Sustainability and wellbeing: the dynamic relationship between subjective wellbeing and sustainability indicators

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Online Appendix

Contents

Appendix: Calculation of adjusted net savings

Table A1. Description of variables

Table A2: Wave 2 EF, ANS (and components), average SWB & macro controls data

Table A3. EF full model coefficients (OLS): 1st and 2nd decades

Table A4. Demographic interactions for EF and disaggregated ANS components. OLS. Dependent variable: SWB

Appendix. Calculation of adjusted net savings

ANS is calculated by the World Bank as:

$$ANS = (GNS - D + CSE - R - CD - PM) / GNI$$

where:

ANS Adjusted net savings

GNS Gross national savings

D Depreciation of fixed capital

CSE Current (non-fixed capital) i.e., expenditure on education

R Rent from natural resources

CD Damages from carbon dioxide emissions

PM Damages from particulate matter (included in PM adjusted ANS only)

GNI Gross national income at market prices

Gross national savings (GNS): GNS is the difference between GNI and public and private consumption plus net transfers.

Depreciation of fixed capital: D is the replacement value of capital consumed in the process of production. It is estimated as a share of national consumption of fixed capital.

Expenditure on education: Education expenditure proxies human capital investments. It covers current operating expenditure on education at all levels (primary, secondary, tertiary, vocational), including salaries and wages but excluding capital expenditures.

Rent from natural resources: Rents from the extraction of minerals and energy resources, e.g., crude oil, gas, coal, is given by:

$$Rent = Production\ volume \times (Market\ price - Cost\ of\ production)$$

Damages from carbon dioxide: The World Bank assumes a conservative figure of $20 as the global marginal social cost of a metric tonne of CO_2 emissions.

Damages from particulate matter: PM damages estimates are given by the willingness to pay for the prevention of morbidity and mortality attributed to particulate matter emissions. It is included only in the PM adjusted estimates of ANS.

Notes: Our measure of $NNS = (GNS - D)/GNI$.

         Our measure of (natural capital depletion) $= -(R + CD + PM) / GNI$.

         Our measure of education $= CSE / GNI$.

Table A1. Description of variables

Part A. SWB and personal controls

Survey Question	Response values	Question #	Notes	Data processing
Q: SWB				
All things considered, how satisfied are you with your life as a whole these days? Using this card on which 1 means you are "completely dissatisfied" and 10 means you are "completely satisfied" where would you put your satisfaction with your life as a whole? (Code one number): Completely dissatisfied Completely satisfied 1 2 3 4 5 6 7 8 9 10	-5 Missing; Not asked by the interviewer -4 Not asked -3 Not applicable -2 No answer -1 Don´t know 1 Dissatisfied 2 3 4 5 6 7 8 9 10 Satisfied	Wave 2: V96 Wave 4: V81 Wave 6: V23	This variable and its responses are consistent across all surveys **Unique values in the data** -5, -2, -1, 1,2,3,4,5,6,7,8,9,10	Dropped rows with missing values i.e.: -5, -2, -1 **Remaining unique values** 1,2,3,4,5,6,7,8,9,10
Q: Age				
Can you tell me your year of birth, please? 19____ (write in last two digits) This means you are ____ years old (write in age in two digits).	-5 Missing; Unknown -4 Not asked in survey -3 Not applicable -2 No answer -1 Don´t know	Wave 2: V355 Wave 4: V225 Wave 6: V242	This variable and its responses are consistent across all surveys **Unique values in the data** -5, -3, -2, -1, 15 – 99	Re-coded missing values as -5 i.e. -5, -3, -2, -1 replaced with -5 **Remaining unique values** Non-missing: 15 – 99 Missing: -5 **Age missing dummy** 1 for -5 and 0 otherwise
Q: Sex				
Sex of respondent: 1 Male 2 Female	-5 Missing; Unknown -4 Not asked in survey -3 Not applicable -2 No answer -1 Don´t know 1 Male 2 Female 9 na (only two rows in wave 4)	Wave 2: V353 Wave 4: V223 Wave 6: V240	This variable and its responses are consistent across all surveys **Unique values in the data** -5, -2, 1,2,9	Re-coded missing values as 99 i.e. -5, -2, 9 replaced with 99 **Sex dummies** Male Female Missing

Survey Question	Response values	Question #	Notes	Data processing
Q: Marital status				
Are you currently (read out and code one answer only): 1 Married 2 Living together as married 3 Divorced 4 Separated 5 Widowed 6 Single	-5 Missing -4 Not asked in survey -3 Not applicable -2 No answer -1 Don´t know 1 Married 2 Living together as married 3 Divorced 4 Separated 5 Widowed 6 Single 10 Living apart while married/cohabitation	Wave 2: V181 Wave 4: V106 Wave 6: V57	This variable and its responses are consistent across all surveys **Unique values in the data** -5, -2, -1, 1,2,3,4,5,6,10	**Variable re-coding** 1. Married: 1,2,10 2. Divorced: 3,4 3. Single: 5 4. Widowed: 6 99 Missing: -5, -2, -1
Q: Employment				
Are you employed now or not?	-5 Missing; RU: Inappropriate response -4 Not asked -3 Not applicable -2 No answer; SG: Refused -1 Don´t know 1 Full-time 2 Part-time 3 Self-employed 4 Retired 5 Housewife 6 Students 7 Unemployed 8 Other	Wave 2: V358 Wave 4: V229 Wave 6: V229	This variable and its responses are consistent across all surveys **Unique values in the data** -5, -4, -3, -2, -1, 1,2,3,4,5,6,7,8	**Variable re-coding** 1. Employed: 1,2,3 2. Unemployed: 4 3. Housewife: 5 4. Student: 6 5. Retired: 7 6. Other: 8 99 Missing: -5, -4, -3, -2, -1

Survey Question	Response values	Question #	Notes	Data processing
Q: Income scale				
On this card is an income scale on which 1 indicates the lowest income group and 10 the highest income group in your country. We would like to know in what group your household is. Please, specify the appropriate number, counting all wages, salaries, pensions and other incomes that come in. (Code one number): Lowest group Highest group 1 2 3 4 5 6 7 8 9 10	-5 Missing; Not asked by the interviewer -4 Not asked -3 Not applicable -2 No answer -1 Don´t know 1 Lower step 2 second step 3 Third step 4 Fourth step 5 Fifth step 6 Sixth step 7 Seventh step 8 Eighth step 9 Ninth step 10 Upper step	Wave 2: V363 Wave 4: V236 Wave 6: V239	This variable and its responses are consistent across all surveys **Unique values in the data** -5, -4, -2, -1, 1,2,3,4,5,6,7,8,9,10	**Variable re-coding** 1 – 10 steps of income 99 Missing: -5, -4, -2, -1
Q: Education				
What is the highest educational level that you have attained? [NOTE: if respondent indicates to be a student, code highest level s/he expects to complete]: 1 No formal education 2 Incomplete primary school 3 Complete primary school 4 Incomplete secondary school: technical/vocational type 5 Complete secondary school: technical/vocational type 6 Incomplete secondary: university-preparatory type 7 Complete secondary: university-preparatory type 8 Some university-level education, without degree 9 University-level education, with degree	-5 Missing; Not asked by the interviewer -4 Not asked -3 Not applicable -2 No answer -1 Don´t know 1 No formal education 2 Incomplete primary school 3 Complete primary school 4 Incomplete secondary school: technical/ vocational type 5 Complete secondary school: technical/ vocational type 6 Incomplete secondary school: university-preparatory type 7 Complete secondary school: university-preparatory type 8 Some university-level education, without degree 9 University - level education, with degree	Wave 2: V375 Wave 4: V226 Wave 6: V248	This variable and its responses are consistent across all surveys **Unique values in the data** -5, -4, -3, -2, -1, 1,2,3,4,5,6,7,8,9	**Variable re-coding** 1. No education: 1 2. Primary: 2,3 3. Secondary: 4,5,6,7 4. University: 8,9 99. Missing: -5, -4, -3, -2, -1

Part B. ANS, EF and macro controls

Variable		Definition	Note and data processing
ANS	Adjusted net savings, including particulate emission damage (% of GNI)	Adjusted net savings are equal to net national savings plus education expenditure and minus energy depletion, mineral depletion, net forest depletion, and carbon dioxide and particulate emissions damage. Disaggregated components (all as % of GNI): Net National Saving (NNS), is calculated as the difference between gross national savings and depreciation/consumption of fixed capital; gross national savings (GNS) is calculated as the difference between gross national income and public and private consumption plus net current transfers according to the World Bank methodology. Education is calculated as education expenditure. (Natural resource depletion) is calculated as (-1)x[energy depletion + mineral depletion + net forest depletion] (Emissions) is calculated as (-1)x[carbon dioxide damage + particulate emissions damage]	Any country which does not have ANS data for the year it was surveyed in WVS wave 2 (or immediate previous or following year) was dropped from the dataset.
EF	Ecological footprint	Ecological footprint is a measure of how much area of biologically productive land and water a country requires to produce all the resources it consumes and to absorb the waste it generates, using prevailing technology and resource management practices. Our measure is expressed as hectares per person.	

Unemployment	Unemployment, total (% of total labour force) (modelled ILO estimate)	Unemployment refers to the share of the labour force that is without work but available for and seeking employment.	This data series starts from 1991 for all countries in WDI data from the World Bank. We used 1991 unemployment figures for the countries which were survey in 1990.
Life expectancy	Life expectancy at birth, total (years)	Life expectancy is the average length of life for a hypothetical cohort assumed to be exposed, from birth through death, to the mortality rates observed at one particular year.	

Data sources:

1. **SWB and personal controls**
   Data is downloaded from World Values Survey website. URLs for each wave as following:
   Wave 2: http://www.worldvaluessurvey.org/WVSDocumentationWV2.jsp
   Wave 4: http://www.worldvaluessurvey.org/WVSDocumentationWV4.jsp
   Wave 6: http://www.worldvaluessurvey.org/WVSDocumentationWV6.jsp
2. **ANS, EF and macro controls**
   1. ANS (including components) plus macro controls downloaded from: http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators
   2. EF downloaded from: http://data.footprintnetwork.org/?_ga=2.51017065.1753367076.1592346579-752875075.1590703016#/

Table A2. Wave 2 EF, ANS (and components), average SWB and macro controls data

Country	Ecological footprint	ANS (% of GNI)	Net national savings (% of GNI)	Education (% of GNI)	Natural capital depletion (% of GNI)	Average SWB	Unemployment	Life Expectancy (years)
Argentina	3.1	7.5	9.7	1.0	3.2	7.3	-7.2	71.6
Chile	2.9	5.7	10.5	2.4	7.2	7.6	-1.6	73.5
China	1.5	16.7	26.9	1.8	12.0	7.3	-0.6	69.1
India	0.8	9.3	12.0	3.5	6.2	6.7	-0.2	57.9
Mexico	2.5	3.7	6.7	2.2	5.1	7.4	-0.8	70.9
Nigeria	1.0	39.0	56.3	1.3	18.7	6.6	-0.1	45.9
South Africa	3.4	-1.8	-0.6	4.8	6.5	6.2	-0.4	63.3
South Korea	3.7	29.0	27.2	2.9	1.1	6.7	-1.1	71.6
Spain	4.5	12.7	10.0	3.3	0.5	7.1	-3.4	76.8
Turkey	2.6	7.6	7.5	1.9	1.8	6.4	0.6	64.3

Note: Unemployment (% of labour force) is the 1991 value minus its average value over 1991 to 2000, representing short-run departure from a longer term average.

Table A3. EF full model coefficients (OLS): 1st and 2nd decades

Variable	1st decade	2nd decade
age	-1.130*** (0.216)	-0.370* (0.171)
age_squared	1.090*** (0.225)	0.309* (0.158)
sex_Female	0.0892* (0.0469)	-0.0532 (0.0441)
ms_Divorced	-0.574*** (0.0964)	-0.222* (0.105)
ms_Single	-0.520*** (0.0627)	-0.275** (0.101)
ms_Widowed	-0.238* (0.122)	-0.141 (0.0920)
es_Unemployed	0.0733 (0.170)	-0.00626 (0.106)
es_Housewife	0.340* (0.176)	0.239 (0.144)
es_Student	-0.206 (0.150)	0.0662 (0.0902)
es_Retired	-0.617*** (0.130)	-0.216 (0.149)
es_Other	-0.340* (0.155)	0.0437 (0.157)
in_Second step	0.0772 (0.152)	0.123 (0.299)
in_Third step	0.226 (0.248)	0.0632 (0.322)
in_Fourth step	0.645** (0.238)	0.321 (0.366)
in_Fifth step	0.911** (0.306)	0.583 (0.386)
in_Sixth step	1.135*** (0.289)	0.836* (0.434)
in_Seventh step	1.330*** (0.253)	1.197** (0.476)
in_Eigth step	1.588*** (0.277)	1.602** (0.496)
in_Nineth step	1.674*** (0.366)	1.985*** (0.587)
in_Tenth step	1.798*** (0.364)	2.431*** (0.478)
ed_Primary	0.275** (0.121)	0.199* (0.0998)
ed_Secondary	0.318 (0.186)	0.286* (0.137)
ed_University	0.333* (0.180)	0.309* (0.159)
swb_t0	0.823*** (0.212)	0.466** (0.152)
EF	-1.643*** (0.373)	0.434 (0.405)
Unemp	0.138 (0.180)	0.727*** (0.223)
Life_Expectancy	-0.799*** (0.136)	0.615** (0.231)
Constant	5.869*** (0.271)	5.927*** (0.463)
Observations	17,733	19,552
Adjusted R^2	0.137	0.131

Notes: Coefficients are standardised (except for dummy variables).

Standard errors (in parentheses) are clustered by country.

*p<0.1; **p<0.05; ***p<0.01.

Table A4. Demographic interactions for EF and disaggregated ANS components. OLS. Dependent variable: SWB

Sustainability variable (OLS estimates)	1st decade	2nd decade
(Ecological footprint)		
Age (<40 yrs)		0.322
(≥40 yrs)		0.540
Sex (Male)		
(Female)		
Education		
Income		
ANS		
Age (<40 yrs)		
(≥40 yrs)		
Sex		
Education (≥ secondary)		-0.290***
(< secondary)		-0.579***
Income		
Net national savings		
Age (<40 yrs)		
(≥40 yrs)		
Sex		
Education (≥ secondary)		-0.218***
(< secondary)		-0.365***
Income		
Education		
Age (<40 yrs)		0.352
(≥40 yrs)		0.212
Sex		
Education (≥ secondary)	0.264	
(< secondary)	-0.449	
Income (decile 6-10)	0.436	
(decile 1-5)	-0.220	
Natural Capital Depletion		
Age (≤40 yrs)		
(≥40 yrs)		
Sex		
Education (≥ secondary)	-0.500	0.377*
(< secondary)	-0.296	0.665***
Income (decile 6-10)		0.355**
(decile 1-5)		0.534**

Notes: All equations include personal and macroeconomic controls. Coefficients are presented for each demographic category (age, sex, education or income) where an interaction term is significant. Age interaction is ≥40 years (=1) vs <40 years (=0); sex interaction is female (=1) vs male (=0); education interaction is primary or below (=1) vs secondary or above (=0); income interaction is decile 1-5 (=1) vs decile 6-10 (=0). Standard errors are clustered by country for all estimates. *p<0.1; **p<0.05; ***p<0.01.