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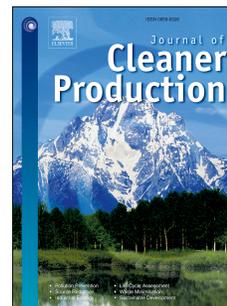


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The Wellbeing—Consumption Paradox: Happiness, Health, Income, and Carbon Emissions in Growing versus Non-Growing Economies

Andrew L. Fanning^{a,} and Daniel W. O'Neill^p*

^a Sustainability Research Institute, School of Earth and Environment, University of Leeds, Leeds, LS2 9JT, United Kingdom

* Corresponding Author: a.l.fanning@leeds.ac.uk (A. Fanning)

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The Wellbeing–Consumption Paradox: Happiness, Health, Income, and Carbon Emissions in Growing versus Non-Growing Economies

Andrew L. Fanning and Daniel W. O’Neill

Abstract

We investigate the relationships between carbon-intensive consumption and two dimensions of human wellbeing (physical health and happiness) for ~120 countries over the 2005–2015 period. Long-term (~10-year) relationships are analysed to re-assess the “happiness–income paradox” (i.e. Easterlin paradox) which states that changes in national income and happiness are correlated in the short-term, but not in the long-term. We broaden the scope of Easterlin’s analysis in two novel ways. First, the evidence for a “health–income” paradox is explored. Second, a parallel analysis using national consumption-based carbon footprints (instead of income) is conducted to explore complementary relationships with both of the wellbeing indicators. We show that countries with declining per capita consumption, measured in terms of either gross domestic product (GDP) or carbon footprint, have significant reductions in average happiness. In contrast, countries with growing per capita consumption have no significant change in happiness. There is no relationship between changes in per capita consumption and health, irrespective of whether GDP or carbon footprint is growing or not. These findings apply to rich and poor countries alike and are robust to the inclusion of other social indicators, such as social support and autonomy. We find that happiness is less sensitive to declines in carbon footprint than declines in GDP, thus lending support to calls for “decoupling” carbon emissions from economic growth. However, observed decoupling trends are insufficient to meet climate targets. If the 2 degree target is to be met without a decline in wellbeing, then either decoupling must be vastly improved, or happiness levels must be made less sensitive to declining consumption.

Keywords

Easterlin Paradox; Sustainable Consumption; Wellbeing; Carbon Footprint; Climate Change

Word Count

8,523 words (including 742 words in tables and figure captions)

28 1 Introduction

29 Nearly half a century has passed since Easterlin (1974) made the paradoxical observation that
30 income and subjective wellbeing are correlated at a given point in time, but happiness does not rise
31 with income over longer time periods (~10 years or more). This “happiness–income paradox” or
32 “Easterlin paradox” is still relevant — and contested — because it challenges conventional economic
33 policy which tends to promote income growth as the main way to increase human wellbeing
34 (Stevenson and Wolfers, 2008; Easterlin et al., 2010).

35 Meanwhile, there is little debate that income growth is tightly coupled to an increase in carbon
36 emissions, and that this increase risks pushing the climate system into a new, more hostile, state
37 with potentially drastic consequences for society (Tapia Granados et al., 2012; Knight and Schor,
38 2014; Steffen et al., 2015a). It is a challenge for countries to achieve the mainstream goal of “green
39 growth”, i.e. to decouple carbon emissions from aggregate output at a rate that is sufficiently rapid
40 to meet climate targets (Bassetti et al., 2013; Antal and van den Bergh, 2016). The decoupling
41 challenge is more difficult for countries that are net importers of upstream carbon emissions after
42 international trade is taken into account using a consumption-based approach, i.e. carbon footprint
43 (Peters et al., 2011; Hoekstra and Wiedmann, 2014).

44 The debates over the Easterlin paradox and decoupling are both concerned with how changes in
45 economic activity are related to changes in other important quantities over time, i.e. happiness and
46 a stable climate. To date, however, there have been very few empirical studies that consider the
47 dependence of happiness on carbon emissions directly, and none that investigate this relationship
48 over time (cf. Knight and Rosa, 2011; Lenzen and Cummins, 2013; York and Bell, 2014; Ambrey and
49 Daniels, 2017). That being said, there is an important body of sustainability research that analyses
50 the relationships between carbon emissions and a number of objective wellbeing indicators, such as
51 life expectancy (e.g. Steinberger et al., 2012; Lamb and Rao, 2015; Jorgenson et al., 2017).

52 Here, we adopt the approach taken by O’Neill et al. (2018), which views life satisfaction and life
53 expectancy as complementary measures of wellbeing, and perform a comparative analysis of the
54 relationship between both of these indicators and carbon-intensive consumption over time. We
55 argue that per capita values of carbon footprint and national income can be seen as alternative
56 proxies for the wellbeing gains of consumption based on different characteristics embodied within
57 final goods and services (i.e. upstream carbon emissions versus market value). The inclusion of
58 income in our analysis also permits the comparison of our results with other studies in the ongoing
59 debate surrounding the happiness–income paradox (e.g. Stevenson and Wolfers, 2013).

60 Specifically, we explore the empirical relationships between each wellbeing–consumption pair
61 across nearly 120 countries over the 2005–2015 period. Of particular relevance to the decoupling
62 debate, we ask whether there is a fundamental difference in these relationships depending on
63 whether consumption is increasing or decreasing. In short, we explore the evidence for a generalised
64 “wellbeing–consumption paradox” with an explicit focus on differences in the relationships between
65 growing and non-growing economies.

66 The remainder of the article is structured as follows. Section 2 reviews relevant literature on
67 subjective and objective wellbeing and the environment. Section 3 includes an overview of the
68 methods used in our empirical analysis, while Section 4 presents our findings on the relationships
69 between wellbeing and consumption over the 2005–2015 period. Section 5 discusses the broader
70 implications of our results for debates surrounding the Easterlin paradox, sustainable consumption,
71 and human wellbeing. Section 6 concludes.

72 2 Wellbeing and the Environment

73 There are a number of different ways of conceptualising human wellbeing. The notion of wellbeing
74 in mainstream economics draws on the utilitarianism of Mill (1863), who argued that the right action
75 is the one that produces the greatest net happiness for all concerned. The Aristotelian notion of
76 *eudemonia*, or “flourishing”, represents the main alternative to the utilitarian perspective (O’Neill,
77 2008). Eudemonic wellbeing argues that happiness is derived from becoming one’s best self, which is
78 a process influenced by the surrounding contexts of people’s lives, notably their opportunities for
79 good health, autonomy, and meaningful relations with others (Ryff and Singer, 2008). Eudemonic
80 wellbeing underpins several prominent development approaches, including the capabilities
81 approach (Nussbaum, 2003; Sen, 1985), human needs frameworks (Doyal and Gough, 1991; Max-
82 Neef, 1991), and models of psychosocial wellbeing (Ryan and Deci, 2000; Ryff and Keyes, 1995).

83 2.1 Subjective Wellbeing

84 Subjective wellbeing measures people’s appraisals and evaluations of their own lives. It can be
85 measured by asking people to evaluate their overall level of satisfaction with life (or health, finances,
86 etc.), or by asking them to provide emotional responses in terms of pleasant versus unpleasant
87 experiences (Diener et al., 2018). Here, we focus on the cognitive evaluation that people provide of
88 their own lives (i.e. life satisfaction), as the latter is the most common measure used in the
89 happiness–income literature. The terms “happiness” and “life satisfaction” are used interchangeably
90 throughout the article to refer to this evaluative measure.

91 The relation between happiness and income over time has been the topic of much debate.
92 Explanations by those who generally accept Easterlin’s (1974) finding that happiness does not
93 increase as income rises over time focus on how people compare their incomes relative to others or
94 to their past self (Clark et al., 2008). The idea is that the happiness you obtain from an increase in
95 income can be offset if others get larger income increases, or if you get a smaller increase than you
96 aspired to, thereby leaving the national happiness level unchanged despite sustained income
97 increases (Easterlin et al., 2010; Layard et al., 2010).

98 However, there are a number of studies that find that average happiness levels *do* increase with
99 income over time, but at a decreasing rate similar to the relation observed in the cross-section
100 (Stevenson and Wolfers, 2008; Diener et al., 2013; Veenhoven and Vergunst, 2014). A lack of
101 consistent time-series data across countries has been identified as a major challenge in the debate
102 over the Easterlin paradox (Knight and Rosa, 2011; Stevenson and Wolfers, 2013).

103 The magnitude of the happiness–income relationship in the studies that do find a statistically
104 significant result is typically quite small in terms of practical significance (Beja Jr., 2014). For
105 example, despite Veenhoven and Vergunst’s (2014) eye-catching title “The Easterlin Illusion:
106 Economic Growth Does Go With Greater Happiness”, the authors find that a 1% increase in annual
107 gross domestic product (GDP) per capita is associated with an increase in average life satisfaction of
108 only 0.003 points on a 0 to 10 scale. Put another way, this result suggests that to achieve a 1 point
109 increase in happiness would require GDP per capita to grow at a rate of 5% per year for 60 years!

110 There has been relatively little research on income reductions in the happiness economics literature,
111 with the few studies that do exist focussing on the individual (Vendrik and Woltjer, 2007; Di Tella et
112 al., 2010; Boyce et al., 2013; Sekulova and van den Bergh, 2013; Boyce et al., 2016). Easterlin (2009)
113 and De Neve et al. (2017) provide the only two analyses at the national level, as far as we are aware.
114 Using a small sample of post-Soviet transition countries, Easterlin (2009) finds average happiness
115 and national income moved together over a ~10-year collapse and recovery period. De Neve et al.

116 (2017) examine year-on-year changes for a large number of countries and find that average life
117 satisfaction is more than five times as sensitive to income contraction as it is to income growth.

118 In general, income losses seem to have a stronger effect on happiness than income gains at both the
119 individual and national level, a finding predicted by the concept of loss aversion in prospect theory
120 (Kahneman and Tversky, 1979). That being said, there is debate as to the level of adaptation to such
121 losses over time, and there is also a need for additional cross-country research to assess De Neve et
122 al.'s (2017) findings from a longer-term perspective.

123 To date, only a few studies have analysed the relationship between happiness and carbon emissions
124 directly. At the national level, O'Neill et al. (2018) examine a cross-section of more than 150
125 countries and find a bivariate relationship between life satisfaction and carbon footprint that
126 exhibits diminishing returns at higher emission levels. At the household level, surveys in Canada,
127 Sweden, and Australia suggest a weak to non-existent relationship between life satisfaction and
128 carbon emissions after controlling for other explanatory variables, including income (Ambrey and
129 Daniels, 2017; Andersson et al., 2014; Wilson et al., 2013).

130 One potential explanation for the lack of a relationship when controlling for explanatory variables
131 could be the very high correlation between carbon emissions and income shown by previous
132 research (Lamb et al., 2014). Given the fossil fuel dependence of modern economic activity, we
133 suspect both indicators are measuring the same thing, i.e. variation in the aggregate consumption of
134 goods and services.

135 Other environmental factors that have received attention in the subjective wellbeing literature
136 include air pollution, natural disasters, and bad weather (which seem to make people less happy),
137 while being outdoors and nice weather seem to make them happier (Ferreira et al., 2013;
138 MacKerron and Mourato, 2013; Maddison and Rehdanz, 2011; Sekulova and van den Bergh, 2016).
139 Non-environmental factors which have been shown to affect happiness include genetic
140 predisposition, personal circumstances such as marriage or unemployment, and social issues such as
141 inequality, corruption, social support, and personal autonomy (Bartels, 2015; Helliwell et al., 2016;
142 Luhmann et al., 2012; Oishi et al., 2011; Tay et al., 2014).

143 *2.2 Objective Wellbeing*

144 Income is the most widely used indicator of objective wellbeing in the climate change literature,
145 thanks to the widespread use of integrated assessment models (IAMs). IAMs analyse the costs and
146 benefits of climate mitigation versus damages in monetary terms, and the results of these cost-
147 benefit analyses are often used to estimate least-cost mitigation pathways and the "social cost of
148 carbon" (Nordhaus, 2017).

149 National pledges to reduce emissions still remain far below the rapid and sustained reductions
150 needed to keep warming below 2 °C (Rogelj et al., 2016). At least part of this gap can be explained
151 using IAM results, which generally suggest the forgone income growth associated with stringent
152 mitigation policy would be too costly for society, since wellbeing is equated with income under the
153 assumptions of welfare economics (van den Bergh, 2010).

154 A growing number of studies are moving beyond the narrow focus on income by adopting
155 eudemonic perspectives to analyse the empirical relationships between wellbeing and carbon-
156 intensive development across countries (Abdallah et al., 2012; Brand-Correa et al., 2018; Jorgenson,
157 2014; Lamb and Rao, 2015; Steinberger et al., 2012). In contrast to the coupling observed between
158 income and carbon emissions, a host of non-income measures of wellbeing show steep diminishing

159 returns with increasing levels of environmental impact across countries (Mazur and Rosa, 1974;
160 O'Neill et al., 2018). The levels of income and carbon emissions associated with a high level of life
161 expectancy, probably the most common indicator of wellbeing after income, have been shown to be
162 declining steadily over time across countries (Preston, 2007; Steinberger and Roberts, 2010).

163 In summary, a number of research gaps emerge from the diverse strands of literature that inform
164 our analysis. First, there is virtually no empirical understanding of the relationship between
165 wellbeing and the long-term reductions in carbon emissions needed for a chance of meeting the 2 °C
166 climate target. Second, although the empirical relation between happiness and income growth has
167 received considerable attention, there is a surprising lack of cross-country research on the role of
168 income contractions on wellbeing. Finally, a growing number of studies analyse resource use in
169 relation to the achievement of basic needs and capabilities based on a eudemonic notion of
170 wellbeing, but few studies include subjective measures of wellbeing alongside objective indicators.
171 The remainder of this article discusses our contribution to filling these gaps in current knowledge.

172 **3 Analytic Framework, Data, and Methods**

173 We adopt the analytic approach proposed by O'Neill et al. (2018), who envision life satisfaction and
174 life expectancy as complementary indicators of wellbeing within a broader analytic framework that
175 links biophysical resource use to basic needs via the mediating role of provisioning systems. Within
176 this approach, human wellbeing is seen as a function of both the level to which basic needs are met,
177 and the degree to which people are satisfied with this level (Costanza et al., 2007). As empirical
178 support for this view, O'Neill et al. (2018) find that the more social thresholds associated with the
179 provision of basic needs a country achieves, the healthier and happier its citizens generally are.

180 We build on O'Neill et al.'s (2018) cross-sectional study by exploring the effects of reductions in
181 carbon-intensive consumption on wellbeing over time. We test the authors' suggestion that
182 resource use (in particular carbon footprint) could be reduced significantly without affecting social
183 outcomes (i.e. life satisfaction and life expectancy) in wealthy countries.

184 Our analysis considers the period from 2005 to 2015, which was chosen for two reasons. First, there
185 is little doubt that the severity of the 2008–09 global economic recession was a defining feature of
186 the period that was felt to a greater or lesser degree by all countries. In contrast (and less well-
187 known), the 2006–07 period stands out as one in which the number of countries experiencing
188 recessions was at a historical low (IMF, 2009). These two features make 2005–2015 a singular period
189 that encompasses the ~10-year contraction and recovery phases of economic activity experienced
190 simultaneously by an unprecedented number of countries. In the absence of ambitious mitigation
191 policy, this period provides a natural experiment to analyse current relationships between wellbeing
192 and the rate of emissions mitigation that climate science suggests is required.

193 *3.1 Dependent Variables*

194 We include life satisfaction and life expectancy as complementary measures of wellbeing in our
195 analysis. Both indicators are widely used in their respective domains with relatively well-known
196 advantages and disadvantages (see Stiglitz et al., 2009 for a useful discussion).

197 Average life satisfaction at the national level is based on individual responses to the Cantril ladder
198 question, which states: "Please imagine a ladder with steps numbered from 0 at the bottom to 10 at
199 the top. The top of the ladder represents the best possible life for you and the bottom of the ladder
200 represents the worst possible life for you. On which step of the ladder would you say you personally
201 feel you stand at this time?" National average life satisfaction data from 2005 to 2015 were obtained

202 from the *World Happiness Report* (Helliwell et al., 2016), and these data were in turn aggregated
203 from the 26 January 2016 release of the Gallup World Poll.

204 Life expectancy at birth estimates the number of years that a newborn infant would live if the
205 prevailing patterns of mortality at the time of its birth were to stay the same throughout the course
206 of its life. National average life expectancy data for the 2005–2015 period were obtained from the
207 World Bank's (2018) *World Development Indicators*.

208 *3.2 Independent Variables*

209 To measure the change in consumption levels over time we selected two alternative indicators: GDP
210 per capita and carbon footprint per capita. GDP measures the total market value of all final goods
211 and services purchased within a country over the course of a year. Carbon footprint, on the other
212 hand, is an indicator of environmental pressure that places the ultimate responsibility for upstream
213 carbon emissions embodied in final goods and services with the individuals who consume them,
214 regardless of where the emissions actually occur (Hoekstra and Wiedmann, 2014). Our approach
215 views GDP per capita and carbon footprint per capita as alternative proxies for the wellbeing gains of
216 consumption based on different characteristics embodied within final goods and services (i.e.
217 market value versus upstream carbon emissions).

218 Carbon footprint is an economy-wide measure associated with a single environmental impact (i.e.
219 climate change). It therefore has a relatively well-defined global boundary in terms of how much
220 carbon dioxide can be safely emitted into the atmosphere (Steffen et al., 2015b). As a result,
221 national carbon footprints can be compared to disaggregated shares of a "safe" cumulative global
222 emissions budget (Fanning and O'Neill, 2016; Peters et al., 2015).

223 Two other important elements of wellbeing are included in the analysis: social capital and
224 autonomy. Social capital is generally conceived as the level of networks, norms, and trust that
225 facilitate mutually beneficial coordination and cooperation (Putnam, 2001). In our study, average
226 levels of national social capital are indicated by a measure of perceived social support, namely the
227 percentage of people responding that they have someone to count on for help in times of need.
228 Autonomy is a widely recognized element determining individuals' capabilities (Sen, 2001). It refers
229 to the capacity to choose some internally conceived values and commitments without external
230 constraint. Here, average perceived autonomy is measured as the percentage of people satisfied
231 with their freedom to make life choices.

232 GDP is reported in terms of purchasing power parity (PPP) adjusted to constant 2011 international
233 dollars. Population and GDP data were obtained from the World Bank (2018). Consumption-based
234 carbon emissions were obtained from the updated Peters et al. (2011) dataset published in the
235 *Global Carbon Budget 2017* (Le Quéré et al., 2018). Social support and autonomy data were obtained
236 from the *World Happiness Report* (Helliwell et al., 2016).

237 *3.3 Long-Run Trends: Extending the Easterlin Paradox*

238 Following Easterlin et al.'s (2010) method, long-run trends in life satisfaction, life expectancy, GDP
239 per capita, and carbon footprint per capita were calculated by regressing each of the indicators over
240 time. Long-run changes in wellbeing are presented in absolute terms for each indicator (i.e. on the
241 0–10 Cantril ladder scale for happiness, and in years for life expectancy). Long-run growth rates for
242 GDP per capita and carbon footprint per capita were calculated by regressing the log-transformed
243 values of each indicator over time, and are presented in percentage terms.

244 Countries were selected using a two-step process. First, only countries with observations spanning at
 245 least nine years over the 2005–2015 period were included. This step yielded unbalanced datasets of
 246 119 countries for the GDP per capita analysis ($N = 1,084$), and 100 countries for the carbon footprint
 247 per capita analysis ($N = 919$). The correlation between GDP per capita and carbon footprint per
 248 capita was extremely high in the panel (Pearson coefficient between 0.90 and 0.95, depending on
 249 the year). This observation is similar to comparisons reported elsewhere (e.g. Lamb et al., 2014), and
 250 lends support to our view that the two indicators represent alternative proxies for aggregate
 251 consumption.

252 Second, following the standard “outlier rule”, countries were not included if their long-run trends
 253 were more than 1.5 times the interquartile range observed for any indicator. This second step
 254 yielded 117 countries for the happiness–income pair, 99 countries for the happiness–carbon pair,
 255 109 countries for the health–income pair, and 91 countries for the health–carbon pair.

256 3.4 Model Estimation Techniques

257 We used four methods to estimate the dynamic relationships between the wellbeing and
 258 consumption indicators. We estimated cross-sectional relationships at the beginning and end of the
 259 period to investigate changes between the end-points of the analysis period (Section 3.4.1). Long-
 260 run changes were analysed using three different model specifications to test for differences in
 261 growing and non-growing economies (Section 3.4.2). We characterised the resilience of wellbeing to
 262 changes in consumption, and assessed whether this resilience was desirable based on long-run
 263 growth rates (Section 3.4.3). Finally, multiple regression panel analysis was conducted to estimate
 264 the contributions of consumption, social support, and autonomy to wellbeing, while controlling for
 265 unobserved heterogeneity across countries and over time (Section 3.4.4).

266 3.4.1 Comparison of Cross-Sectional Relationships

267 We draw upon O’Neill et al.’s (2018) finding that a linear-log model provides the best-fit curve to
 268 estimate cross-sectional relationships between carbon footprint and both wellbeing indicators
 269 compared to alternative functional forms, namely linear and saturation curves. The linear-log
 270 ordinary least squares (OLS) model was specified as follows:

$$WB_i = \alpha + \beta \log(C_i) + \varepsilon_i \quad (1)$$

271 where WB_i is the wellbeing indicator (either life satisfaction or life expectancy) of country i , α is the
 272 intercept, β is the effect on wellbeing of a one-unit change in that country’s log-transformed level of
 273 consumption C_i (either GDP per capita or carbon footprint), and ε_i is the country-specific error term.

274 To test for changes in the cross-sectional relationships at the beginning and end of the 2005–2015
 275 period, we took 3-year average values for each indicator (i.e. from 2005 to 2007, and from 2013 to
 276 2015, respectively). Average values were used to decrease the sensitivity of the estimates to year-
 277 specific variation, and also to ensure that the full sample of countries was included for each
 278 wellbeing–consumption pair since not every country has an observation for every year in the
 279 unbalanced panel. The analysis is similar to previous studies on the changing relations between
 280 carbon emissions and objective wellbeing (Steinberger et al., 2012; Steinberger and Roberts, 2010),
 281 but represents the first time the method has been applied to subjective wellbeing measures, as far
 282 as we are aware.

283 3.4.2 Long-Run Relationships: Growing versus Non-Growing Economies

284 Three different functional forms were used to test which model explains the most cross-country
 285 variation in the long-run change of each wellbeing–consumption pair. We compared a linear model,
 286 a quadratic model, and an interaction model as follows:

$$\Delta WB_i = \alpha_1 + \beta_1 \Delta C_i + \varepsilon_i \quad (2)$$

$$\Delta WB_i = \alpha_2 + \beta_2 \Delta C_i + \beta_3 \Delta C_i^2 + \varepsilon_i \quad (3)$$

$$\Delta WB_i = \alpha_3 + \beta_4 \Delta C_i + \beta_5 NoGrow_i + \beta_6 \Delta C_i * NoGrow_i + \varepsilon_i \quad (4)$$

287 Equation (2) estimates a continuous linear relationship between the (long-run) change in wellbeing
 288 ΔWB_i for country i , and the change in the country's level of consumption ΔC_i , where α_1 is the
 289 intercept, β_1 is the predicted change in wellbeing from a 1% change in long-run consumption
 290 growth, and ε_i is the country-specific error term.

291 Equation (3) estimates a continuous non-linear (curvilinear) relationship between the change in
 292 wellbeing and consumption of country i . In this case, β_2 is the rate of change in wellbeing when
 293 consumption growth is equal to zero, while β_3 gives both the direction and steepness of the
 294 curvature.

295 Equation (4) is an interaction model that estimates an asymmetrical relationship between the
 296 change in wellbeing and consumption that depends on whether country i 's consumption is growing
 297 or not, as indicated by a dummy variable $NoGrow_i$ (equal to 1 if consumption is not growing). Here,
 298 β_4 is the predicted change in wellbeing from a 1% change in country i 's consumption when it is
 299 growing (and α_3 is the intercept). If country i 's consumption is not growing, then the predicted effect
 300 on wellbeing is given by adding the interaction coefficient $\beta_4 + \beta_6$, and the non-growing intercept is
 301 given by adding the dummy coefficient $\alpha_3 + \beta_5$. Given the potential sensitivity of this approach to
 302 the threshold between “growing” and “non-growing” consumption, we tested three models (i.e. the
 303 threshold was set at zero, a percentage point above zero, and a percentage point below zero).

304 In total, five models were specified to estimate the relationship between long-run changes in
 305 wellbeing and consumption (one linear model, one quadratic model, and three interaction models
 306 with the non-growing consumption dummy set to -1%, 0%, and 1%, respectively). The best-fit model
 307 for each wellbeing-consumption pair was chosen in two steps. First, the linear model was chosen if
 308 none of the larger models explained significantly more variation than the simplest model based on
 309 the F-test of an analysis of variance (ANOVA). Second, if any of the larger models were found to
 310 explain significantly more variation than the linear model in the first step, we chose the model with
 311 the highest adjusted R^2 value.

312 3.4.3 The Resilience of Wellbeing to Changes in Consumption

313 The concept of “resilience” offers a way to interpret different relationships between wellbeing and
 314 consumption in growing and non-growing economies. Resilience refers to (i) the capacity of a system
 315 to self-organize and absorb shocks without shifting to a different state, and (ii) the ability to re-
 316 organize and take advantage of new opportunities opened up by disturbances (Folke, 2006). A key
 317 insight is that resilience can be “good” if the system is in a desirable state, or “bad” if the system is in
 318 an undesirable state (Tanner et al., 2015). For example, macro-algae dominated reefs or urban slums
 319 are systems in undesirable states that may be highly resilient, which is to say they withstand
 320 attempts to transform them into different, more desirable states (Angeler and Allen, 2016).

321 We characterised the resilience of wellbeing to changes in consumption in three steps. First, for each
 322 country we calculated an annual rate-of-change index (relative to a base year) for each wellbeing
 323 and consumption indicator. Second, national wellbeing was characterised as “resilient” if it changed
 324 by less than consumption over the same period, or “sensitive” if it changed by more than
 325 consumption. Third, the relationship was characterised as “desirable” if wellbeing increased by more
 326 than consumption, or if it declined by less than consumption. We characterised the relationship as
 327 “undesirable” if wellbeing increased by less than consumption, or if it declined by more than
 328 consumption.

329 3.4.4 Multiple Regression Panel Analysis

330 Multiple regression panel analysis provides a useful robustness check to test the results of the long-
 331 run analysis described in Section 3.4.2. It is also the method employed by studies that tend to find a
 332 significant relation between income growth and happiness, allowing our results to be directly
 333 compared to those on both sides of the Easterlin paradox debate. Pooled OLS multiple regression
 334 analysis was used to estimate the contribution of consumption to national average wellbeing
 335 alongside perceived levels of social capital and autonomy. The estimated model is as follows:

$$WB_{it} = \beta x_{it} + u_i + w_t + \varepsilon_{it} \quad (5)$$

336 where WB_{it} is the national average wellbeing indicator for country i in year t , β is the vector of
 337 coefficients for independent variables that vary over time, x_{it} is the matrix of independent variable
 338 values for each country and year, u_i is the country-specific term that controls for unobserved
 339 heterogeneity within countries, and w_t is the year-specific term that controls for unobserved
 340 heterogeneity over time. Individual country and year fixed effects were included in the preferred
 341 model based on their significance compared to alternative models with no such effects (F-test).
 342 Robust standard errors controlling for heteroskedasticity and autocorrelation were estimated after
 343 testing for their presence in the unbalanced panel dataset.

344 4 Results

345 This section presents the findings of each of the four methods described in Section 3.4. We find that
 346 for a given level of consumption, life expectancy is increasing over time, but happiness is not
 347 (Section 4.1). In fact, life expectancy increases steadily in all countries with no relation to
 348 consumption, while happiness shows an asymmetrical relationship that depends on whether
 349 consumption is growing or not (Section 4.2). When consumption does not grow, happiness tends to
 350 decrease, although it is more sensitive to declines in income than declines in carbon footprint
 351 (Section 4.3). The relationship for each wellbeing–consumption pair holds when additional indicators
 352 are included (social support and autonomy) using multiple regression panel analysis (Section 4.4).

353 4.1 Comparison of Cross-Sectional Relationships

354 The relationship between happiness and consumption is fairly stable over the 2005–2015 time
 355 period considered in our analysis (Figure 1a, b), while the relationship between life expectancy and
 356 consumption has changed over time to be less consumption-intensive (Figure 1c, d). The results are
 357 remarkably similar when consumption is measured in terms of either GDP or carbon footprints.

358 For a given level of income or carbon footprint, life expectancy is increasing over time but happiness
 359 is not. Or seen the other way, a given level of life expectancy is associated with a lower level of
 360 income and emissions at the end of the period compared to the beginning, whereas happiness

361 shows no such change. Indeed, the level of happiness associated with a given level of income
 362 decreases slightly over the analysis period.

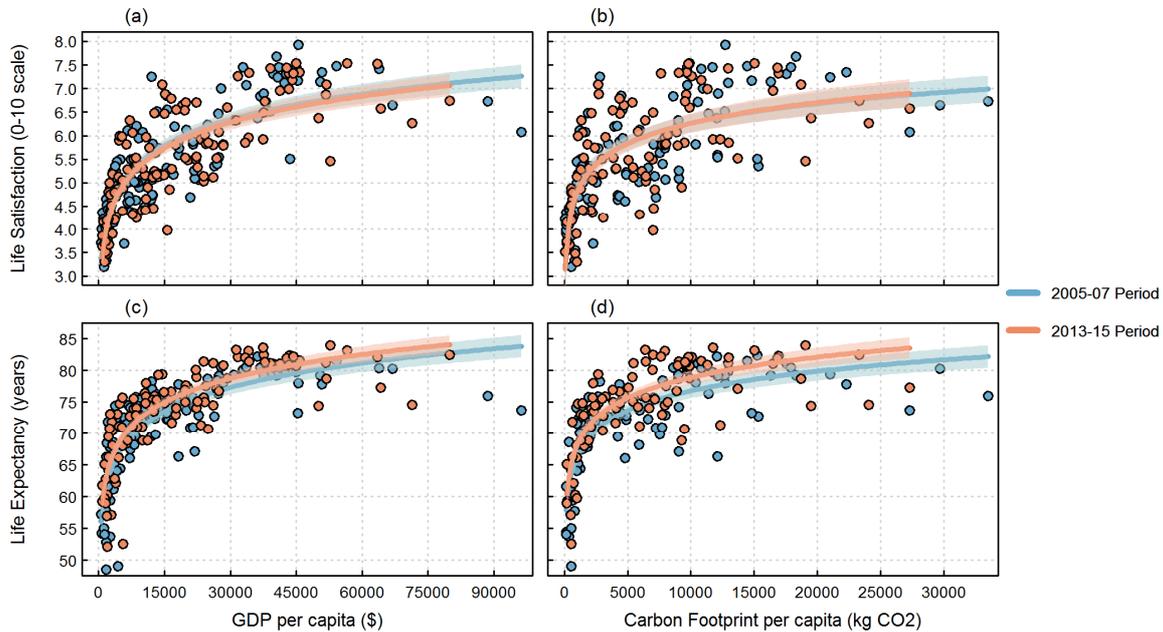


Figure 1. Cross-sectional relationships for (a) life satisfaction and GDP per capita, (b) life satisfaction and carbon footprint per capita, (c) life expectancy and GDP per capita, and (d) life expectancy and carbon footprint per capita, using 3-year averages at the beginning (blue) and end (orange) of the 2005–2015 period. 95% confidence interval bands are shown with a lighter tint around each regression curve. See Table 1 for regression coefficients and Supplementary Data for country-level data.

363 At the beginning of the period, 75 years of life expectancy and a life satisfaction of 6 out of 10 were
 364 both associated with a per capita income of \$20,000 and a carbon footprint of 6.7 tonnes CO₂. By
 365 the end of the period, the same 75 years of life expectancy could be achieved with 25% less income
 366 and 35% less carbon (i.e. \$15,000 and 4.3 tonnes CO₂, respectively). In contrast, the same life
 367 satisfaction of 6 out of 10 at the end of the period was associated with slightly more income and
 368 carbon (\$21,500 and 6.8 tonnes CO₂).

Table 1. Cross-Sectional Regression Results for Wellbeing–Consumption Pairs at the Beginning and End of the 2005–2015 period

	Dependent variables:							
	Life Satisfaction (0–10 Cantril Scale)				Life Expectancy (years)			
	2005–07 (1)	2013–15 (2)	2005–07 (3)	2013–15 (4)	2005–07 (5)	2013–15 (6)	2005–07 (7)	2013–15 (8)
Log GDP per capita	0.784*** (0.045)	0.796*** (0.043)			5.554*** (0.416)	5.453*** (0.378)		
Log CO ₂ Footprint			0.597*** (0.048)	0.634*** (0.049)			4.465*** (0.427)	4.626*** (0.470)
Constant	-1.742*** (0.395)	-1.919*** (0.390)	0.762* (0.385)	0.423 (0.387)	20.09*** (4.044)	22.53*** (3.722)	35.66*** (3.696)	36.30*** (4.012)
Countries	117	117	99	99	109	109	91	91
Adjusted R ²	0.698	0.660	0.554	0.503	0.688	0.710	0.625	0.614

Notes: OLS regression on 3-year averages of each wellbeing–consumption pair at the beginning (2005–07) and end (2013–15) of the 2005–2015 analysis period. Robust standard errors are shown in parentheses. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

369

370 4.2 Long-Run Relationships: Growing versus Non-Growing Economies

371 Our analysis of long-run changes in wellbeing and consumption over the 2005–2015 period finds
 372 that consuming less is generally associated with a decline in happiness, while consuming more has
 373 no discernible effect on happiness (Figure 2a, b). This finding suggests a fundamental difference in
 374 the relationship between happiness and consumption in growing versus non-growing economies. In
 375 contrast, life expectancy increases steadily in all countries, and appears unaffected by changes in
 376 consumption (Figure 2c, d).

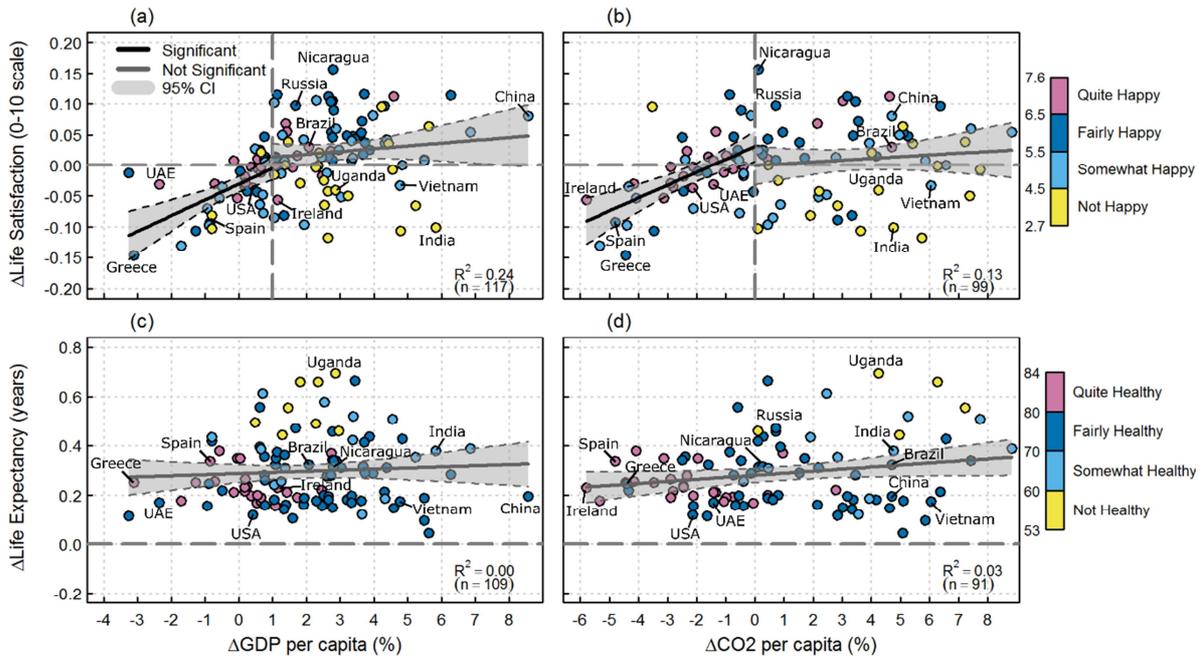


Figure 2. The relationship between long-run annual trends (denoted by Δ) in: (a) life satisfaction and GDP per capita, (b) life satisfaction and carbon footprint per capita, (c) life expectancy and GDP per capita, and (d) life expectancy and carbon footprint per capita, across countries over the 2005–2015 period. Best-fit curves and adjusted- R^2 values are shown on each plot. The best-fit threshold between “growing” and “non-growing” consumption groups is shown by the vertical dashed line in (a) and (b), while the horizontal dashed line shows zero change in the dependent variable. Slopes are significant at $p < 0.05$ with 95% confidence interval (CI) bands shown in light grey. See Table 2 for regression coefficients and Supplementary Data for country-level data.

377 For the happiness–income pair (Figure 2a), we find no evidence that happiness increases across
 378 countries with rising income ($N = 80$), but we do find evidence that happiness declines across
 379 countries with incomes that do not rise ($N = 37$). These asymmetrical long-run results are consistent
 380 with De Neve et al.’s (2017) short-run findings. Out of the five models that we tested, the interaction
 381 model that categorises countries with growth rates less than 1% per year as non-growing provides
 382 the best-fit model for GDP per capita (see Section 3.4.2 for a description of the linear, quadratic, and
 383 interaction models tested).

384 Each percentage point drop in long-run GDP per capita below 1% per year is associated with a
 385 significant decline in happiness of 0.03 points per year. In other words, we find that a decline in
 386 income of 5% per year would be associated with a 1-point decline in happiness after only 8 years,
 387 based on current relationships. In contrast, the happiness–income relation across countries in the
 388 growing group is not statistically significant, and even if it were, the estimated effect is less than one
 389 fifth the size of the relation in non-growing countries.

Table 2. Long-Run Regression Results for Wellbeing-Consumption Pairs (2005-2015)

Independent variable	Dependent variables:			
	ΔLife Satisfaction (0-10 scale)		ΔLife Expectancy (years)	
	(1)	(2)	(3)	(4)
ΔGDP per capita	0.005 (0.004)		0.005 (0.006)	
ΔCO ₂ Footprint per capita		0.003 (0.003)		0.008 (0.004)
NoGrow _{Dummy}	-0.040* (0.016)	0.031 (0.021)		
ΔGDP per capita x NoGrow _{Dummy}	0.021* (0.011)			
ΔCO ₂ Footprint per capita x NoGrow _{Dummy}		0.018** (0.006)		
Constant	0.287*** (0.016)	0.280*** (0.013)	0.009 (0.015)	-0.0002 (0.016)
Countries	117	99	109	91
Adjusted R ²	0.25	0.13	0.00	0.03

Notes: Best-fit OLS models for explaining long-run trends in each wellbeing-consumption pair (robust standard errors).
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

390 For the happiness–carbon pair (Figure 2b), the relationships are similar to the happiness–income
391 findings (Figure 2a). That is, we find an asymmetrical relationship in which happiness is not related
392 to carbon footprint when the latter is growing ($N = 56$), but happiness is related to carbon footprint
393 when the latter is not growing ($N = 43$). The interaction model that categorises countries with long-
394 run growth rates less than 0% per year as non-growing provides the best-fit model for carbon
395 footprint.

396 In contrast to the happiness–income results, where non-growing income is always associated with a
397 decline in happiness, a mild decline in carbon footprint (i.e. between -2% and 0% per year) is not
398 significantly associated with a decline in happiness. However, we find that a larger decline in carbon
399 footprint per capita of 5% per year would be associated with a 1-point decline in happiness after 10
400 years, based on current relationships. This finding is troubling from a climate change perspective
401 because a global mitigation rate of 5% per year would take around 80 years to decarbonise the
402 economy (Le Quéré et al., 2018). For the group of countries with growing carbon footprints, the
403 estimated happiness–carbon relationship is one seventh the size of the non-growing relationship,
404 and not statistically significant.

405 The long-run health–income (Figure 2c) and health–carbon (Figure 2d) relationships across countries
406 are also very similar to one another. Essentially, the number of years an infant can expect to live is
407 increasing in all countries (the average increase is an additional 3.6 months per year), and the
408 increase bears no relation to whether income or carbon footprint is growing or not. None of the
409 alternative models that we tested provide a better fit than the linear model for the long-run health–
410 income and health–carbon relationships. These findings are more promising than the happiness
411 results because they suggest the universal trend towards longer, healthier lives may be compatible
412 with ambitious mitigation policy.

413 4.3 The Resilience of Wellbeing to Changes in Consumption

414 The results presented so far have focused on the general relationships between wellbeing and
 415 consumption in growing versus non-growing economies. However, there is also considerable
 416 variability in how these indicators have changed over time in individual countries (with the exception
 417 of life expectancy which increases steadily in all countries). Here, we illustrate possible pathways
 418 countries may follow by characterising the resilience or sensitivity of wellbeing to changes in
 419 consumption in four nations (Figure 3).

420 In Spain (Figure 3a), life satisfaction declined by more than GDP did in percentage terms—a case of
 421 *undesirable sensitivity* of happiness to declining income levels. It would clearly be preferable for life
 422 satisfaction to decline by less than GDP, a situation exemplified by Ireland (Figure 3b), which we
 423 label as *desirable resilience*. By contrast, life satisfaction increased by much less than income and
 424 carbon footprint in Vietnam (Figure 3c), a case of the *undesirable resilience* of happiness to
 425 increasing consumption levels. If consumption increases, then the hope would be for life satisfaction
 426 to increase by at least as much, a situation observed in Nicaragua (Figure 3d), which we characterize
 427 as *desirable sensitivity*.

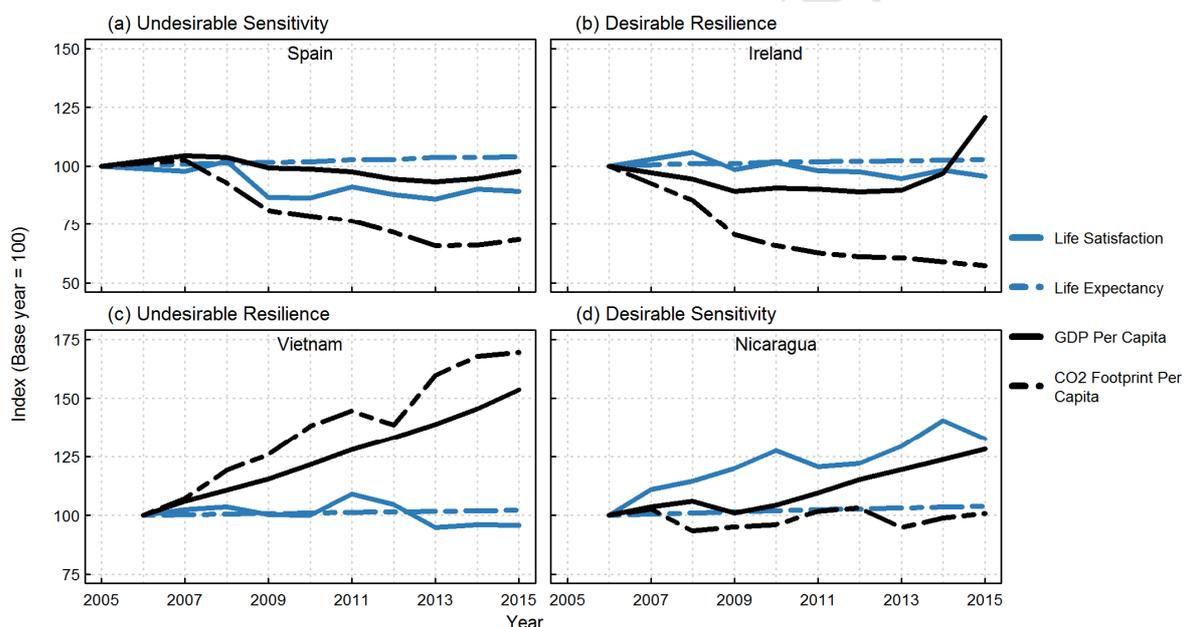


Figure 3. Country plots of annual rate-of-change indices over time (relative to a base year), illustrating four wellbeing–consumption pathways. The top two panels show countries where GDP is largely declining, while the bottom two panels show countries where it is increasing. In Panel (a) for Spain, life satisfaction declines by more than GDP, a case of “undesirable sensitivity”. In Panel (b) for Ireland, life satisfaction declines by less than GDP, a case of “desirable resilience”. In Panel (c) for Vietnam, life satisfaction increases by less than GDP, a case of “undesirable resilience”. In Panel (d) for Nicaragua, life satisfaction increases by more than GDP, a case of “desirable sensitivity”. Life expectancy increases steadily in all cases. See <https://goodlife.leeds.ac.uk/paradox> for an interactive website that produces plots for all countries.

428 In the majority of the 100 countries that we analysed, happiness is either undesirably sensitive to
 429 decreases in income ($N = 29$) or undesirably resilient to increases in income ($N = 60$). Only 6
 430 countries are desirably sensitive to income growth, while 5 countries are desirably resilient to
 431 income contractions. At the same time, happiness in most countries is generally resilient to changes
 432 in carbon footprint: it is desirably resilient when carbon footprint declines ($N = 35$), and undesirably
 433 resilient when it increases ($N = 51$). This latter finding is particularly worrying because it suggests
 434 that emissions growth brings very little (if any) return in terms of wellbeing, but it does have an
 435 unambiguous cost in terms of climate stability.

436 4.4 Multiple Regression Panel Analysis

437 The results presented so far suggest that whether changes in consumption are relevant to explaining
 438 changes in wellbeing across countries depends on whether consumption is growing or not, and
 439 diverse pathways are possible notwithstanding the general trends. Clearly, consumption is only one
 440 potential factor that determines overall wellbeing. Table 3 therefore presents multivariate panel
 441 regression results for each wellbeing indicator. The panel includes consumption indicators (using
 442 GDP and carbon footprint as alternative proxies) alongside two other well-known determinants of
 443 wellbeing: social capital and personal autonomy.

444 The panel analysis (Table 3) reaffirms the earlier findings. It suggests that per capita GDP and carbon
 445 footprint are important predictors of life satisfaction in non-growing economies, but not in growing
 446 economies, even after controlling for additional explanatory variables and unobserved
 447 heterogeneity across countries and over time. Neither consumption indicator is an important
 448 predictor of life expectancy.

Table 3. Multiple Regressions to Explain National Wellbeing

Independent variable	Dependent variables:					
	Life Satisfaction (0-10 scale)				Life expectancy (years)	
	$\Delta\text{GDP} \leq 1\%$ (1)	$\Delta\text{GDP} > 1\%$ (2)	$\Delta\text{CO}_2 \leq 0\%$ (3)	$\Delta\text{CO}_2 > 0\%$ (4)	Full Sample (5)	(6)
Log GDP Per Capita	1.483* (0.732)	0.452 (0.366)			0.169 (0.511)	
Log CO2 Footprint Per Capita			1.146*** (0.254)	0.389 (0.231)		0.437 (0.314)
Social Support	0.013 (0.007)	0.016*** (0.004)	0.017* (0.007)	0.016** (0.005)	0.012* (0.006)	0.009 (0.007)
Autonomy	0.013** (0.004)	0.007* (0.003)	0.012** (0.004)	0.009* (0.004)	-0.001 (0.004)	-0.001 (0.004)
Countries	36	73	41	50	109	91
Observations	302	670	361	455	972	816
Adjusted R ²	0.941	0.898	0.918	0.872	0.996	0.996

Notes: Pooled OLS models for unbalanced panels with country and year fixed effects included. ΔGDP denotes long-run change in annual GDP per capita. ΔCO_2 denotes long-run change in annual carbon footprint per capita. Only countries with observations spanning at least 9 years over the 2005–2015 period are included. Robust standard errors of the coefficients are reported in parentheses. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

449 The sizes of the wellbeing–consumption effects in the multivariate panel analysis are only marginally
 450 smaller than the results using Easterlin’s bivariate long-run method, which suggests that omitted
 451 variables and/or unobserved heterogeneity play a minor, albeit significant, role. The panel results
 452 estimate that a 1 point decline in happiness would take 17 years (13 years) with a 5% per year
 453 decline in carbon footprint per capita (GDP per capita), compared to 10 years (8 years) with
 454 Easterlin’s method. For growing economies, the happiness–income and happiness–carbon panel
 455 coefficients are not statistically significant, and even if they were, their magnitude suggests a 1 point
 456 increase in happiness would take ~50 years to achieve with income or carbon footprint growth of 5%
 457 per year.

458 Autonomy and social support are both statistically significant across four of the six models, which
 459 suggests they are important features of wellbeing irrespective of whether consumption is increasing
 460 or decreasing. Social support has the most consistent effect on wellbeing across all models, and it is
 461 also generally the largest single predictor of national average happiness and health. Although

462 autonomy contributes significantly to happiness, our results suggest its effect on health is negligible.
463 Indeed, we find that the steady increase in life expectancy observed across countries is not
464 explained at all by changes in consumption or autonomy after taking into account country- and year-
465 specific fixed effects.

466 5 Discussion

467 When countries are compared at a point in time, wellbeing and consumption appear to be linked,
468 but only up to a point after which more consumption contributes little to wellbeing (Figure 1). It has
469 been suggested that wealthy countries that have crossed this turning point could reduce resource
470 use considerably with little effect on wellbeing, thereby freeing up ecological space for poorer
471 countries to increase consumption to meet basic needs (Kerschner, 2010; Raworth, 2017). If life
472 expectancy is used to measure wellbeing, then our results support this view because people are
473 living longer irrespective of whether consumption declines or increases. However, if happiness is
474 used to measure wellbeing, then our results do not support this view, as a decline in consumption is
475 associated with a decline in happiness.

476 Most of the countries with increasing income and carbon footprint are nations with relatively low
477 levels of wellbeing that arguably have the most to gain from increasing consumption, but we see no
478 such effect on either wellbeing indicator. These findings suggest Easterlin's happiness–income
479 paradox can be seen as a specific case of a general “wellbeing–consumption paradox” where
480 consumption and wellbeing are correlated at a point in time, but increasing consumption does not
481 significantly increase wellbeing (although decreasing consumption may still reduce it, as with
482 happiness).

483 The pursuit of economic growth appears to be a dangerously inefficient strategy to increase
484 wellbeing in a climate-constrained world. We find that there is no statistically significant relationship
485 between income growth and happiness, and even if there were, the size of the effect suggests that a
486 1 point increase in happiness would require ~50 years of income growth at 5% per year. This 12-fold
487 increase in economic activity would take place over a period when global carbon emissions already
488 need to decline by ~10% per year for a likely chance to meet the 2 °C target without negative
489 emissions technologies (Anderson, 2015). In other words, to keep warming below 2 °C and increase
490 world average happiness by a single point over the next 50 years would require carbon emissions to
491 be decoupled from global economic activity at an implausibly high rate of ~15% per year.

492 While life satisfaction and life expectancy tend to follow a parallel trajectory in growing economies,
493 the same is not true for non-growing economies. Non-growing consumption is associated with
494 significant declines in happiness, but not with declines in life expectancy. These diverging findings
495 highlight the complementary nature of objective and subjective measures of wellbeing. Together,
496 the two indicators suggest that the 2005–2015 period was a difficult time for many people (as
497 indicated by declines in happiness), but it was not so difficult that the provision of basic needs broke
498 down (as indicated by the lack of effect on life expectancy).

499 The finding that a decrease in carbon footprint is associated with a decline in happiness represents a
500 major challenge to the achievement of the 2 °C climate target. A mitigation rate of ~6% per year
501 would be needed to reduce the average carbon footprint of countries in our non-growing group
502 from 10 t CO₂ per capita in 2015 down to 1.6 t by 2050, a level proposed to be broadly consistent
503 with the 2 °C target (O'Neill et al., 2018). However, happiness in these predominantly wealthy
504 countries would decline by 2.5 out of 10 points over the same period, based on current relationships
505 (and assuming that countries did not adapt to sustained declines in emissions to some degree).

506 For the majority of countries with non-growing consumption, happiness fell by more than income
507 over the past decade, but less than carbon footprint (in percentage terms). This finding generally
508 supports the green growth view of emissions mitigation, which argues that the way to achieve
509 climate objectives without sacrificing current well-being is to avoid contractions in GDP (New
510 Climate Economy, 2014). That said, current mitigation rates are too slow to meet climate targets and
511 an unplanned economic contraction (as observed in many countries over the past decade) could
512 have a rather different effect on happiness than a voluntary transition to a non-growing economy.

513 In this sense, our findings could be interpreted by advocates of “degrowth” as evidence that
514 societies must “decolonize their imagination” from growth to achieve the required decreases in
515 carbon emissions without undue hardship (D’Alisa et al., 2014). Degrowth and postgrowth scholars
516 seek to liberate public debate from unquestioned reliance on economic growth to imagine radical
517 alternatives that equitably downscale consumption to sustainable levels, while maintaining or
518 enhancing human wellbeing (Büchs and Koch, 2017; Schneider et al., 2010). In a recent review of the
519 degrowth literature, Kallis et al. (2018) find that economic contractions need not lead to declines in
520 happiness if accompanied by redistribution and a shared sense of prosperity that values community
521 and the environment.

522 Our results also contribute to growing interest in “demand-side” climate solutions that target
523 strategies to change consumption behaviour and understand their wellbeing implications alongside
524 the mainstream focus on supply-side technical solutions (Creutzig et al., 2018). The upcoming sixth
525 assessment report of the Intergovernmental Panel on Climate Change (IPCC) will feature a chapter
526 on demand that asks how demand-side mitigation measures impact on human wellbeing, among
527 other questions (Ibid.). Our findings provide a baseline that suggests people in countries with
528 mitigation rates relatively close to the rates required to meet climate targets can expect to live
529 longer, but less happy lives, on average.

530 Overall, the asymmetrical results on happiness in growing versus non-growing economies are
531 consistent with previous research at national and individual levels, with the added concern that
532 these happiness–income relations also apply to carbon footprint. The concept of loss aversion is the
533 most common explanation for why growth does not make people happier, while a lack of it makes
534 them unhappier (De Neve et al., 2017). Unfulfilled expectations appear to play a central role via the
535 associated frustration and futility (anticipated or experienced) that arise when plans go worse than
536 expected.

537 Interestingly, Boyce et al. (2016) find that highly conscientious, goal-oriented people experience
538 large losses in happiness when their incomes decline, while people low in conscientiousness
539 experience no significant reduction in happiness. Thus, our finding that non-growing consumption is
540 accompanied by declines in happiness could be driven by a subset of people high in
541 conscientiousness who experience very large losses. In short, it seems that the less people aspire
542 towards high levels of consumption, the smaller the loss in their wellbeing when material aspirations
543 are not fulfilled (Matthey, 2010). There is evidence that major life events can result in changes to
544 individual personality (Boyce et al., 2015), which provides one possible avenue for future research to
545 better understand how to steer aspirations towards low-carbon lifestyles during economic
546 downturns.

547 Finally, our empirical analysis of the relationships between wellbeing and consumption in growing
548 versus non-growing economies has some important limitations. Although we argue that the 2005–
549 2015 period provides a natural experiment to explore wellbeing implications of fairly deep emissions
550 cuts in the absence of ambitious mitigation policy, we also recognize that a single decade is barely

551 sufficient to assess long-run trends. As more time-series data become available, further research will
552 be able to re-assess our findings. Additionally, current relationships may not be a good guide for the
553 future if ambitious action is successful in eliminating the fossil fuel dependence of modern
554 economies in the coming decades. Still, it is useful to have an idea of where we currently stand even
555 if the goal is to end up elsewhere. Last but not least, our analysis provides an indication of the
556 relationships between changes in consumption and wellbeing across countries, but it provides little
557 guidance on how to manage the social and technical processes that drive these relationships
558 towards climate-friendly outcomes. Additional research is needed to better understand cross-
559 country differences in the social and technical provisioning systems that mediate the relationships
560 between resource use, consumption, the achievement of basic needs, and ultimately, human
561 wellbeing.

562 **6 Conclusions**

563 This study examined the relationships between wellbeing and consumption in countries with
564 growing versus non-growing economies over the 2005–2015 period. By integrating insights from
565 happiness economics and sustainability science, our analysis makes three contributions.

566 First, we have expanded Easterlin’s happiness–income work by including two additional indicators,
567 namely life expectancy and carbon footprint per capita. Our approach views life satisfaction and life
568 expectancy as complementary measures of wellbeing, whereas GDP and carbon footprint are seen
569 as alternative measures of consumption. We find that the happiness–income paradox can be seen as
570 a specific case of a generalised “wellbeing–consumption paradox”. Each wellbeing–consumption pair
571 is strongly correlated at a point in time, but wellbeing does not increase with either GDP per capita
572 or carbon footprint per capita in the long-run.

573 Second, the wellbeing–carbon relationships are remarkably similar to the wellbeing–income
574 relationships, which demonstrates the continued fossil fuel dependence of consumption. Of
575 particular concern from a climate change perspective, we show for the first time that there is
576 currently an asymmetrical relationship between happiness and carbon footprint that depends on
577 whether emissions are growing or not. For the group of countries with declining carbon footprint,
578 happiness tends to decline as well. In contrast, for the group of countries with growing carbon
579 footprint, the relationship is nil. More optimistically, life expectancy increases in all countries, and
580 bears no relation to consumption whatsoever. These results are robust to the inclusion of additional
581 explanatory variables (social support and autonomy) and after controlling for unobserved
582 heterogeneity across countries and over time.

583 Finally, in recognition of the variability across countries for each wellbeing–consumption pair, we
584 characterised four illustrative pathways that countries have followed. The criteria were based on (i)
585 the resilience or sensitivity of wellbeing to changes in consumption, and (ii) the desirability of that
586 resilience or sensitivity based on growing and non-growing consumption trends. The vast majority of
587 countries have happiness levels that increase by less (or even decrease) in percentage terms
588 compared to consumption growth (i.e. undesirable resilience). In most countries with non-growing
589 income, happiness decreased by more than the associated drop in income (i.e. undesirable
590 sensitivity). In contrast, happiness declined by less than carbon footprint in most of the countries
591 with non-growing per capita carbon footprints (i.e. desirable resilience).

592 Overall, our findings suggest that in order to achieve climate targets without sacrificing current well-
593 being, non-growing GDP per capita should be avoided — at least based on current relationships.
594 However, observed decoupling trends are insufficient to meet climate targets. If the 2-degree target

595 is to be met, then either decoupling must be vastly improved, or happiness must be made more
596 resilient to a decline in income.

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600 **References**

- 601 Abdallah, S., Michaelson, J., Shah, S., Stoll, L., Marks, N., 2012. The Happy Planet Index: 2012 Report.
602 A Global Index of Sustainable Well-Being. nef, London.
- 603 Ambrey, C.L., Daniels, P., 2017. Happiness and footprints: assessing the relationship between
604 individual well-being and carbon footprints. *Environ Dev Sustain* 19, 895–920.
605 <https://doi.org/10.1007/s10668-016-9771-1>
- 606 Anderson, K., 2015. Duality in climate science [WWW Document]. *Nature Geoscience*.
607 <https://doi.org/10.1038/ngeo2559>
- 608 Andersson, D., Nässén, J., Larsson, J., Holmberg, J., 2014. Greenhouse gas emissions and subjective
609 well-being: An analysis of Swedish households. *Ecological Economics* 102, 75–82.
610 <https://doi.org/10.1016/j.ecolecon.2014.03.018>
- 611 Antal, M., van den Bergh, J.C., 2016. Green growth and climate change: conceptual and empirical
612 considerations. *Climate Policy* 16, 165–177. <https://doi.org/10.1080/14693062.2014.992003>
- 613 Bartels, M., 2015. Genetics of Wellbeing and Its Components Satisfaction with Life, Happiness, and
614 Quality of Life: A Review and Meta-analysis of Heritability Studies. *Behav Genet* 45, 137–156.
615 <https://doi.org/10.1007/s10519-015-9713-y>
- 616 Bassetti, T., Benos, N., Karagiannis, S., 2013. CO2 Emissions and Income Dynamics: What Does the
617 Global Evidence Tell Us? *Environ Resource Econ* 54, 101–125.
618 <https://doi.org/10.1007/s10640-012-9583-1>
- 619 Beja Jr., E.L., 2014. Income growth and happiness: reassessment of the Easterlin Paradox. *Int Rev*
620 *Econ* 61, 329–346. <https://doi.org/10.1007/s12232-014-0211-y>
- 621 Boyce, C.J., Wood, A.M., Banks, J., Clark, A.E., Brown, G.D.A., 2013. Money, Well-Being, and Loss
622 Aversion: Does an Income Loss Have a Greater Effect on Well-Being Than an Equivalent
623 Income Gain? *Psychological Science*. <https://doi.org/10.1177/0956797613496436>
- 624 Boyce, C.J., Wood, A.M., Daly, M., Sedikides, C., 2015. Personality change following unemployment. *J*
625 *Appl Psychol* 100, 991–1011. <https://doi.org/10.1037/a0038647>
- 626 Boyce, C.J., Wood, A.M., Ferguson, E., 2016. Individual Differences in Loss Aversion:
627 Conscientiousness Predicts How Life Satisfaction Responds to Losses Versus Gains in Income.
628 *Personality and Social Psychology Bulletin*. <https://doi.org/10.1177/01461672166634060>
- 629 Brand-Correa, L.I., Martin-Ortega, J., Steinberger, J.K., 2018. Human Scale Energy Services:
630 Untangling a 'golden thread.' *Energy Research & Social Science* 38, 178–187.
- 631 Büchs, M., Koch, M., 2017. Postgrowth and Wellbeing: Challenges to Sustainable Welfare. Palgrave
632 MacMillan, Basingstoke.
- 633 Clark, A.E., Frijters, P., Shields, M.A., 2008. Relative Income, Happiness, and Utility: An Explanation
634 for the Easterlin Paradox and Other Puzzles. *Journal of Economic Literature* 46, 95–144.
- 635 Costanza, R., Fisher, B., Ali, S., Beer, C., Bond, L., Boumans, R., Danigelis, N.L., Dickinson, J., Elliott, C.,
636 Farley, J., Gayer, D.E., Glenn, L.M., Hudspeth, T., Mahoney, D., McCahill, L., McIntosh, B.,
637 Reed, B., Rizvi, S.A.T., Rizzo, D.M., Simpatico, T., Snapp, R., 2007. Quality of life: An approach
638 integrating opportunities, human needs, and subjective well-being. *Ecological Economics* 61,
639 267–276. <https://doi.org/10.1016/j.ecolecon.2006.02.023>
- 640 Creutzig, F., Roy, J., Lamb, W.F., Azevedo, I.M.L., Bruin, W.B. de, Dalkmann, H., Edelenbosch, O.Y.,
641 Geels, F.W., Grubler, A., Hepburn, C., Hertwich, E.G., Khosla, R., Mattauch, L., Minx, J.C.,
642 Ramakrishnan, A., Rao, N.D., Steinberger, J.K., Tavoni, M., Ürge-Vorsatz, D., Weber, E.U.,

- 643 2018. Towards demand-side solutions for mitigating climate change. *Nature Climate Change*
644 8, 260–263. <https://doi.org/10.1038/s41558-018-0121-1>
- 645 D’Alisa, G., Demaria, F., Kallis, G., 2014. *Degrowth: A Vocabulary for a New Era*. Routledge.
- 646 De Neve, J.-E., Ward, G., De Keulenaer, F., Van Landeghem, B., Kavetsos, G., Norton, M.I., 2017. The
647 Asymmetric Experience of Positive and Negative Economic Growth: Global Evidence Using
648 Subjective Well-Being Data. *The Review of Economics and Statistics* 100, 362–375.
649 https://doi.org/10.1162/REST_a_00697
- 650 Di Tella, R., Haisken-De New, J., MacCulloch, R., 2010. Happiness adaptation to income and to status
651 in an individual panel. *Journal of Economic Behavior & Organization* 76, 834–852.
652 <https://doi.org/10.1016/j.jebo.2010.09.016>
- 653 Diener, E., Oishi, S., Tay, L., 2018. Advances in subjective well-being research. *Nature Human*
654 *Behaviour* 2, 253–260. <https://doi.org/10.1038/s41562-018-0307-6>
- 655 Diener, E., Tay, L., Oishi, S., 2013. Rising income and the subjective well-being of nations. *Journal of*
656 *Personality and Social Psychology* 104, 267–276. <https://doi.org/10.1037/a0030487>
- 657 Doyal, L., Gough, I., 1991. *A Theory of Human Need*. Palgrave, Basingstoke, Hampshire.
- 658 Easterlin, R.A., 2009. Lost in transition: Life satisfaction on the road to capitalism. *Journal of*
659 *Economic Behavior & Organization* 71, 130–145. <https://doi.org/10.1016/j.jebo.2009.04.003>
- 660 Easterlin, R.A., 1974. Does Economic Growth Improve the Human Lot? Some Empirical Evidence, in:
661 David, P.A., Reder, M.W. (Eds.), *Nations and Households in Economic Growth*. Academic
662 Press, pp. 89–125. <https://doi.org/10.1016/B978-0-12-205050-3.50008-7>
- 663 Easterlin, R.A., McVey, L.A., Switek, M., Sawangfa, O., Zweig, J.S., 2010. The happiness—income
664 paradox revisited. *Proceedings of the National Academy of Sciences of the United States of*
665 *America* 107, 22463–22468.
- 666 Fanning, A.L., O’Neill, D.W., 2016. Tracking resource use relative to planetary boundaries in a steady-
667 state framework: A case study of Canada and Spain. *Ecological Indicators* 69, 836–849.
668 <https://doi.org/10.1016/j.ecolind.2016.04.034>
- 669 Ferreira, S., Akay, A., Brereton, F., Cuñado, J., Martinsson, P., Moro, M., Ningal, T.F., 2013. Life
670 satisfaction and air quality in Europe. *Ecological Economics, Transaction Costs and*
671 *Environmental Policy* 88, 1–10. <https://doi.org/10.1016/j.ecolecon.2012.12.027>
- 672 Helliwell, J., Huang, H., Wang, S., 2016. The Distribution of World Happiness, in: Helliwell, J., Layard,
673 R., Sachs, J. (Eds.), *World Happiness Report 2016, Update (Vol. 1)*. Sustainable Development
674 Solutions Network, New York, pp. 8–49.
- 675 Hoekstra, A.Y., Wiedmann, T.O., 2014. Humanity’s unsustainable environmental footprint. *Science*
676 344, 1114–1117. <https://doi.org/10.1126/science.1248365>
- 677 IMF, 2009. *World Economic Outlook (WEO): Crisis and Recovery*. International Monetary Fund,
678 Washington D.C.
- 679 Jorgenson, A.K., 2014. Economic development and the carbon intensity of human well-being. *Nature*
680 *Climate Change* 4, 186–189. <https://doi.org/10.1038/nclimate2110>
- 681 Jorgenson, A.K., Dietz, T., Kelly, O., 2017. Inequality, poverty, and the carbon intensity of human
682 well-being in the United States: a sex-specific analysis. *Sustain Sci* 1–8.
683 <https://doi.org/10.1007/s11625-017-0517-2>
- 684 Kahneman, D., Tversky, A., 1979. Prospect Theory: An Analysis of Decision under Risk. *Econometrica*
685 47, 263–291. <https://doi.org/10.2307/1914185>
- 686 Kallis, G., Kostakis, V., Lange, S., Muraca, B., Paulson, S., Schmelzer, M., 2018. Research on Degrowth.
687 *Annu. Rev. Environ. Resour.* <https://doi.org/10.1146/annurev-environ-102017-025941>
- 688 Kerschner, C., 2010. Economic de-growth vs. steady-state economy. *Journal of Cleaner Production*,
689 *Growth, Recession or Degrowth for Sustainability and Equity?* 18, 544–551.
690 <https://doi.org/10.1016/j.jclepro.2009.10.019>
- 691 Knight, K.W., Rosa, E.A., 2011. The environmental efficiency of well-being: A cross-national analysis.
692 *Social Science Research* 40, 931–949. <https://doi.org/10.1016/j.ssresearch.2010.11.002>

- 693 Knight, K.W., Schor, J.B., 2014. Economic Growth and Climate Change: A Cross-National Analysis of
694 Territorial and Consumption-Based Carbon Emissions in High-Income Countries.
695 Sustainability 6, 3722–3731. <https://doi.org/10.3390/su6063722>
- 696 Lamb, W.F., Rao, N.D., 2015. Human development in a climate-constrained world: What the past
697 says about the future. *Global Environmental Change* 33, 14–22.
698 <https://doi.org/10.1016/j.gloenvcha.2015.03.010>
- 699 Lamb, W.F., Steinberger, J.K., Bows-Larkin, A., Peters, G.P., Roberts, J.T., Wood, F.R., 2014.
700 Transitions in pathways of human development and carbon emissions. *Environmental*
701 *Research Letters* 9, 1–10.
- 702 Layard, R., Mayraz, G., Nickell, S., 2010. Does Relative Income Matter? Are the Critics Right?, in:
703 Diener, E., Helliwell, J., Kahneman, D. (Eds.), *International Differences in Well-Being*. Oxford
704 University Press.
- 705 Le Quéré, C., Andrew, R.M., Friedlingstein, P., Sitch, S., Pongratz, J., Manning, A.C., Korsbakken, J.I.,
706 Peters, G.P., Canadell, J.G., Jackson, R.B., Boden, T.A., Tans, P.P., Andrews, O.D., Arora, V.K.,
707 Bakker, D.C.E., Barbero, L., Becker, M., Betts, R.A., Bopp, L., Chevallier, F., Chini, L.P., Ciais, P.,
708 Cosca, C.E., Cross, J., Currie, K., Gasser, T., Harris, I., Hauck, J., Haverd, V., Houghton, R.A.,
709 Hunt, C.W., Hurtt, G., Ilyina, T., Jain, A.K., Kato, E., Kautz, M., Keeling, R.F., Klein Goldewijk,
710 K., Körtzinger, A., Landschützer, P., Lefèvre, N., Lenton, A., Lienert, S., Lima, I., Lombardozi,
711 D., Metzl, N., Millero, F., Monteiro, P.M.S., Munro, D.R., Nabel, J.E.M.S., Nakaoka, S., Nojiri,
712 Y., Padin, X.A., Peregon, A., Pfeil, B., Pierrot, D., Poulter, B., Rehder, G., Reimer, J.,
713 Rödenbeck, C., Schwinger, J., Séférian, R., Skjelvan, I., Stocker, B.D., Tian, H., Tilbrook, B.,
714 Tubiello, F.N., Laan-Luijckx, I.T. van der, Werf, G.R. van der, Heuven, S. van, Viovy, N.,
715 Vuichard, N., Walker, A.P., Watson, A.J., Wiltshire, A.J., Zaehle, S., Zhu, D., 2018. Global
716 Carbon Budget 2017. *Earth System Science Data* 10, 405–448.
717 <https://doi.org/https://doi.org/10.5194/essd-10-405-2018>
- 718 Lenzen, M., Cummins, R.A., 2013. Happiness versus the Environment—A Case Study of Australian
719 Lifestyles. *Challenges* 4, 56–74. <https://doi.org/10.3390/challe4010056>
- 720 Luhmann, M., Hofmann, W., Eid, M., Lucas, R.E., 2012. Subjective well-being and adaptation to life
721 events: A meta-analysis. *Journal of Personality and Social Psychology* 102, 592–615.
722 <https://doi.org/10.1037/a0025948>
- 723 MacKerron, G., Mourato, S., 2013. Happiness is greater in natural environments. *Global*
724 *Environmental Change* 23, 992–1000. <https://doi.org/10.1016/j.gloenvcha.2013.03.010>
- 725 Maddison, D., Rehdanz, K., 2011. The impact of climate on life satisfaction. *Ecological Economics* 70,
726 2437–2445. <https://doi.org/10.1016/j.ecolecon.2011.07.027>
- 727 Matthey, A., 2010. Less is more: the influence of aspirations and priming on well-being. *Journal of*
728 *Cleaner Production, Growth, Recession or Degrowth for Sustainability and Equity?* 18, 567–
729 570. <https://doi.org/10.1016/j.jclepro.2009.03.024>
- 730 Max-Neef, M.A., 1991. *Human Scale Development: Conception, Application and Further Reflections*.
731 Zed Books Ltd, New York.
- 732 Mazur, A., Rosa, E., 1974. Energy and Life-Style. *Science* 186, 607–610.
- 733 Mill, J.S., 1863. *Utilitarianism*, 1st ed. Parker, Son and Bourn.
- 734 *New Climate Economy*, 2014. *Better Growth, Better Climate: The New Climate Economy Report*.
735 Global Commission on the Economy and Climate, Washington, DC.
- 736 Nordhaus, W.D., 2017. Revisiting the social cost of carbon. *PNAS* 114, 1518–1523.
737 <https://doi.org/10.1073/pnas.1609244114>
- 738 Nussbaum, M., 2003. Capabilities as Fundamental Entitlements: Sen and Social Justice. *Feminist*
739 *Economics* 9, 33–59. <https://doi.org/10.1080/1354570022000077926>
- 740 Oishi, S., Schimmack, U., Diener, E., 2011. Progressive Taxation and the Subjective Well-Being of
741 Nations: *Psychological Science*. <https://doi.org/10.1177/0956797611420882>
- 742 O’Neill, D.W., Fanning, A.L., Lamb, W.F., Steinberger, J.K., 2018. A good life for all within planetary
743 boundaries. *Nature Sustainability* 1, 88–95. <https://doi.org/10.1038/s41893-018-0021-4>

- 744 O'Neill, J., 2008. Happiness and the Good Life [WWW Document].
 745 <https://doi.org/info:doi/10.3197/096327108X303819>
- 746 Peters, G.P., Andrew, R.M., Solomon, S., Friedlingstein, P., 2015. Measuring a fair and ambitious
 747 climate agreement using cumulative emissions. *Environ. Res. Lett.* 10, 105004.
 748 <https://doi.org/10.1088/1748-9326/10/10/105004>
- 749 Peters, G.P., Minx, J.C., Weber, C.L., Edenhofer, O., 2011. Growth in emission transfers via
 750 international trade from 1990 to 2008. *Proceedings of the National Academy of Sciences of*
 751 *the United States of America* 108, 8903–8908.
- 752 Preston, S.H., 2007. The changing relation between mortality and level of economic development.
 753 *Int J Epidemiol* 36, 484–490. <https://doi.org/10.1093/ije/dym075>
- 754 Putnam, R.D., 2001. *Bowling Alone*. Simon and Schuster.
- 755 Raworth, K., 2017. *Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist*.
 756 Random House Business, London.
- 757 Rogelj, J., den Elzen, M., Höhne, M., Franzen, T., Fekete, H., Winkler, H., Schaeffer, R., Sha, F., Riahi,
 758 K., Meinshausen, M., 2016. Paris Agreement climate proposals need a boost to keep
 759 warming well below 2°C. *Nature* 534, 631–639. <https://doi.org/10.1038/nature18307>
- 760 Ryan, R.M., Deci, E.L., 2000. Self-determination theory and the facilitation of intrinsic motivation,
 761 social development, and well-being. *American Psychologist* 55, 68–78.
 762 <https://doi.org/10.1037//0003-066X.55.1.68>
- 763 Ryff, C.D., Keyes, C.L., 1995. The structure of psychological well-being revisited. *J Pers Soc Psychol*
 764 69, 719–727.
- 765 Ryff, C.D., Singer, B.H., 2008. Know Thyself and Become What You Are: A Eudaimonic Approach to
 766 Psychological Well-Being. *Journal of Happiness Studies*; Dordrecht 9, 13–39.
 767 <https://doi.org/http://0-dx.doi.org.wam.leeds.ac.uk/10.1007/s10902-006-9019-0>
- 768 Schneider, F., Kallis, G., Martinez-Alier, J., 2010. Crisis or opportunity? Economic degrowth for social
 769 equity and ecological sustainability. Introduction to this special issue. *Journal of Cleaner*
 770 *Production, Growth, Recession or Degrowth for Sustainability and Equity?* 18, 511–518.
 771 <https://doi.org/10.1016/j.jclepro.2010.01.014>
- 772 Sekulova, F., van den Bergh, J.C.J.M., 2016. Floods and happiness: Empirical evidence from Bulgaria.
 773 *Ecological Economics* 126, 51–57. <https://doi.org/10.1016/j.ecolecon.2016.02.014>
- 774 Sekulova, F., van den Bergh, J.C.J.M., 2013. Climate change, income and happiness: An empirical
 775 study for Barcelona. *Global Environmental Change* 23, 1467–1475.
 776 <https://doi.org/10.1016/j.gloenvcha.2013.07.025>
- 777 Sen, A., 2001. *Development as Freedom*. OUP Oxford.
- 778 Sen, A., 1985. Well-Being, Agency and Freedom: The Dewey Lectures 1984. *The Journal of*
 779 *Philosophy* 82, 169–221. <https://doi.org/10.2307/2026184>
- 780 Steffen, W., Broadgate, W., Deutsch, L., Gaffney, O., Ludwig, C., 2015a. The trajectory of the
 781 Anthropocene: The Great Acceleration. *The Anthropocene Review* 2, 81–98.
 782 <https://doi.org/10.1177/2053019614564785>
- 783 Steffen, W., Richardson, K., Rockström, J., Cornell, S.E., Fetzer, I., Bennett, E.M., Biggs, R., Carpenter,
 784 S.R., Vries, W. de, Wit, C.A. de, Folke, C., Gerten, D., Heinke, J., Mace, G.M., Persson, L.M.,
 785 Ramanathan, V., Reyers, B., Sörlin, S., 2015b. Planetary boundaries: Guiding human
 786 development on a changing planet. *Science* 347, 1259855.
 787 <https://doi.org/10.1126/science.1259855>
- 788 Steinberger, J.K., Roberts, J.T., 2010. From constraint to sufficiency: The decoupling of energy and
 789 carbon from human needs, 1975–2005. *Ecological Economics, Special Section: Ecological*
 790 *Distribution Conflicts* 70, 425–433. <https://doi.org/10.1016/j.ecolecon.2010.09.014>
- 791 Steinberger, J.K., Roberts, J.T., Peters, G.P., Baiocchi, G., 2012. Pathways of human development and
 792 carbon emissions embodied in trade. *Nature Climate Change* 2, 81–85.

- 793 Stevenson, B., Wolfers, J., 2013. Subjective Well-Being and Income: Is There Any Evidence of
794 Satiation? *The American Economic Review*; Nashville 103, 598–604. [https://doi.org/http://0-
796 dx.doi.org.wam.leeds.ac.uk/10.1257/aer.103.3.598](https://doi.org/http://0-
795 dx.doi.org.wam.leeds.ac.uk/10.1257/aer.103.3.598)
- 796 Stevenson, B., Wolfers, J., 2008. Economic Growth and Subjective Well-Being: Reassessing the
797 Easterlin Paradox. *Brookings Papers on Economic Activity* 2008, 1–87.
798 <https://doi.org/10.1353/eca.0.0001>
- 799 Stiglitz, J.E., Sen, A., Fitoussi, J.-P., 2009. Report by the Commission on the Measurement of
800 Economic Performance and Social Progress. Commission on the Measurement of Economic
801 Performance and Social Progress, Paris.
- 802 Tapia Granados, J.A., Ionides, E.L., Carpintero, Ó., 2012. Climate change and the world economy:
803 short-run determinants of atmospheric CO₂. *Environmental Science & Policy* 21, 50–62.
804 <https://doi.org/10.1016/j.envsci.2012.03.008>
- 805 Tay, L., Herian, M.N., Diener, E., 2014. Detrimental Effects of Corruption and Subjective Well-Being:
806 Whether, How, and When. *Social Psychological and Personality Science* 5, 751–759.
807 <https://doi.org/10.1177/1948550614528544>
- 808 van den Bergh, J.C., 2010. Safe climate policy is affordable--12 reasons. *Climatic Change* 101, 339–
809 385. <https://doi.org/http://0-dx.doi.org.wam.leeds.ac.uk/10.1007/s10584-009-9719-7>
- 810 Veenhoven, R., Vergunst, F., 2014. The Easterlin illusion: economic growth does go with greater
811 happiness. *International Journal of Happiness and Development* 1, 311–343.
812 <https://doi.org/10.1504/IJHD.2014.066115>
- 813 Vendrik, M.C.M., Woltjer, G.B., 2007. Happiness and loss aversion: Is utility concave or convex in
814 relative income? *Journal of Public Economics* 91, 1423–1448.
815 <https://doi.org/10.1016/j.jpubeco.2007.02.008>
- 816 Wilson, J., Tyedmers, P., Spinney, J.E.L., 2013. An Exploration of the Relationship between
817 Socioeconomic and Well-Being Variables and Household Greenhouse Gas Emissions. *Journal*
818 *of Industrial Ecology* 17, 880–891. <https://doi.org/10.1111/jiec.12057>
- 819 World Bank, 2018. *World Development Indicators*. World Bank, Washington D.C.
- 820 York, R., Bell, S.E., 2014. Life satisfaction across nations: The effects of women's political status and
821 public priorities. *Social Science Research* 48, 48–61.
822 <https://doi.org/10.1016/j.ssresearch.2014.05.004>
823

The Wellbeing–Consumption Paradox: Happiness, Health, Income, and Carbon Emissions in Growing versus Non-Growing Economies

Andrew L. Fanning and Daniel W. O’Neill

Highlights

- Happiness and health are used as separate indicators of wellbeing
- GDP and carbon footprint per capita are used as alternative consumption indicators
- Countries are split into “growing” and “non-growing” consumption groups
- Neither happiness nor health increase with growing consumption
- Happiness falls with non-growing consumption, with implications for climate policy