoted to compensating for the well-being loss by social bads, and the remaining to compensate from increased temperature changes from anthropocentric GHG emissions and particulate matter.

Figure 1: Expected Compensatory amounts in terms of consumption and income



Note: Expected compensating consumption is measured as the sum of each bads' over-time average multiplied by its compensating consumption per unit (column 3 of table 1). Similarly, expected compensating income is the sum of each bads' over-time average multiplied by its compensating income per unit (column 3 of table 3).

4.3 Robustness check using an alternative measure of environmental bads

Our selection of environmental bads is constrained by data availability. To test the robustness of our results, we estimate the same specifications using an alternative composite measure of environmental pollution. We construct this variable using data from the Quality of Governance (QoG) institution[5], which sources environmental variables form The Emissions Database for Global Atmospheric Research (EDGAR) - Global Air Pollutant Emissions dataset (Povitkina et al., 2021; Crippa et al., 2020). The QoG data includes harmonized, country level data on various anthropogenic greenhouse gas emissions and air pollutants over time. We derive the composite pollution indicator as the first principal component of nine pollutants contained in the EDGAR dataset. These include SO2, PM2.5, PM10, OC, NOX, NMVOC, NH3,

[5] https://www.gu.se/en/quality-government/qog-data/data-downloads/environmental-indicators-dataset

N2O, CO2[6]. The resulting indicator serves as a synthetic measure of the overall burden of anthropogenic emissions capturing variations across multiple pollutants.

We did not include this indicator in our main analysis as its components would be highly collinear with environmental bads we used (PM2.5 and temperature changes from greenhouse gases) and would introduce double counting.

Table 4 shows the results of the two estimated equations of firstly, the Cantril ladder of life satisfaction on the composite pollution indicator and consumption, and secondly of SWB on pollution and GDP. In both specifications, pollution negatively correlates with subjective well-being, whereas both consumption and GDP are associated with higher SWB. Table A5 in the Appendix shows the full table, including control variables.

Our results suggest the compensatory consumption values are 286 US$ per capita per year, higher than both the consumption valuations of temperature changes from GHG and PM2.5. Compensatory income values instead amount to 508 US$, higher than that of temperature changes, but lower than income valuations for PM2.5.

Table 4: Regression of subjective well-being on a composite pollution indicator

	Cantril ladder of life satisfaction			
	(1)		(2)	
Pollution indicator	-0.000265***	(0.0000237)	-0.000163***	(0.0000219)
Log consumption	2.290***	(0.109)		
Log GDP pc			1.182***	(0.0987)
Constant	-17.68***	(1.145)	-6.795***	(1.066)
N	495491		495491	
R2	0.152		0.137	
Controls	Yes		Yes	

Note: *** < 1%; ** < 5%; * < 10%. Standard errors are in parentheses. Individual level controls include age categories, unemployment and educational attainment, gender, household size, marital status, income in quintiles, whether urban or rural resident; Macro level controls include unemployment rate, inflation rate, latitude and macro-region dummies (Europe and Central Asia, Latin America and Caribbean, Middle East and North Africa, North America, Sub-Saharan Africa. East Asia and Pacific is the baseline). Year dummies are included, the period of observation is 2009-2019. Standard errors clustered by country and year are shown in parentheses. The sample is smaller in column 1 as Mistrust is not observed every year. Sample 1 includes 42 countries, sample 2 includes 47 countries. Environmental pollution indicator the first principal component of 9 separate pollution variables sourced from the EDGAR dataset. The variables are SO2, PM25, PM10, OC, NOX, NMVOC, NH3, N2O, CO2. Alpha coefficient reliability of the indicator is 0.94.

5. Our results in context

The life satisfaction approach provides an alternative to traditional valuation methods such as contingent valuation and hedonic pricing, both of which have been widely used to estimate

[6] Cronbach alpha of the composite indicator is 0.94, suggesting a good sorting of the variables. Pollutants are: Sulfur dioxide, Fine particulate Matter (10 and 2.5), Carbon Monoxide, Nitrogen Oxides, Non-Methane Volatile Organic Compounds, Ammonia, Nitrus Oxide, Carbon Dioxide.

the monetary value of non-marketable goods and bads. Contingent valuation, a stated preference technique, elicits individuals' willingness to pay (WTP) for an improvement or their willingness to accept (WTA) compensation for a deterioration of a given good by directly asking them through surveys (Mitchell & Carson, 1989). While widely applied in environmental and public economics, this approach is susceptible to hypothetical bias, as respondents may overstate or understate their valuations depending on the framing of questions, strategic incentives, or the difficulty of accurately pricing intangible benefits (Hausman, 2012). Alternatively, the hedonic pricing method infers the value of non-market goods from observed market transactions, such as variations in property prices reflecting differences in environmental quality or exposure to disamenities, and it assumes that perfectly mobile individuals would relocate to better housing with better amenities (Rosen, 1974). This method, however, requires strong assumptions about market efficiency and individuals' ability to perceive and act upon differences in non-market attributes, which may not always hold.

In contrast, the life satisfaction approach overcomes these limitations by leveraging self-reported well-being measures as a proxy for utility. By regressing life satisfaction scores on income and non-market factors of interest (such as environmental quality or social conditions) we can derive implicit monetary valuations based on how changes in these factors correlate with subjective well-being (Frey et al., 2010; Welsch, 2006). This method does not require individuals to explicitly assign a monetary value to non-market goods, reducing the cognitive burden and potential biases associated with contingent valuation surveys. Moreover, it captures individuals' actual experiences rather than their hypothetical choices, making it suited for assessing public goods and externalities that lack a market.

Despite its advantages, the life satisfaction approach has limitations, as it relies on the assumption that reported well-being accurately reflects true utility and that income has a stable and comparable marginal effect across individuals and contexts (Diener et al., 1999; Frey and Stutzer, 2000; Veenhoven, 1993). Nonetheless, it provides a complement to other valuation methods and enhances our understanding of the welfare costs associated with environmental and social disruptions. The paper from Welsh and Kuhling (2009) provides a thorough discussion of the life satisfaction approach used in the literature of valuation of non-market goods, as well as a review of the literature.

Many scholars in the literature adopted the well-being approach to estimate the value of social, non-market goods and bads. Frey et al. (2009b) estimate that the compensating surplus, or the necessary income to forego terrorism, amounts to $2,150 and $7,641 per capita per year in France and the British Isles, respectively. Similarly, Clark and Oswald (2002) estimate the costs of widowhood at £170,000 per capita per year, while the cost of falling unemployed is significantly higher at £276,000, based on a sample of UK individuals between 1991 and 1997. Using data from the British Household Panel Survey, Powdthavee (2008) finds that an increase in social involvement (measured as frequency of meetings with friends and neighbours) has the same SWB value as an additional £85,000 per year. Moreover, Murtin et al. (2017) determine that households would be willing to forgo half of their income (approximately $2,614 in their sample) to avoid a 1% increase in unemployment. Additionally, other findings suggest that the monetary compensation required for increased unemployment is approximately $200 per capita per year, while inflation costs around $70 per capita annually (Di Tella et al., 2003).

The well-being approach has been used to estimate the value of the environment as well. For instance, Welsch (2002) estimates that individuals require $70 per year per capita to accept a 1-kiloton per capita increase in nitrogen dioxide emissions. Similarly, Di Tella and MacCulloch (2008) find that an increase of one standard deviation in sulfur dioxide (SO2) emissions correlates with a decline in happiness equivalent to a 17% reduction in income. Several studies employ happiness measures to value air quality improvements. Welsch utilizes various cross-sectional and panel data at the country level, finding that reductions in nitrogen dioxide and lead pollution in Europe from 1990 to 1997 were valued at $750 and $1,400 per capita, respectively, in 2008 dollars (Welsch, 2006). Levinson (2012) estimates that the marginal willingness to pay for an increase in PM10 air quality is $459, which equates to spending $18 per day to achieve a one standard deviation reduction in PM10 levels.

Other studies highlight the economic burden of social and environmental stressors. Powdthavee (2008) estimates the cost of crime in South Africa at $240 per month, while Van Praag and Braasma (2005) determine that the required monthly compensation per household for airport noise in the Amsterdam region ranges between €17 and €57. Welsch (2008) calculates that the average monetary value of corruption is approximately $900 per capita per year, based on a sample of around 50 countries. Furthermore, Brown (2015) finds that the economic cost of ill-health amounts to an annual loss of $41,650 per capita in a sample of U.S. individuals between 1975 and 2010.

The yearly compensating amounts that we estimate in this paper range between 229 and 503 dollars per year for the consumption values, and between 350 and 2000 dollars for compensating income values. Overall, our estimates are line with monetary valuations of, especially, environmental variables derived in the cross-country literature. However, within-country studies report larger compensating income variations than those identified in cross-country studies.

6. Conclusion

In this paper we estimate the monetary valuation of selected social and environmental bads in affluent economies. Using a compensating differential approach, we estimate the amount of consumption per capita required to maintain well-being in the face of increased social and environmental bads. Our results suggest that individuals in high-income countries would require between 200 US$ and 500 US$ per year in additional consumption to offset the well-being loss associated with one standard deviation increase in these bads.

Importantly, our approach allows us to measure the monetary equivalent of the well-being loss attributable to social and environmental degradation. These figures reflect a monetary valuation and should be interpreted as shadow prices for societal bads, revealing the compensating consumption necessary to preserve subjective well-being in deteriorating conditions. Under the assumption that people defend themselves from the degradation that surrounds them, we compute the expected amount of compensatory defensive consumption. This amounts to around 6500 dollars per year in our sample of high-income countries observed between 2009 and 2019.
The idea of defensive consumption is not new: authors have defined defensive consumption as the amount of money people spend on private goods and services to compensate for the degradation of the common resources that surrounds them. When lack of cooperation makes it impossible for economies to solve the collective good problems, individuals resort to private solution to take care of themselves and their loved ones. Whereas this theory is extensively theoretically discussed (Bartolini and Bilancini, 2008), an estimate of the size of defensive consumption is still missing.

Our results provide an idea of the necessary amount of consumption needed for people to maintain their well-being in face of the decreasing quality of public goods such as the environment and social relations. If people consumed exactly what they value the protection from each bad to be, expected defensive consumption from the bads we observe would amount to 23% of total observed consumption in our sample. Given we only observe a selected number of bads, we argue that the total amount of defensive consumption is probably higher.

While providing a precise benchmark for the scale of defensive consumption and defensive GDP is challenging, our estimates align with those reported by Kubiszewski et al. (2013) in their assessment of the Genuine Progress Indicator (GPI). The GPI accounts for the depletion of natural and social capital as costs, and thus serves as a measure of the welfare-generating component of economic activity. In their study, the authors find that, in 2005, the average GPI per capita was approximately 40% of total GDP per capita in their sample. This implies that the remaining 60% of GDP reflects economic activity that does not contribute to net societal welfare - what could be interpreted as "uneconomic growth" in Daly’s (1999) terms, and akin to defensive growth. Under the assumption that the gap between GDP and GPI captures the welfare-negative share of growth - driven for instance by compensatory expenditures, environmental degradation, and social decline - the 60% figure obtained from their study offers a benchmark for our results. Our estimate that expected compensating income accounts for approximately 50% of total GDP can therefore be interpreted as a conservative or lower-bound estimate of the defensive component of economic output.

Our findings carry significant implications for how we conceptualize economic growth. If a meaningful portion of total consumption is defensive, that is, aimed at compensating for deteriorating public goods, then part of GDP is also defensive. In this light, GDP can be understood as comprising both non-defensive (creative) and defensive components. Yet only the former benefits well-being. This distinction is essential for rethinking our understanding of progress. A society growing rapidly due to increased sales of defensive goods may show high GDP figures but simultaneously be failing in terms of well-being, trust, or ecological integrity. A non-defensive growth, even if slower, may better align with the goals of sustainability and human flourishing. It would emphasize prevention and the maintenance of public goods, rather than private coping mechanisms. Recognizing the defensive dimension of consumption has important policy implications. Rather than relying on market-based private solutions to compensate for degraded environments and fraying social cohesion, public investment in prevention and public goods such as clean air, social trust and green spaces may be both more efficient and more equitable. These investments can reduce the need for defensive expenditures, freeing up resources for creative, productive, and life-enhancing uses.

Our results signal that a significant part of economic activity is potentially driven by the need to defend well-being against rising social and environmental pressures. If left unaddressed, this pattern may further stimulate a growth model that is both unsustainable and self-defeating. A new model of progress, one that tracks the quality and sustainability of life, rather than just the quantity of output, is needed.

References

Antoci, A., & Bartolini, S. (2004). Negative externalities, defensive expenditures and labour supply in an evolutionary context. *Environment and Development Economics, 9*(5), 591–612.

Bartolini, S., & Bonatti, L. (2003). Endogenous growth and negative externalities. *Journal of Economics*, 123–144.

Bartolini, S., & Bonatti, L. (2008). Endogenous growth, decline in social capital and expansion of market activities. *Journal of Economic Behavior & Organization, 67*(3–4), 917–926.

Brown, D. (2015). The economic impact of ill-health on life satisfaction. *Journal of Economic Psychology, 50*, 1-15.

Costanza, R., Hart, M., Talberth, J., & Posner, S. (2009). Beyond GDP: The need for new measures of progress. *The pardee papers*.

Clark, A. E. (2016). Happiness, habits and high rank: Comparison in economic and social life. In S. Bartolini, L. Bruni, & P. L. Porta (Eds.), *Policies for Happiness* (pp. 62–94). Oxford University Press.

Clark, A. E., & Oswald, A. J. (2002). A simple statistical method for measuring how life events affect happiness. *International Journal of Epidemiology, 31*(6), 1139-1144.

Clark, A. E., Frijters, P., & Shields, M. A. (2008). Relative income, happiness, and utility: An explanation for the Easterlin Paradox. *Journal of Economic Literature, 46*(1), 95-144.

Crippa, Monica, Diego Guizzardi, Marilena Muntean, Edwin Schaaf, et al. 2019. EDGAR v5.0 Global Air Pollutant Emissions. url: http://data.europa.eu/89h/377801af-b094- 4943-8fdc-f79a7c0c2d19

Daly, H. E. (1997). *Beyond growth: the economics of sustainable development*. Beacon press.

Daly, H. E. (1998). Uneconomic growth. *Clemens Lecture*, *11*, 10.

Daly, H. E. (1999). Uneconomic growth: in theory, in fact, in history, and in relation to globalization.

Diener, E., E. M. Suh, R. E. Lucas and H. L. Smith (1999). Subjective Well-Being: Three Decades of Progress, Psychological Bulletin. 125: 276 – 302.

Dixson-Decleve, S., Gaffney, O., Ghosh, J., Randers, J., Rockström, J., & Stoknes, P. E. (2022). *Earth for all: A survival guide for humanity*. New Society Publishers.

Di Tella, R., & MacCulloch, R. (2008). Gross national happiness as an answer to the Easterlin Paradox? *Journal of Development Economics, 86*(1), 22-42.

Di Tella, R., MacCulloch, R. J., & Oswald, A. J. (2003). The macroeconomics of happiness. *Review of Economics and Statistics, 85*(4), 809-827.

Easterlin, R. A. (1974). Does economic growth improve the human lot? Some empirical evidence. In *Nations and households in economic growth* (pp. 89-125). Academic press.

Easterlin, R. A., & O'Connor, K. J. (2022). The easterlin paradox. In *Handbook of labor, human resources and population economics* (pp. 1-25). Cham: Springer International Publishing.

Ferreira, S., Moro, M., & Welsch, H. (2024). Using life satisfaction and happiness data for environmental valuation: An experienced preference approach.

Fleurbaey, M. (2009). Beyond GDP: The quest for a measure of social welfare. *Journal of Economic literature*, *47*(4), 1029-1075.

Frey, B. S., & Stutzer, A. (2002). *Happiness and economics: How the economy and institutions affect well-being.* Princeton University Press.

Frey, B. S., Luechinger, S., & Stutzer, A. (2009). The life satisfaction approach to environmental valuation. *Annual Review of Resource Economics, 1*(1), 239-260.

Frey, B. S., Luechinger, S., & Stutzer, A. (2009b). The life satisfaction approach to valuing public goods: The case of terrorism. *Public Choice*, *138*, 317-345.

Frey, B. S., Luechinger, S., & Stutzer, A. (2010). The life satisfaction approach to environmental valuation. *Annu. Rev. Resour. Econ.*, *2*(1), 139-160.

Frey, B. S. and A. Stutzer (2000). Maximizing Happiness?, German Economic Review. 1: 145 –168.

Frey, B. S., Luechinger, S., & Stutzer, A. (2004). Valuing public goods: The life satisfaction approach. *Available at SSRN 528182*.

Fujiwara, D. (2013). A general method for valuing non-market goods using wellbeing data: Three-stage wellbeing valuation.

Hausman, J. (2012). Contingent valuation: from dubious to hopeless. *Journal of economic perspectives*, *26*(4), 43-56.

Hirsch, F. (1976). *Social limits to growth.* Harvard University Press.

Jansen, A., Wang, R., Behrens, P., & Hoekstra, R. (2024). Beyond GDP: a review and conceptual framework for measuring sustainable and inclusive wellbeing. *The Lancet Planetary Health*, *8*(9), e695-e705.

Jones, M. W., Peters, G. P., Gasser, T., et al. (2023). National contributions to climate change due to historical emissions of carbon dioxide, methane, and nitrous oxide since 1850. *Scientific Data, 10*, 155. https://doi.org/10.1038/s41597-023-02041-1

Kahneman, D., Wakker, P. P., & Sarin, R. (1997). Back to Bentham? Explorations of experienced utility. *The quarterly journal of economics*, *112*(2), 375-406.

Kubiszewski, I., Costanza, R., Franco, C., Lawn, P., Talberth, J., Jackson, T., & Aylmer, C. (2013). Beyond GDP: Measuring and achieving global genuine progress. Ecological economics, 93, 57-68.

Levinson, A. (2012). Valuing public goods using happiness data: The case of air quality. *Journal of Public Economics, 96*(9-10), 869-880.

Macchia, L. (2022). Pain trends and pain growth disparities, 2009–2021. *Economics & Human Biology, 47*, 101200.

Mikucka, M., Sarracino, F., & Dubrow, J. K. (2017). When does economic growth improve life satisfaction? *World Development, 93*, 447–459.

Mitchell, R. C., & Carson, R. T. (2013). *Using surveys to value public goods: the contingent valuation method*. Rff press.

Moore, S., & Shepherd, J. P. (2006). The cost of fear: shadow pricing the intangible costs of crime. *Applied Economics*, *38*(3), 293-300.

Murtin, F., Boarini, R., Cordoba, J. C., & Ripoll, M. (2017). Beyond GDP: Is there a law of one shadow price? *European Economic Review, 100*, 390-411.

Pleeging, E., Burger, M., & van Exel, J. (2021). Hope mediates the relation between income and subjective well-being. *Journal of Happiness Studies*, *22*(5), 2075-2102.

Povitkina, M., Alvarado Pachon, N., & Dalli, C. M. (2021). The quality of government environmental indicators dataset, version sep21. *University of Gothenburg: The Quality of Government Institute, https://www. gu. se/en/quality-government*.

Powdthavee, N. (2008). Putting a price tag on friends, relatives, and neighbours: Using surveys of life satisfaction to value social relationships. *Journal of Socio-Economics, 37*(4), 1459-1480.

Rehdanz, K., & Maddison, D. (2005). Climate and happiness. Ecological Economics, 52(1), 111-125.

Rosen, S. (1974). Hedonic prices and implicit markets: product differentiation in pure competition. *Journal of political economy*, *82*(1), 34-55.

Sarracino, F., & Mikucka, M. (2017). Social capital in Europe from 1990 to 2012: Trends and convergence. *Social Indicators Research, 131*(1), 407–432.

Sarracino, F., & O'Connor, K. J. (2023). Neo-humanism and COVID-19: Opportunities for a socially and environmentally sustainable world. *Applied Research in Quality of Life*, *18*(1), 9-41.

Sarracino, F., & Slater, G. (2025): Economic possibilities for our grandchildren reloaded. *MPRA* 125369

Slomczynski, K. M., Tomescu-Dubrow, I., Wysmulek, I., Powałko, P., Jenkins, J. C., Ślarzyński, M., Zieliński, M. W., Skora, Z., Li, O., & Lavryk, D. (2023). SDR2 Database. Harvard Dataverse.

Van Praag, B. M. S., & Baarsma, B. E. (2005). Using happiness surveys to value intangibles: The case of airport noise. *Economic Journal, 115*(500), 224-246.

Veenhoven, R. (1993). Happiness in Nations: Subjective Appreciation of Life in 56 Nations 1946 – 1992. Rotterdam: Erasmus University Press.

Welsch, H. (2002). Preferences over prosperity and pollution: Environmental valuation based on happiness surveys. *Kyklos, 55*(4), 473-494.

Welsch, H. (2006). Environment and happiness: Valuation of air pollution using life satisfaction data. *Ecological Economics, 58*(4), 801-813.

Welsch, H. (2008). The welfare costs of corruption. *Applied Economics, 40*(14), 1839-1849.

Welsch, H. (2008b). The social costs of civil conflict: evidence from surveys of happiness. Kyklos, 61(2), 320-340.

Welsch, H., & Kühling, J. (2009). Using happiness data for environmental valuation: issues and applications. *Journal of Economic Surveys*, *23*(2), 385-406.

Appendix

Table A 1: Summary statistics

	Observations	Mean	Std. Dev	Min	Max
			Sample 1		
SWB	258923	6.577592	0.7470536	4.668911	7.788252
Gini	258923	31.18621	5.323999	22.7067	48.6782
Mistrust (share)	258923	67.92355	15.05251	0	96.48013
Distress (share)	258923	31.28359	6.422346	17.4112	52.28193
Lack of pro-social behaviours	258923	60.74604	11.98736	38.62043	87.145
Consumption pc	258923	28678.23	7228.496	12887.92	46330.79
GDP pc	258923	40531.49	14618.35	15929.72	86808.66
Log consumption per capita	258923	10.22802	0.2772774	9.464046	10.74356
			Sample 2		
SWB	491286	6.596274	2.021991	0	10
Temperature changes from GHG	491286	0.015524	0.0395049	0	0.275
PM2.5	491286	18.23479	15.08453	5.257788	85.96687
Consumption pc	491286	29130.03	7225.242	13926.05	51063.34
GDP pc	491286	43048.39	17175.21	17123.71	120747.9
Log consumption per capita	491286	10.24674	0.2616331	9.541516	10.84082
			Sample 3		
SWB	495491	6.580854	2.034517	0	10
Environmental Pollution	495491	338.69	815.136	1.029414	5488.893
Consumption pc	495491	28931.29	7337.516	12887.92	51063.34
GDP pc	495491	42663.03	17155.46	15929.72	120747.9
Log consumption per capita	495491	10.23829	0.2682661	9.464046	10.84082

Sample 1: Australia, Austria, Bahrain, Belgium, Canada, Chile, China, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Panama, Poland, Portugal, Republic of Korea, Romania, Saudi Arabia, Singapore, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom, United States, Uruguay

Sample 2: Australia, Austria, Bahrain, Belgium, Canada, Chile, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Kuwait, Latvia, Lithuania, Luxembourg, Mauritius, Netherlands, New Zealand, Norway, Oman, Panama, Poland, Portugal, Qatar, Republic of Korea, Romania, Saudi Arabia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Trinidad and Tobago, United Arab Emirates, United Kingdom, United States, Uruguay

Sample 3: Australia, Austria, Bahrain, Belgium, Canada, Chile, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Kuwait, Latvia, Lithuania, Luxembourg, Malta, Mauritius, Netherlands, New Zealand, Norway, Oman, Panama, Poland, Portugal, Qatar, Republic of Korea, Romania, Saudi Arabia, Singapore, Slovakia, Slovenia, Spain, Sweden, Switzerland, Trinidad and Tobago, United Arab Emirates, United Kingdom, United States, Uruguay

Table A 2: regression of SWB on bads and consumption pc

	(1)		(2)	
Gini	-0.0377***	(0.00810)		
Mistrust (share)	-0.0124***	(0.00182)		
Distress (share)	-0.0207***	(0.00424)		
Lack of pro-social beh. (share)	-0.0124***	(0.00216)		
Temperature change from GHG			-4.806***	(0.431)
PM2.5			-0.0227***	(0.00207)
Log consumption	1.914***	(0.145)	2.151***	(0.108)
Age (25-45)	-0.637***	(0.0262)	-0.567***	(0.0200)
Age (46-65)	-0.775***	(0.0336)	-0.685***	(0.0268)
Age (65+)	-0.600***	(0.0458)	-0.532***	(0.0350)
Household size	0.187***	(0.00983)	0.162***	(0.00772)
Female	0.152***	(0.0130)	0.158***	(0.0102)
Married or coupled	0.155***	(0.0193)	0.164***	(0.0154)
Separated or divorced	-0.212***	(0.0230)	-0.238***	(0.0193)
Widowed	-0.233***	(0.0293)	-0.196***	(0.0234)
Secondary education	0.290***	(0.0265)	0.372***	(0.0259)
Tertiary education	0.610***	(0.0266)	0.701***	(0.0279)
Unemployed	-0.698***	(0.0268)	-0.608***	(0.0223)
2nd quintile	0.363***	(0.0209)	0.346***	(0.0148)
3rd quintile	0.628***	(0.0240)	0.588***	(0.0173)
4th quintile	0.888***	(0.0285)	0.838***	(0.0199)
5th quintile	1.214***	(0.0351)	1.158***	(0.0246)
Small town or village	-0.104***	(0.0226)	-0.102***	(0.0203)
City	-0.0870**	(0.0266)	-0.0842**	(0.0267)
City suburbs	-0.148***	(0.0309)	-0.0735**	(0.0257)
Inflation rate	-0.0229	(0.0141)	0.000386	(0.0144)
Unemployment rate	0.0165*	(0.00772)	-0.0425***	(0.00655)
Latitude	-0.00132	(0.00211)	-0.00467**	(0.00155)
Europe and Central Asia	0.119	(0.151)	0.488***	(0.104)
Latin America and Caribbean	2.060***	(0.170)	1.172***	(0.121)
Middle East and north Africa	0.637***	(0.179)	0.669***	(0.110)
North America	0.0198	(0.177)	0.743***	(0.122)
Sub-Saharan Africa			0.136	(0.110)
Constant	-10.68***	(1.578)	-15.90***	(1.138)
N	258923		491286	
R2	0.202		0.162	

Note: East Asia and Pacific is baseline of the macro-region dummies. Year dummies are included, period of observation is 2009-2017 in the first sample, and 2010-2019 in the second. Standard errors shown in parenthesis are clustered at the country-year level. Baseline for residency is rural area or farm.

Table A 3: regression of SWB on bads and GDP pc

	Cantril Ladder of Life Satisfaction			
	(1)		(2)	
Gini	-0.0450***	(0.00923)		
Mistrust (share)	-0.0125***	(0.00217)		
Distress (share)	-0.0227***	(0.00460)		
Lack of pro-social beh. (share)	-0.0151***	(0.00270)		
Temperature change from GHG			-2.394***	(0.455)
PM2.5			-0.0327***	(0.00213)
Log GDP	1.034***	(0.118)	1.222***	(0.0802)
Age (25-45)	-0.639***	(0.0254)	-0.573***	(0.0194)
Age (46-65)	-0.773***	(0.0339)	-0.677***	(0.0270)
Age (65+)	-0.587***	(0.0464)	-0.516***	(0.0353)
Household size	0.173***	(0.0102)	0.158***	(0.00808)
Female	0.153***	(0.0130)	0.165***	(0.0101)
Married or coupled	0.163***	(0.0200)	0.170***	(0.0155)
Separated or divorced	-0.207***	(0.0235)	-0.230***	(0.0196)
Widowed	-0.258***	(0.0316)	-0.214***	(0.0245)
Secondary education	0.294***	(0.0272)	0.378***	(0.0266)
Tertiary education	0.608***	(0.0291)	0.679***	(0.0298)
Unemployed	-0.694***	(0.0272)	-0.609***	(0.0226)
2nd quintile	0.356***	(0.0208)	0.343***	(0.0149)
3rd quintile	0.616***	(0.0238)	0.585***	(0.0174)
4th quintile	0.874***	(0.0285)	0.836***	(0.0201)
5th quintile	1.195***	(0.0350)	1.157***	(0.0252)
Small town or village	-0.0785**	(0.0249)	-0.0745***	(0.0222)
City	-0.0747**	(0.0276)	-0.0767**	(0.0265)
City suburbs	-0.102**	(0.0311)	-0.0331	(0.0261)
Inflation rate	-0.0162	(0.0159)	0.00944	(0.0153)
Unemployment rate	0.00547	(0.00921)	-0.0414***	(0.00605)
Latitude	-0.00421	(0.00221)	-0.00650***	(0.00147)
Europe and Central Asia	0.404**	(0.145)	0.662***	(0.0865)
Latin America and Caribbean	1.704***	(0.167)	0.776***	(0.116)
Middle East and north Africa	0.855***	(0.190)	0.881***	(0.0989)
North America	0.753***	(0.163)	0.963***	(0.112)
Sub-Saharan Africa			0.179	(0.121)
Constant	-1.533	(1.415)	-6.772***	(0.872)
N	258923		491286	
R2	0.202		0.162	

Note: East Asia and Pacific is baseline of the macro-region dummies. Year dummies are included; the period of observation is 2009-2017 for the first sample, and 2010-2019 for the second. Standard errors shown in parenthesis are clustered at the country-year level. Baseline for residency is rural area or farm.

Table A4: Regression of SWB on each bad independently of others

	Cantril Ladder of Life Satisfaction					
	(1)	(2)	(3)	(4)	(5)	(6)
Gini	-0.0499***					
	(0.00446)					
Mistrust (share)		-0.0166***				
		(0.00208)				
Distress (share)			-0.0269***			
			(0.00408)			
Lack of pro-social beh. (share)				-0.0260***		
				(0.00249)		
Temperature change from GHG					-5.159***	
					(0.440)	
PM2.5						-0.0236***
						(0.00214)
Log Consumption	2.276***	2.321***	2.021***	1.556***	2.333***	2.001***
	(0.0973)	(0.132)	(0.108)	(0.111)	(0.109)	(0.103)
2010	0.0172	-0.0128	0.0734	0.0267	0.0843	0
	(0.121)	(0.120)	(0.127)	(0.112)	(0.128)	(.)
2011	0.0412	0.105	0.0806	-0.0141	0.0922	0.0292
	(0.124)	(0.128)	(0.134)	(0.117)	(0.132)	(0.110)
2012	-0.0189	-0.0260	0.00979	-0.176	0.0107	-0.0805
	(0.115)	(0.124)	(0.128)	(0.115)	(0.120)	(0.108)
2013	0.00944	-0.135	0.114	-0.0328	0.0360	-0.0410
	(0.110)	(0.123)	(0.118)	(0.105)	(0.117)	(0.102)
2014	-0.0794	-0.145	0.0728	-0.168	-0.0705	-0.164
	(0.110)	(0.135)	(0.116)	(0.103)	(0.117)	(0.101)
2015	-0.114	-0.237*	0.00644	-0.168	-0.105	-0.192
	(0.107)	(0.114)	(0.115)	(0.101)	(0.116)	(0.103)
2016	-0.115	-0.255*	0.0183	-0.0906	-0.0988	-0.219*
	(0.106)	(0.112)	(0.115)	(0.0972)	(0.114)	(0.103)
2017	-0.0611	-0.119	0.0541	-0.0759	-0.0662	-0.169
	(0.104)	(0.129)	(0.110)	(0.0986)	(0.113)	(0.0968)
2018	-0.131		0.0104	0.0915	-0.134	-0.243*
	(0.106)		(0.113)	(0.0967)	(0.112)	(0.0948)
2019	-0.125		0.0350	0.0701	-0.134	-0.235*
	(0.107)		(0.115)	(0.0995)	(0.115)	(0.102)
Age (25-45)	-0.584***	-0.645***	-0.568***	-0.577***	-0.576***	-0.568***
	(0.0205)	(0.0253)	(0.0201)	(0.0201)	(0.0199)	(0.0201)
Age (46-65)	-0.709***	-0.762***	-0.657***	-0.676***	-0.668***	-0.687***
	(0.0274)	(0.0341)	(0.0274)	(0.0269)	(0.0275)	(0.0268)
Age (65+)	-0.557***	-0.585***	-0.500***	-0.513***	-0.500***	-0.543***
	(0.0355)	(0.0465)	(0.0363)	(0.0345)	(0.0356)	(0.0355)

Household size	0.159***	0.181***	0.149***	0.156***	0.145***	0.163***
	(0.00766)	(0.0104)	(0.00860)	(0.00779)	(0.00818)	(0.00807)
Female	0.162***	0.157***	0.172***	0.171***	0.171***	0.157***
	(0.00998)	(0.0130)	(0.0100)	(0.00992)	(0.0102)	(0.0102)
Married or coupled	0.180***	0.144***	0.158***	0.174***	0.160***	0.169***
	(0.0152)	(0.0209)	(0.0160)	(0.0154)	(0.0157)	(0.0156)
Separated or divorced	-0.201***	-0.219***	-0.250***	-0.213***	-0.232***	-0.237***
	(0.0190)	(0.0232)	(0.0196)	(0.0193)	(0.0193)	(0.0192)
Widowed	-0.198***	-0.241***	-0.251***	-0.208***	-0.229***	-0.198***
	(0.0227)	(0.0297)	(0.0238)	(0.0222)	(0.0240)	(0.0231)
Secondary education	0.359***	0.360***	0.359***	0.349***	0.413***	0.356***
	(0.0256)	(0.0314)	(0.0256)	(0.0257)	(0.0263)	(0.0276)
Tertiary Education	0.669***	0.671***	0.675***	0.640***	0.733***	0.682***
	(0.0257)	(0.0310)	(0.0264)	(0.0265)	(0.0279)	(0.0287)
Unemployed	-0.624***	-0.717***	-0.634***	-0.649***	-0.638***	-0.610***
	(0.0228)	(0.0291)	(0.0226)	(0.0226)	(0.0228)	(0.0222)
2nd quintile	0.341***	0.358***	0.336***	0.339***	0.333***	0.346***
	(0.0147)	(0.0207)	(0.0145)	(0.0145)	(0.0144)	(0.0149)
3rd quintile	0.588***	0.618***	0.577***	0.583***	0.569***	0.590***
	(0.0172)	(0.0240)	(0.0171)	(0.0168)	(0.0169)	(0.0175)
4th quintile	0.836***	0.874***	0.825***	0.834***	0.815***	0.840***
	(0.0198)	(0.0289)	(0.0200)	(0.0196)	(0.0196)	(0.0201)
5th quintile	1.153***	1.200***	1.144***	1.157***	1.130***	1.161***
	(0.0246)	(0.0358)	(0.0252)	(0.0243)	(0.0247)	(0.0248)
Small Town	-0.125***	-0.106***	-0.0803***	-0.0950***	-0.104***	-0.105***
	(0.0199)	(0.0238)	(0.0213)	(0.0203)	(0.0209)	(0.0205)
City	-0.0895***	-0.133***	-0.108***	-0.0727**	-0.130***	-0.0714**
	(0.0244)	(0.0286)	(0.0270)	(0.0255)	(0.0270)	(0.0267)
City Suburbs	-0.0865***	-0.134***	-0.0602*	-0.131***	-0.0846**	-0.0701**
	(0.0240)	(0.0347)	(0.0271)	(0.0272)	(0.0267)	(0.0262)
Inflation	0.000791	-0.0389*	-0.000372	0.0145	0.000867	0.000891
	(0.0147)	(0.0164)	(0.0157)	(0.0155)	(0.0163)	(0.0151)
Unemployment	-0.0218**	-0.00102	-0.0122	-0.0145*	-0.0329***	-0.0403***
	(0.00717)	(0.00787)	(0.00727)	(0.00640)	(0.00712)	(0.00683)
Latitude	-0.00299	0.00140	-0.00511**	0.00273	-0.00370*	-0.00350*
	(0.00195)	(0.00265)	(0.00190)	(0.00175)	(0.00185)	(0.00173)
Europe and Central Asia	0.196	0.213	0.525***	0.165	0.441***	0.444***
	(0.116)	(0.177)	(0.110)	(0.0959)	(0.101)	(0.115)
Latin America and Caribbean	1.839***	2.030***	1.308***	1.127***	1.327***	1.166***
	(0.141)	(0.182)	(0.130)	(0.128)	(0.137)	(0.126)
Middle East and north Africa	0.251**	0.199	0.307**	-0.208*	-0.0259	0.719***
	(0.0905)	(0.246)	(0.102)	(0.0960)	(0.101)	(0.113)
North America	0.226	-0.267	0.575***	-0.289	0.842***	0.123
	(0.145)	(0.218)	(0.173)	(0.152)	(0.126)	(0.169)
Sub-Saharan Africa	0.314*		0.116	0.00371	0.213	0.163
	(0.125)		(0.111)	(0.117)	(0.120)	(0.115)

Constant	-16.07***	-17.20***	-14.47***	-8.844***	-18.21***	-14.43***
	(1.034)	(1.448)	(1.160)	(1.236)	(1.137)	(1.096)
N	491619	260877	514656	504274	515605	491286
R2	0.165	0.191	0.152	0.159	0.152	0.158

Note: Standard errors shown in parenthesis are clustered at the country-year level.

Table A 5: Robustness – SWB regression on Environmental Pollution

	Cantril Ladder of Life Satisfaction			
	(1)		(2)	
Environmental pollution indicator	-0.000265***	(0.0000237)	-0.000163***	(0.0000219)
Log consumption	2.290***	(0.109)		
Log GDP pc			1.182***	(0.0987)
Age (25-45)	-0.587***	(0.0202)	-0.591***	(0.0199)
Age (46-65)	-0.685***	(0.0278)	-0.666***	(0.0285)
Age (65+)	-0.512***	(0.0368)	-0.477***	(0.0375)
Household size	0.143***	(0.00851)	0.128***	(0.00921)
Female	0.177***	(0.0103)	0.188***	(0.0104)
Married or coupled	0.160***	(0.0161)	0.161***	(0.0165)
Separated or divorced	-0.243***	(0.0198)	-0.241***	(0.0205)
Widowed	-0.234***	(0.0243)	-0.281***	(0.0265)
Secondary education	0.405***	(0.0279)	0.436***	(0.0299)
Tertiary education	0.727***	(0.0294)	0.730***	(0.0314)
Unemployed	-0.628***	(0.0234)	-0.636***	(0.0243)
2nd quintile	0.329***	(0.0146)	0.321***	(0.0147)
3rd quintile	0.561***	(0.0172)	0.547***	(0.0174)
4th quintile	0.810***	(0.0201)	0.794***	(0.0205)
5th quintile	1.124***	(0.0250)	1.105***	(0.0259)
Small town or village	-0.114***	(0.0211)	-0.0806***	(0.0241)
City	-0.136***	(0.0278)	-0.149***	(0.0284)
City suburbs	-0.0906**	(0.0275)	-0.0359	(0.0281)
Inflation rate	0.00527	(0.0165)	0.0104	(0.0182)
Unemployment rate	-0.0323***	(0.00775)	-0.0375***	(0.00747)
Latitude	-0.00311	(0.00179)	-0.00591**	(0.00198)
Europe and Central Asia	0.348***	(0.101)	0.627***	(0.102)
Latin America and Caribbean	1.266***	(0.135)	0.765***	(0.142)
Middle East and north Africa	-0.0726	(0.101)	-0.162	(0.115)
North America	0.812***	(0.123)	1.271***	(0.117)
Sub-Saharan Africa	0.167	(0.120)	0.152	(0.143)
Constant	-17.68***	(1.145)	-6.795***	(1.066)
N	495491		495491	
R2	0.152		0.137	

Note: *** < 1%; ** < 5%; * < 10%. Standard errors are in parentheses. Year dummies are included; the period of observation is 2009-2019.