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Sustainable economic policy and well-being: The relationship between adjusted net savings and subjective well-being

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Abstract
We analyse the relationship between subjective wellbeing (SWB) and the World Bank's measure of a country's economic sustainability, adjusted net savings (ANS). We model SWB at individual level and at aggregated group level as a function of past ANS levels, after controlling for a country's initial levels of SWB. The empirical models utilise World Values Surveys (WVS) data for self-reported life-satisfaction (our proxy for SWB). Our results show that ANS is negatively associated with future SWB outcomes over relatively short timespans (10-15 years) but this relationship is neutralised, or even reversed, for a longer timespan (20 years). The results demonstrate an important challenge in political economy. Governments that choose to save less in the short term may be able to spend more on the well-being of the current generation (i.e. current voters) but they diminish the reserves available to improve future generations' well-being. At a more technical level, our results reinforce the concept that ANS is a useful sustainability indicator for infinite (or at least very long) time horizons, but it is not a good indicator of well-being developments over short time horizons.

JEL codes
D91, H75, Q01, Q56, R23

Keywords
Adjusted net savings, subjective wellbeing, intergenerational sustainability

Summary haiku
Wellbeing versus
Sustainable policies:
Temporal trade-offs

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1 Introduction

We examine the relationship between the individual well-being of citizens and the sustainability of economic policies at the national level. In doing so, we highlight a difficult trade-off that governments must make between running sustainable economic policies and raising the more immediate welfare of their citizens. This trade-off helps to explain why many governments fail to adopt sustainable economic policies even though by doing so they would improve the well-being of future generations.

The World Bank's adjusted net savings (ANS) series has been widely adopted as a comprehensive indicator to measure sustainability over the long-run (Arrow et al., 2012, Ferreira & Vincent, 2005, Greasley et al., 2014, 2016, Hanley, Dupuy, & McLaughlin, 2015)[1]. Starting with Ferreira, Hamilton, & Vincent (2008), many researchers have applied ANS as a predictor of aggregate objective well-being. However, far less attention has been given to testing the relationship between ANS and subjective well-being at individual level. The present paper aims to fill this gap by examining the relationship between ANS and life-satisfaction[2] which is a commonly used proxy of subjective well-being (SWB). To the best of our knowledge, this study is the first to test whether ANS helps to predict developments in life-satisfaction at individual level.

We explore the relationship between individual level SWB and their country's ANS using both ordinary least squares (OLS) and ordered logit regression models. We also explore the relationship between aggregated group level SWB and ANS using pseudo-panel OLS models created by aggregating data into several groups defined by various age and sex combinations.

We find that initial levels of ANS for a country are *negatively* associated with the future SWB of its inhabitants over relatively short time horizons e.g. up to 15 years; and the link is highly significant. This relationship, however, turns *positive* and, for the cross-sectional OLS estimates, significant as the time horizon becomes longer. A negative relationship between ANS and SWB in the shorter periods is consistent with countries that have high (low) initial levels of national savings tending to spend less (more) on the welfare of the current generation. Over longer time periods, the investment in future generations exhibited by countries with high

1 ANS is also referred to as genuine savings (GS), comprehensive investment (CI), comprehensive savings (CS) or inclusive wealth (IW) in the literature. ANS has been developed in many ways in terms of time horizon, model specification and its components. For example, it has been expanded over very long time-horizons by Blum, McLaughlin, & Hanley (2013), Greasley et al. (2014) and Hanley et al. (2016) and they refer it as genuine savings (GS). Qasim, Oxley, & McLaughlin (2017) expanded ANS by incorporating forestry and expanding time-horizon for New Zealand and also call it GS. Greasley et al. (2016) has expanded ANS model by adjusting it for minerals and TFP for Australia and they call it comprehensive investment (CI). Similarly, it has been referred to as comprehensive wealth in (Ferreira, Hamilton, & Vincent, 2008). In this paper, all these terms are used interchangeably for World Bank's ANS.

2 The terms life-satisfaction and SWB have been used synonymously in well-being literature and we will also use these terms interchangeably in this paper.

levels of ANS can be expected to raise future levels of SWB as resources are set aside for future generations. This is consistent with the positive relationship between ANS and future SWB over our longest timespan. One reason that the relationship between ANS and SWB is positive only for the longest timespan in our results is likely to be due to the fact that ANS is conceptually a tool to measure sustainability over infinite time horizons (Blum, McLaughlin, & Hanley, 2013, Greasley et al., 2014). Our results are consistent with this relationship becoming significantly positive over longer durations but at the expense of immediate SWB outcomes.

To minimize the risk of omitted variable bias, we control for personal variables which have been shown to be linked with SWB such as age, sex, income, marital status, employment status and education (collected in World Values Surveys face-to-face interviews) as well as macroeconomic variables such as real gross national income (GNI) per capita, unemployment rate and inflation rate as suggested by a number of SWB studies (Bonini, 2008, Engelbrecht, 2009, Gnègnè, 2009, Grimes et al., 2016, R. Di Tella, MacCulloch, & Oswald, 2001).

The remainder of this paper is organized as follows: section 2 describes ANS and SWB in detail and reviews the relevant theory. Section 3 explains the specifications of the empirical models with a detailed description of variables. Section 4 covers the process of collecting data from several sources and explains how data is processed. In section 5, we present the results from the empirical models with a detailed discussion of research findings. In the final section, conclusions are drawn with a re-enforcement of key findings.

2 Background

2.1 What is Adjusted Net Savings?

ANS is an indicator to measure sustainable development at the macro-level over the long-run (Arrow et al., 2012, Blum, Ducoing, & McLaughin, 2017, Gnègnè, 2009, Greasley et al., 2014, Hamilton & Clemens, 1999, Pezzey, 2004). ANS was first introduced by Pearce & Atkinson (1993) as an indicator of "weak sustainability"[3] based on the reformation of the Hartwick Rule (Hartwick, 1977, 1990). According to the Hartwick Rule income from the exploitation of non-renewable resources should be reinvested in renewable resources in order to maintain total wealth and to achieve non-declining well-being over time. This rule emerged from the Hicksian definition of income as being the maximum amount of consumption in one period that does not

3 The concept of weak sustainability (WS) is rooted in the argument that natural capital and produced capital are similar and infinitely substitutable. This notion of WS emerged in the 1970s (Dietz & Neumayer (2007)) when neoclassical models of economic growth were extended to account for non-renewable natural capital as a factor of production (Dasgupta & Heal, 1974, Hartwick, 1977, Solow, 1974). These aggregate economic growth models account for the optimal use of income produced from the non-renewable resource extraction to establish a rule on how much of it to consume and how much should be reinvested in produced capital for future consumption.

compromise the ability to afford the same level of consumption in the following period (Hicks, 1946).

Pearce and Atkinson (D. W. Pearce & Atkinson, 1993, W. D. Pearce, Markandya, & Barbier, 1989) defined a sustainable economy as one which saves more than the combined depreciation of its stocks of natural capital and produced capital. Whenever ANS takes negative values, it indicates an unsustainable development path. Similarly, according to (Hamilton & Atkinson, 2006), if the total wealth (i.e. sum of all types of capital stocks i.e. human capital, produced capital and natural capital) is related to social welfare, then sustainability necessarily involves maintaining total wealth. In other words, a non-declining level of per capita total wealth has to be maintained intergenerationally to realise sustainability (Dasgupta & Mäler, 2001).

ANS is calculated by the World Bank as net national savings plus education expenditure, and minus energy depletion, mineral depletion, net forest depletion, and carbon dioxide and particulate matter (PM) emissions damage. The World Bank has been publishing ANS estimates for all countries for which these data are available starting from 1970. A detailed description of the components of ANS and how it is calculated is provided in appendix A1.

2.2 What is subjective well-being?

Well-being results from a set of factors that are required for a flourishing life. Well-being may be understood subjectively or via a range of observed (objective) social indicators. The definition of well-being varies across people, groups and disciplines (Galloway et al., 2006, Higgins, 1997, Roberts et al., 2015). For instance, Huppert, Baylis, & Keverne (2004), on page 1331, define well-being as

> *"a positive and sustainable state that allows individuals, groups or nations to thrive and flourish"*. According to Defra (2009), on page 119, well-being *"is understood to be a positive physical, social and mental state; it is not just the absence of pain, discomfort and incapacity. It requires that basic needs are met, that individuals have a sense of purpose, that they feel able to achieve important personal goals and participate in society. It is enhanced by conditions that include supportive personal relationships, strong and inclusive communities, good health, financial and personal security, rewarding employment, and a healthy and attractive environment."*

There are several concepts of well-being which are categorised into two broader categories, objective well-being and subjective well-being (SWB). The former broadly deals with material measures of well-being (such as income, longevity, etc.) and the latter focuses on people's self-reported happiness and satisfaction of life (Cummins, 2012, Gleisner, Llewellyn-Fowler, & McAlister, 2011, MacKerron, 2012, Roberts et al., 2015, Waldron, 2010).

There is a range of contributors to well-being discussed in different disciplines. For instance, economics traditionally understands well-being as an outcome of utility maximization subject to constraints. Hence a person with higher income can have more goods and services

leading to higher levels of satisfaction (Green, 2013, Jackson, Jager, & Stagl, 2004, MacKerron, 2012). This approach implies that the relationship of happiness (i.e. utility) to income exhibits diminishing returns and several papers have confirmed this relationship (Cummins, 2012, Dodds, 1997, Easterlin et al., 2010, Frey & Stutzer, 2002, J. F. Helliwell, 2003, Jackson, Jager, & Stagl, 2004, Schwartz et al., 2002, Veenhoven, 1995). In a recent New Zealand focused study, Sengupta et al. (2012) found the same relationship for New Zealanders. Their key finding was that there was a robust relationship between income and happiness for annual incomes from 10,000 NZD to 30,000 NZD. This relationship becomes less responsive and tends to plateau beyond an average annual income of 65,000 NZD, while increases in income beyond 125,000 NZD had an insignificant incremental effect on happiness.

Subjective well-being studies examine the subjective feeling of the subject regarding her happiness, unhappiness, and satisfaction with life through different survey questions (Dodds, 1997, Frey & Stutzer, 2002, Jamison, 2008, Schwartz et al., 2002, Waldron, 2010). The Gallup Poll[4], Eurobarometer Surveys[5], European Values Surveys (EVS)[6], General Social Surveys (GSS)[7], and World Values Surveys (WVS)[8] are examples of such surveys conducted internationally.

Happiness and life-satisfaction have sometimes been used interchangeably in the literature; however there is a clear distinction between them. According to Diener et al. (2010), people tend to correlate life-satisfaction with material prosperity when they answer how satisfied they are with their lives whereas they tend to correlate happiness with social prosperity once they have all their basic needs met. Most studies in the economics literature concentrate on life-satisfaction rather than on (shorter term) happiness. By contrast, studies in psychology tend to concentrate more on the attainment/presence of happiness or avoidance/absence of pain; and/or on the eudaimonic approach to well-being, which defines well-being in term of how a person is functioning in her life (Deci & Ryan, 2008, J. Helliwell, Layard, & Sachs, 2012, Konow & Earley, 2006, Ryan & Deci, 2001).

2.2.1 Factors affecting well-being

The social context in which well-being is defined, referenced, perceived, or applied has significant impact on the extent and interpretation of well-being (Diener, Lucas, & Oishi, 2002). What is considered desirable varies from person to person, society to society and religion to religion. It may also vary with age, social status, sexual orientation, marital status and so on within the same society. One focus of empirical research on individual well-being has been identifying the determinants of happiness among various population groups. This research

4 http://www.well-beingindex.com/
5 http://ec.europa.eu/commfrontoffice/publicopinion/index.cfm
6 http://www.europeanvaluesstudy.eu/
7 http://www.norc.org/Research/Projects/Pages/general-social-survey.aspx
8 http://www.worldvaluessurvey.org/wvs.jsp

shows a considerable degree of consensus across survey locations, on key determinants of happiness which include age, sex, cultural affiliations, happiness of relatives and friends, strengths of social network, and marital status (Brown & Tierney, 2009, Frey & Stutzer, 2002, Gross et al., 1997).

A number of studies including Dengah (2014) and Brown & Tierney (2009) also find that religiosity demonstrates strong correlation with well-being and happiness particularly among elderly people. Brown & Tierney (2009), for instance, argue that religion has greater impact on the SWB of men than that of women. In faith based communities, people provide support to each other in the face of vulnerabilities so religious people tend to rebound from divorce, illness, unemployment etc.; religion may also foster higher expected utility from a belief in the hereafter (Azzi & Ehrenberg, 1975, Ellison, Gay, & Glass, 1989, Ellison, 1991).

Well-being research from social psychology analyses numerous factors that may explain why societies differ in terms of well-being. A culture shapes personality in a number of ways which influence an individual's realization of well-being (Tiberius, 2004). Other key factors responsible for shaping personality are wealth and self-serving biases[9] such as self-assessment, self-enhancement, self-criticism etc. (Diener, Oishi, & Lucas, 2003). Wealthier nations score higher on human rights, equality, justice, democratic governance etc. implying a positive relationship between well-being and these aspects of human rights (Biswas-Diener & Diener, 2001, Diener, Oishi, & Lucas, 2003).

Strength of social networks is also seen as a determinant of well-being which may vary across groups (Ellison, Gay, & Glass, 1989, J. F. Helliwell & Putnam, 2004, Kettner, Köppl, & Stagl, 2012). However, various type of social networks may have different correlations with well-being. For instance, Helliwell & Putnam (2004) found a robust and independent relationship between social capital and SWB through family ties, relationship with neighbours, friends and relatives etc. However, no significant correlation has been proven between ethnic homogeneity in an internet based friendship network (e.g. facebook) and SWB (Seder & Oishi, 2009).

Similarly, ethnic diversity is believed to affect well-being by influencing people's preferences and behaviours. In America, for example, housing prices in a neighbourhood with a more homogeneous minority population are higher than in more diverse neighbourhoods (Li, 2014). Ethnic diversity is also found to impact behaviours in developing countries. In sub-Saharan Africa, public good provisioning such as funding for primary education is strongly

9 Self-serving biases are deviations from reality in which respondents tend to report overestimated or underestimated facts. For example, researchers have found that East Asians are weaker in self-enhancement (a self-serving bias in which one rates herself better compared to how she rates others) compared to Americans, whereas, they tend to have high self-criticism tendencies (Heine, Takata, & Lehman, 2000, Heine et al., 1999). Oishi & Diener (2003) found that European Americans tend to overestimate the number of anagrams they solved last week whereas, Asian American underestimate this number. Dockery (2010) argues that indigenous culture should be viewed as a part of well-being enhancement and not as part of a problem.

associated with ethnicity, while public schools in Kenya that have high ethnic diversity receive much lower funding than largely homogenous schools (Miguel & Gugerty, 2005).

In the empirical models of our study, we control for both personal and country level factors to study well-being. Personal level variables include age, sex, marital status, employment status, income scale and education levels. Country level variables include internationally comparable GNI per capita in terms of purchasing power parity (PPP), inflation rate and unemployment rate as these variables are suggested to have strong relationships with SWB (Gnègnè, 2009, Grimes et al., 2016, Novak & Pahor, 2017, R. Di Tella, MacCulloch, & Oswald, 2001, Welsch & Kühling, 2016).

2.3 Possible relationships between ANS and SWB

The relationship between the individual components of ANS such as natural capital, human capital, produced capital and its rate of return (measured by income per capita) and SWB has been extensively studied in the literature. The predictive power of ANS to explain changes in national level well-being – but not individual level well-being – has also been examined.

Well-being may be analysed at both individual and aggregate levels (e.g. regional or national aggregates) as an outcome of individual traits[10] and a range of national level indicators[11]. We can postulate eight possible combinations of relationship between ANS and SWB (or other measures of well-being) as summarized in Table 1 (where Δ signifies a change in that variable across time).

Table 1: Possible model specifications (each controlling for other variables)

Dependent variable / Independent variable(s)	**Individual level**	**Aggregate level**
SWB / ANS	X	X
SWB / ΔANS	X	X
ΔSWB / ANS	X	X
ΔSWB / ΔANS	X	X

From Table 1, the relationship between SWB and ANS can be modelled at individual or country level, with one or both variables expressed either in levels or changes. A summary of existing literature relevant to this subject in terms of the above combinations is presented in Table 2.

10 Key individual traits collected in WVS or EVS include age, sex, education level, employment status, marital status, income level, religious affiliation etc.
11 National level indicators including both single indicators (e.g. GDP, GNP etc.) and composite indicators (such as HDI, GS, ANS etc.). For details see Qasim (2017).

Examining Table 2, we observe two groups of studies. First, ANS (or its variants i.e. GS, CI, CW) has been used as a predictor of changes in future well-being at national level (Greasley et al. (2016), Hanley et al. (2016), Greasley et al. (2014), Blum, McLaughlin, & Hanley (2013), Gnègnè (2009)). Ferreira, Hamilton, & Vincent (2008) have used GS to predict changes in future real consumption per capita which has been used as a proxy for national level well-being.

Second, all SWB studies for individual or aggregate country level models are formulated using both the dependent variables and the explanatory variables at levels (rather than changes)[12]. To the best of our knowledge, none of the papers has applied ANS or any of its variants to predict future individual level SWB while controlling also for past levels of SWB. However, the literature on cultural and other determinants of SWB show that it is vital to control for SWB levels across different countries and cultures, so studies that omit this country-specific aspect are likely to be flawed. The present paper is the first to fill this gap.

[12] Using current variables at levels may induce the risk of endogeneity in the results. This problem is elaborated further in the methodology part together with our mitigation strategy.

Table 2: Key studies including well-being and ANS or its individual components (recent to older)

Reference	Dependent variable(s)	Independent variable(s) in one or more models	Type of study LHS vs RHS	Scope of study
Novak & Pahor (2017)	SWB	GNI per capita, Unemployment rate, inflation, relative income, unemployment, gender, marital status, number of children, health, education, age, immigrant, democracy	Levels – Levels	Individual level
Greasley et al. (2016)	PVΔC	Net national investment, Green investment, comprehensive investment (GS, ANS), Cl adjusted for minerals, CI adjusted for TFP	Changes – Levels	Country level
Grimes et al. (2016)	SWB	Fiscal variables, personal controls	Levels – Levels*	Individual level
Hanley et al. (2016)	PVΔC	GS, GS adjusted for TFP	Changes – Levels	Country level
Grimes & Reinhardt (2015)	SWB	Respondent income, mean income of others, relative gross national disposable income	Levels – Levels*	Country level
Greasley et al. (2014)	PVΔC, PVΔW	GS and its individual components	Changes – Levels	Country level
Blum, McLaughlin, & Hanley (2013)	PVΔC	GS and its individual components	Changes – Levels	Country level
Engelbrecht (2012)	SWB	Total wealth per capita, GNI per capita, natural capital per capita, produced capital, intangible capital	Levels – Levels	Country level
Verme (2011)	SWB	income, income inequality, relative income, country's wealth, age, sex, education, trust, work, politics, religion	Levels – Levels	Individual level
Pittau, Zelli, & Gelman (2010)	SWB	personal income, national income, age, sex, education, employment, marital status	Levels – Levels	Country level
Engelbrecht (2009)	LS, Happiness, SWB Index	Natural capital per capita, GNI per capita, Trust variable, Gini coefficient, Unemployment, inflation	Levels – Levels	Country level
Gnègnè (2009)	ΔHDI ΔIMR	ANS per capita, NNS per capita, ANS_E, ANS_P, ANS EP, Initial income, Initial life expectancy, Initial school, Public consumption, Trade, Gastil index	Changes – Levels	Country level
Bonini (2008)	LS	HDI, ESI, GDP per capita, Age, education, sex	Levels – Levels	Individual level
Ferreira, Hamilton, & Vincent (2008)	PVΔC	Gross savings, Net savings, Green savings, Population adjusted savings, Population growth rate Total population	Changes – Levels	Country level
Vemuri & Costanza (2006)	LS/SWB	HDI, ESP per squared km index, Press freedom	Levels – Levels	Country level

Reference	Dependent variable(s)	Independent variable(s) in one or more models	Type of study LHS vs RHS	Scope of study
Leigh & Wolfers (2006)	SWB, Happiness	HDI, GDP per capita	Levels – Levels	Country level
Schyns (2002)	SWB	income at low medium and high levels, national income	Levels – Levels	Country level

Notes: * Individual level study with cross-sectional country fixed effects added. GS and CI: Genuine savings and comprehensive investment (these are alternative terms for ANS). TFP: Total factor productivity. PVΔC: Present values (PV) of changes in per capita consumption in real-terms. PVΔW: PV of changes in real wages per capita. PVΔC and PVΔW are used as a proxy for aggregate objective well-being. ΔHDI: Change in human development index. ΔIMR: Change in infant mortality rate. ANS_P: ANS calculated without CO2 damage. ANS_E: ANS calculated without education expenditure. ANS_EP: ANS calculated without CO2 damage and education expenditure. ESI: Environmental sustainability index. GNI: Gross national income. NNS: Net national savings. LS: Life-satisfaction from the WVS. This is referred to as SWB in our paper. ESP: Ecosystem services product.

2.4 Components of ANS and SWB

Research on the relationship between particular components of ANS and SWB has been conducted since the early 1970s (Land & Michalos, 2017). This includes work on the relationship between income and happiness (Easterlin, 1974, 2005, Easterlin et al., 2010, R. D. Tella & MacCulloch, 2008), Grimes & Reinhardt (2015), Verme (2011), Schyns (2002) and Pittau, Zelli, & Gelman (2010)). Many of these studies find that if all residents within a country have the same proportionate increase in income then no-one feels better-off since all relativities remain unchanged. This is known as the Easterlin Paradox. However, other income and happiness studies such as Leigh & Wolfers (2006) and Stevenson & Wolfers (2008) have found that the Easterlin Paradox does not exist and an increase in income does result in higher life-satisfaction.

Significant work has been undertaken to explain SWB using composite indicators including natural capital, produced capital and human capital components. For instance, Leigh & Wolfers (2006) analyzed the relationship between the Human Development Index (HDI) and individual happiness using a WVS dataset of 115,000 individuals from 32 countries. Their results suggested that, in general, people from countries with high HDI are happier. In another study on the same relationship, Blanchflower & Oswald (2005) have shown a few exceptional countries, such as Australia, that have high HDI but lower average happiness scores which they call an HDI happiness paradox. Vemuri & Costanza (2006) also used HDI (as a proxy for human capital and produced capital) with an index for ecosystem services per square kilometer (as a proxy for natural capital) in their model for 57 countries to explain the relationship between SWB (using WVS data) and various types of capitals (e.g. human capital, produced capital, natural capital). Their results suggested that combinations of these capitals can explain 72% of the variation in individuals' life-satisfaction. Engelbrecht (2009) also found a positive and significant relationship between natural capital and the levels of individual life-satisfaction. However these latter studies use levels of each of the series which may yield distorted conclusions.

Bonini (2008) analyses the variation in the individual life-satisfaction of 76,038 individuals from 63 countries using a WVS dataset. A key finding of this study is that individual life-satisfaction differs significantly across countries and regions and that slope coefficients also differ across countries; therefore, universal development indicators may not adequately cover the policies required to address well-being across countries. Grimes et al. (2016) explored the association between fiscal policies and SWB using data for over 170,000 individuals from 35

countries and find that distortionary taxes (e.g. income tax) are positively associated with SWB compared to non-distortionary taxes (e.g. sales tax).

Finally, ANS itself has been widely adopted as a predictor of aggregate objective well-being. For example, the changes in the discounted value of real consumption per capita as a proxy for aggregate objective well-being has been explained using GS/ANS/CI/IW by (Blum, McLaughlin, & Hanley, 2013, Ferreira, Hamilton, & Vincent, 2008, Greasley et al., 2016, Hanley et al., 2016). Similarly, Greasley et al. (2014) took real wages per capita as a proxy for objective well-being to study the explanatory power of GS. A summary of other relevant literature is presented in Table 3.

Table 3: Summary of related SWB literature

Title/Reference	Data	Study type/design	Models
Novak & Pahor (2017) Using a multilevel modelling approach to explain the influence of economic development on the subjective well-being of individuals	WVS survey 2005 – 2009 Data for 49 countries from From the World Bank Development Indicators	Individual level study Cross-sectional data	Multilevel modelling
Gnègnè (2009) Adjusted net saving and welfare change	Data for 36 Countries From the World Bank HDI data from UNDP	Country level study Panel data Variables at difference	Regression models
Bonini (2008) Cross-National Variation in Individual Life-satisfaction: Effects of National Wealth, Human Development, and Environmental Conditions	WVS 1999 – 2003 76,038 Adults 63 countries* HDI from UNDP 2000 ESI from CIESIN 2001	Individual level study Cross-sectional data Variables at levels	Multilevel modelling
Vemuri & Costanza (2006) The role of human, social, built, and natural capital in explaining life-satisfaction at the country level: Toward a National Well-Being Index (NWI)	WVS 1990 – 1995 57 countries Proxies for data on 4 types of capitals from UNDP for 171 countries Freedom house press (1999)	Country level study Cross-sectional data Variables at levels	Regression models
Ferreira, Hamilton, & Vincent (2008) Comprehensive Wealth and Future Consumption: Accounting for Population Growth	1970 – 1982 Data for 64 Countries From the World Bank Development Indicators	Country level study Panel data Country fixed effect	Regression models
Engelbrecht (2009) Natural Capital, SWB, and the New Welfare Economics of Sustainability: Some Evidence from Cross-Country Regressions	WVS 2005 58 countries Natural capital data from the World Bank's Millennium Capital Assessment	Country level study Cross-sectional data Variables at levels	Regression models
Grimes et al. (2016) Subjective Wellbeing Impacts of National and Subnational Fiscal Policies	35 countries 130 years 170,000 individuals' SW IMF Govt. Financial Statistics 2014 with OECD data to fill missing data WVS 2014	Individual level study Panel data Country fixed effect Time fixed effect	Regression models

Title/Reference	Data	Study type/design	Models
Grimes & Reinhardt (2015) Relative Income and Subjective Wellbeing: Intra-national and Inter-national Comparisons by Settlement and Country Type	WVS 1990 – 2009 27 countries 16 OECD and 11 others 68 cross-sections 78,058 individuals	Country level study Panel data Country fixed effect Time fixed effect	Regression models
Verme (2011) Life-satisfaction and Income Inequality	WVS 1981 & 2004 267,870 individuals 1,349 regions 84 countries IMF: GDP, PPP UNU–WIDER: inequality	Individual level study Panel data Country fixed effect	Regression models
Leigh & Wolfers (2006) Happiness and the Human Development Index: Australia Is Not a Paradox	WVS 2005 78 countries 115,000 individuals Happiness ISSP 2002 32 countries 50,000 individuals HDI	Country level study Cross-sectional data Variables at levels	Regression models
Engelbrecht (2012) Some empirics of the bivariate relationship between average SWB and the sustainable wealth of nations	WVS 1990 – 2002 World Bank 2006	Country level study Cross-sectional data Variables at levels	Regression models
Schyns (2002) Wealth of Nations, Individual Income and Life-satisfaction In 42 Countries: A Multilevel Approach	WVS 1990 42 countries 50,046 individuals	Both individual and country level study Panel data Country fixed effect	Multilevel OLS
Pittau, Zelli, & Gelman (2010) Economic Disparities and Life-satisfaction in European Regions	1970 – 2002 Eurobarometer surveys 15 EU countries 1.1 million respondents	Both individual and country level study Panel data Country/regions fixed effect	Multilevel Models
Greasley et al. (2016) Australia: A land of missed opportunities?	1870 – 2011 for Australia	Country level study Single country study Time-series data Dependent variable as change in value	Regression models

Title/Reference	Data	Study type/design	Models
Hanley et al. (2016) Empirical testing of Genuine Savings as an indicator of weak sustainability: a three-country analysis of long-run trends.	1870 – 2008 for Britain, USA, Germany	Country level study three country study Time-series data Dependent variable as change in value	Regression models
Greasley et al. (2014) Testing genuine savings as a forward-looking indicator of future well-being over the (very) long-run	Britain 1760 - 2000	Country level study Single country study Time-series data Dependent variable as change in value	Regression models
Blum, McLaughlin, & Hanley (2013) Genuine savings and future well-being in Germany, 1850-2000	Germany	Country level study Single country study Time-series data Dependent variable as change in value	Regression models

To the best of our knowledge, ANS has not been applied to study changes in SWB of individuals across countries. Consistent with the recommendations of Stiglitz, Sen, & Fitoussi (2010) we consider it important to focus on individual (or household) well-being, rather than on aggregate measures of well-being. For methodological reasons, we also consider it important to focus on changes in well-being (rather than on levels). The present work, which examines the effects of a country's ANS on changes in its residents' SWB, aims to fill these gaps.

2.5 Hypothesis

Consistent with studies that analyse the aggregate relationship between ANS and certain well-being indicators, we hypothesize that countries with higher levels of ANS perform better, in the long-run, in terms of changes in SWB of their inhabitants. The reason underlying this hypothesis is that the countries which save more (in a comprehensive sense) are better able to have resources available, in the long term, to promote the well-being of future citizens. We aim to test this hypothesis using three different regression-based models discussed in the following section.

3 Methods

The main aim of this paper is to test whether ANS helps to predict future SWB outcomes. In order to isolate this effect, we control for a set of variables which have been shown in the previous literature to have high explanatory power for SWB. Equation (1) illustrates a baseline model. SWB for individual i in country c at time t is expressed as a function of M, a vector of macro-controls, X, a vector of personal controls, ANS, wave (time) fixed effects λ_w, and country fixed effects λ_c:

$$SWB_{i,c,t} = \beta_0 + \beta_1 M_{c,t} + \beta_2 X_{i,t} + \beta_3 ANS_{c,t} + \lambda_w + \lambda_c + \epsilon_{i,c,t} \qquad (1)$$

where:

SWB subjective well-being

i individual

c country

t time

M vector of macro controls

X vector of personal controls

ANS adjusted net savings

λ_c country fixed effect

λ_w time (wave) fixed effect

One potential problem with equation (1) is that this model may be subject to an endogeneity problem due to simultaneity (or omitted variables). For example, ANS at any given time for a country potentially has a strong relationship with its current level of income, and thence its current SWB. For this reason, while this model is our own starting point, we do not attempt to interpret its (likely biased) results. (For completeness, we report its results in Appendix Table F6) In model (2) we attempt to mitigate the endogeneity problem by modifying model (1) utilising the timing of our variables. We will focus on the results of this model in the later sections.

$$SWB_{i,c,t1} = \beta_0 + \beta_1 M_{c,t0} + \beta_2 X_{i,t1} + \beta_3 ANS_{c,t0} + \beta_4 SWB_{c,t0} + \epsilon_{i,c,t1} \qquad (2)$$

Equation (2) represents a cross-sectional model (and hence excludes country and wave fixed effects) in which $t1$ is the *'end-wave'* and $t0$ is the *'initial-wave'* for a particular country group. For example, (as discussed in section 4) for Group 1 countries, $t1$ is wave 4 and $t0$ is wave 2 of the WVS. Thus, we are regressing individual SWB in wave 4 on personal characteristics of those same individuals in wave 4 and on country variables (M, ANS and aggregate SWB) from wave 2. This model indicates how the initial ANS affects subsequent individual SWB after controlling for initial levels of a country's SWB. The need to control for a country's initial mean level of SWB – which has not been done in the prior SWB studies summarised in Table 2 and Table 3 (other, implicitly, than those that include individual country fixed effects) – is shown to be important in the studies summarised in section 2.2.1. We also estimate the per annum change in SWB aggregated to several age and sex groups in model (3) to conduct a pseudo-panel analysis that links changes in SWB of types of people to the initial SWB of that person type.

$$\frac{\Delta SWB_{gct}}{\#Years} = \beta_0 + \beta_1 SWB_{gct0} + \beta_2 M_{c,t0} + \beta_3 ANS_{ct0} + \lambda_g + \epsilon_{gct} \qquad (3)$$

where, #Years is the length of period (in years) between two waves of WVS for each group, so coefficients can be interpreted as per year effects on SWB changes of the RHS variables, g represents group averages.

The following four groups are defined based on age and sex:

- Age-sex group 1 & 2: 15 – 29 years old male/female
- Age-sex group 3 & 4: 30 – 44 years old male/female
- Age-sex group 5 & 6: 45 – 59 years old male/female
- Age-sex group 7 & 8: 60 + years old male/female

We drop any country which does not have any observations for each group in each time-period. For example, Brazil does not have any data for individuals over 60 years old in the 2nd wave of WVS, and therefore is dropped from the sample. The number of individuals in each group by country and by wave are summarised in Appendix Table E.

The World Bank provides estimates for two variants of ANS: (1) ANS excluding emission damage from particulate matter (% of GNI)[13]; (2) ANS including emission damage from particulate matter (% of GNI)[14]. We estimated all of our models for both of these variants. While SWB is a categorical (ordered) variable, it is common to treat SWB as if it were a cardinal variable and to estimate SWB models using OLS (Ferrer-i-Carbonell & Frijters, 2004, Luttmer, 2005) given that results have been found to be similar when estimating using OLS and ordered logit. Given this tradition, we estimate model (2) using each of OLS and ordered logit. Equation (3) is estimated using OLS.

4 Data

4.1 SWB and personal controls

Self-reported subjected well-being and data on personal controls[15], such as age, sex, marital status, employment status, income level and education were downloaded from WVS website[16] for waves 2,4,5 and 6[17]. The surveys are conducted in each country with domestic funding using stratified multistage random sampling, national random sampling or quota sampling methods. All WVS surveys are conducted in the national language with face-to-face interviews (Donnelly & Pop-Eleches, 2012). The SWB question is asked in the local language as:

13 Adjusted net savings are equal to net national savings plus education expenditure and minus energy depletion, mineral depletion, net forest depletion, and carbon dioxide. This series excludes particulate emissions damage.
14 This series includes carbon dioxide and particulate emissions damage. See A1 for detailed noted on the calculation of ANS.
15 Personal controls include age, sex, marital status, employment status, income level and education; and all WVS questionnaires include this information. The order of questions against which this information is recorded is different in different waves and we adjusted the data accordingly.
Another major challenge in processing WVS data is the use of different scales to record the answer of same questions. For example, the question on marital status is recorded as one of the following responses in wave 2 and wave 6:
-5: Missing; Unknown; Inappropriate; -4: Not asked; -3: Not applicable; -2: No answer; -1: Don't know; 1: Married; 2: Living together as married; 3: Divorced; 4: Separate; 5: Widow; 6: Single
The same questions have two additional categories of responses in wave 4 and wave 5 which are:
7: Divorced, separated or Widow; 10: Living apart while married/cohabitation.
Such data inconsistencies make the careful re-coding of data imperative prior to conduct any further analysis. Detailed notes on data preparation and re-coding are provided in the Appendix Table A.
16 http://www.worldvaluessurvey.org/WVSContents.jsp last visited on 19/08/2017.
17 Wave years: Wave 2: 1990–94; Wave 4: 1999–04; Wave 5: 2005–09; Wave 6: 2010–14.

> 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 1 2 3 4 5 6 7 8 9 10 Completely satisfied.

SWB is tightly distributed across all countries and all groups, with a mean of 6.7, median 7.0 and standard deviation of approximately 2.4. Hence a small change in its value can be economically material. Figure A1 shows the distribution of SWB by income levels by WVS wave in each group. General trends in the data reveal that higher income levels are associated with higher levels of SWB. Further details on the data from WVS are provided in Appendix Table A. The number of individuals surveyed in each wave by country is summarised in Appendix Table D.

WVS data have been criticised for inconsistencies of data categorization for the same variable across different waves. Income distribution, for instance, associated with ten categories are not income deciles, as interpreted by some researchers, and the method to record them also varies across different waves (Donnelly & Pop-Eleches, 2012, Grimes & Reinhardt, 2015, Grimes et al., 2016). In the majority of surveys, respondents are asked to place themselves in one of ten income brackets (e.g. $1 – $1,000, $1,000 – $5,000 etc.) where these income brackets are pre-determined by WVS. Donnelly & Pop-Eleches (2012) noted that the documentation for some income brackets for a number of countries were missing. As a result, these brackets do not generate a uniform distribution of income. In other cases, respondents are asked to place themselves on a 1 to 10 income scale, 1 being the lowest and 10 being the highest decile income group. In such cases, most of the people tend to report a central number. For example, 84% of Americans in the 2006 wave reported they are in one of the 5 middle deciles (i.e. 3 – 7) (Grimes et al., 2016). In some cases, respondents are asked to report their actual income which is later translated into a 1 to 10 scale.

Because of these data inconsistencies, we interpret income level as an ordinal variable within each data group (discussed under the following section) i.e. if somebody falls in a higher income level that person is likely to earn more. However, the cardinal relationship between income categories is not known. Since income is a control variable, rather than a direct variable of intent, in this study we do not attempt to interpret the income parameters.

4.2 ANS and other country level variables

Data for the key independent variable ANS and other country level variables i.e. real GNI per capita in PPP, inflation rate, and unemployment rate were downloaded from the World Bank's World Development Indicators Database (WDI). This dataset is provided in Appendix Table C (see data appendix for URL and variable details).

We divided the final dataset into four separate groups for our analysis. Each group includes SWB data from two different waves of WVS for all countries which are covered in both waves and that have ANS data from the World Bank. The composition of these data groups is given in Table 4.

Table 4: Composition of data groups

Data group	WVS Waves & no. of respondents	Duration between waves	Countries included
1.	Wave 2: 14,904 respondents Wave 4: 17,733 respondents	approx. 10 years	**10 countries:** Argentina, Chile, China, India, Mexico, Nigeria, South Africa, South Korea, Spain, Turkey
2.	Wave 2: 17,077 respondents Wave 5: 16,831 respondents	approx. 15 years	**11 countries:** Argentina, Brazil, Chile, China, India, Mexico, South Africa, South Korea, Spain, Switzerland, Turkey
3.	Wave 2: 16,674 respondents Wave 6: 21,035 respondents	approx. 20 years	**11 countries:** Argentina, Brazil, Chile, China, India, Mexico, Nigeria, South Africa, South Korea, Spain, Turkey
4.	Wave 4: 33,664 respondents Wave 6: 36,316 respondents	approx. 10 years	**21 countries:** Algeria, Argentina, Chile, China, Egypt, India, Japan, Jordan, Kyrgyzstan, Mexico, Morocco, Nigeria, Pakistan, Peru, Philippines, Singapore, South Africa, South Korea, Spain, Sweden, Turkey, United States

In our regression models, age is a continuous variable and both age and age squared are included to capture the curvilinear effect of age on SWB. Sex, marital status, employment status, income level and education levels are coded as dummy variables. Reference groups for these variables are males, employed, lowest income step, and no formal education respectively. In the result tables, these variables have the following identity prefixes sex_, ms_, es_, in_, and ed_ respectively. We also included dummies for missing entries for these variables and a dummy for missing age in our estimates.

For the pseudo-panel models, we split the dataset into 8 groups of panel data based on age and sex. The count of observations in each group and in each wave is summarised in Appendix Table E. These groups are defined in section 3.

We dropped 107 observations from the final group level dataset where data for age and sex were not available. Brazil was excluded from group 2 and 3 as it does not have any observations for individuals over 60 in WVS wave 2. In the result tables of pseudo-panel models, the 15 – 29 year old female group is the reference group.

4.3 Handling missing values

4.3.1 ANS

A few countries covered in WVS do not have ANS data for the same year from the World Bank. In such a case where a country does not have an ANS estimate for the year it was surveyed for WVS, we used the ANS values from the next or previous year. Any country which does not meet this condition was dropped from the dataset resulting in the following omissions:

- Japan was dropped from group 1, 2 and 3;
- Russia was dropped from group 2 and 3;
- Belarus was dropped from group 3;
- Iraq and Zimbabwe were dropped from group 4;
- Algeria was dropped from group 4.

4.3.2 Unemployment

Unemployment data series start from 1991 for all countries in WDI data. Therefore, we used 1991 values for the following countries which were surveyed in 1990 by WVS.
Chile, China, India, Mexico, Nigeria, South Africa, South Korea, Spain, Switzerland, Turkey

4.3.3 GNI (PPP)

A GNI series for China was not available from the World Bank Data Bank. It was sourced from UNDP's data website: http://hdr.undp.org/en/data on a consistent basis with the World Bank's data.

4.4 Summary Information

Before estimating our models, we plot the relationship between SWB and income levels recorded in WVS as shown in Figure A2.1. As expected, higher income, on average, is associated with higher levels of SWB across all waves of WVS. However, this relationship appears non-linear. An increase in income from the lowest step towards the middle step (i.e. from lowest step to step five) results in a larger increase in SWB than beyond that level of income. Similarly, we observe a direct and positive relationship between SWB and real PPP-adjusted GNI per capita in Figure A2.2. These results are intuitive and consistent with the results of many other similar studies such as (Engelbrecht, 2009, 2012). These patterns reinforce the results by Pittau, Zelli, & Gelman (2010) that personal income matters more in poor countries than in rich

countries. Summary data descriptive information is included in Appendix Table C to Appendix Table E.

5 Results and discussion

Coefficients on ANS for all four groups in both model (2) and model (3) are summarised in Table 1. Full model 2 results using OLS are summarised in Table 6– Table 9 while the model (3) results are presented in Table 10– Table 13. The full ordered logit results for model 2 are presented in Appendix Table G. In general, the results for the control variables are intuitive and consistent with the results of previous studies. In individual controls, for instance, we observe age exhibiting a non-linear and significant relationship with SWB. In the beginning, age is negatively correlated with SWB and after a certain age, this relationship is reversed. This result confirms the findings of Gross et al. (1997) and Carstensen et al. (2000) that young and older people are happier than mid-aged.

It is a general perception that women might have lower levels of life-satisfaction because they have access to fewer resources and traditionally possessed less power, freedom and status than men (Diener & Diener, 2009). However, many studies have found no or negligible differences between the SWB of men and women (Headey & Wearing, 1992, Herzog, Rodgers, & Woodworth, 1982, Schyns, 2002). Our estimates also show mixed results for sex. Women have positive SWB in the results of group 1 and group 2, but the relationship is insignificant in the results of group 3 and 4. Another interesting finding is that the housewife group is significantly more satisfied than any other group in the employment status category (especially in groups 1 and 4).

Higher levels of both income and education are significantly and positively related to SWB in all four cases of model (2). Similar results have been shown by others (Diener & Biswas-Diener, 2002, 2002, Schyns, 2002). Another consistent finding is that the magnitude of increase in life-satisfaction in response to increases in income exhibits a concave pattern. In other words, an increase in income is associated with higher SWB, however, with diminishing returns. Finally, our results show higher levels of average SWB in the first period is directly and significantly associated with higher life-satisfaction of individuals in the following period in 3 of the 4 models, while it has a negative significant association for group 2. This shows the criticality of including a control for prior SWB in any study of the relationship of another variable of interest (ANS in our case) with SWB; many prior studies have failed to do so.

In terms of macro controls, the relationship between initial ppp-adjusted real GNI per capita and subsequent life-satisfaction is positive and significant. Initial unemployment rates are negatively associated with subsequent SWB across all groups, while the coefficient of initial

inflation shows a positive relationship with SWB in all cases except group 1 where the coefficients are not significant[18].

In general, coefficients of macro controls for Model (2) using both OLS (Table 6 – Table 9) and ordered logit models (Appendix Table G) are consistent in terms of signs and significance levels. Each of these macro variables is included to control for prevalent economic conditions across countries, and so we do not attempt to interpret their estimated coefficients. However, as with initial SWB, the significance of the (initial period) macro controls demonstrates the importance of controlling for (prior) country-specific factors when assessing the relationship between ANS and SWB, which has often been overlooked in cross-sectional studies.

Now we turn our focus to Table 5 to interpret the relationship of (future) life-satisfaction to the two variants of initial ANS (i.e. ANS including PM and ANS excluding PM). In both models, we observe that higher initial levels of ANS (in each of its variants) is negatively associated with future SWB over time horizons of 10 – 15 years with this relationship being significantly negative in 15 out of 18 cases. By contrast, the relationship is positive over the longer time horizon (i.e. 20 years in the group 3 results), and are significantly so using the cross-sectional OLS models.

Table 5: Coefficients of ANS variables

	Group 1 **Wave 2 & 4** **≈10 years**	Group 2 **Wave 2 & 5** **≈15 years**	Group 3 **Wave 2 & 6** **≈20 years**	Group 4 **Wave 4 & 6** **≈10 years**
Model 2: Cross-sectional models (using OLS)				
ANS inc. PM	-0.03***	-0.04***	0.01***	-0.01***
ANS exc. PM	-0.04***	-0.05***	0.01***	-0.005***
Model 2: Cross-sectional models (using ordered logit)				
ANS inc. PM	-0.03***	-0.04***	0.001	-0.01***
ANS exc. PM	-0.03***	-0.05***	0.001	-0.01***
Model 3: Pseudo-panel models (OLS)				
ANS inc. PM	-0.005***	-0.001	0.0003	-0.001
ANS exc. PM	-0.01***	-0.001*	0.0003	-0.001

Note: *p<0.1; **p<0.05; ***p<0.01

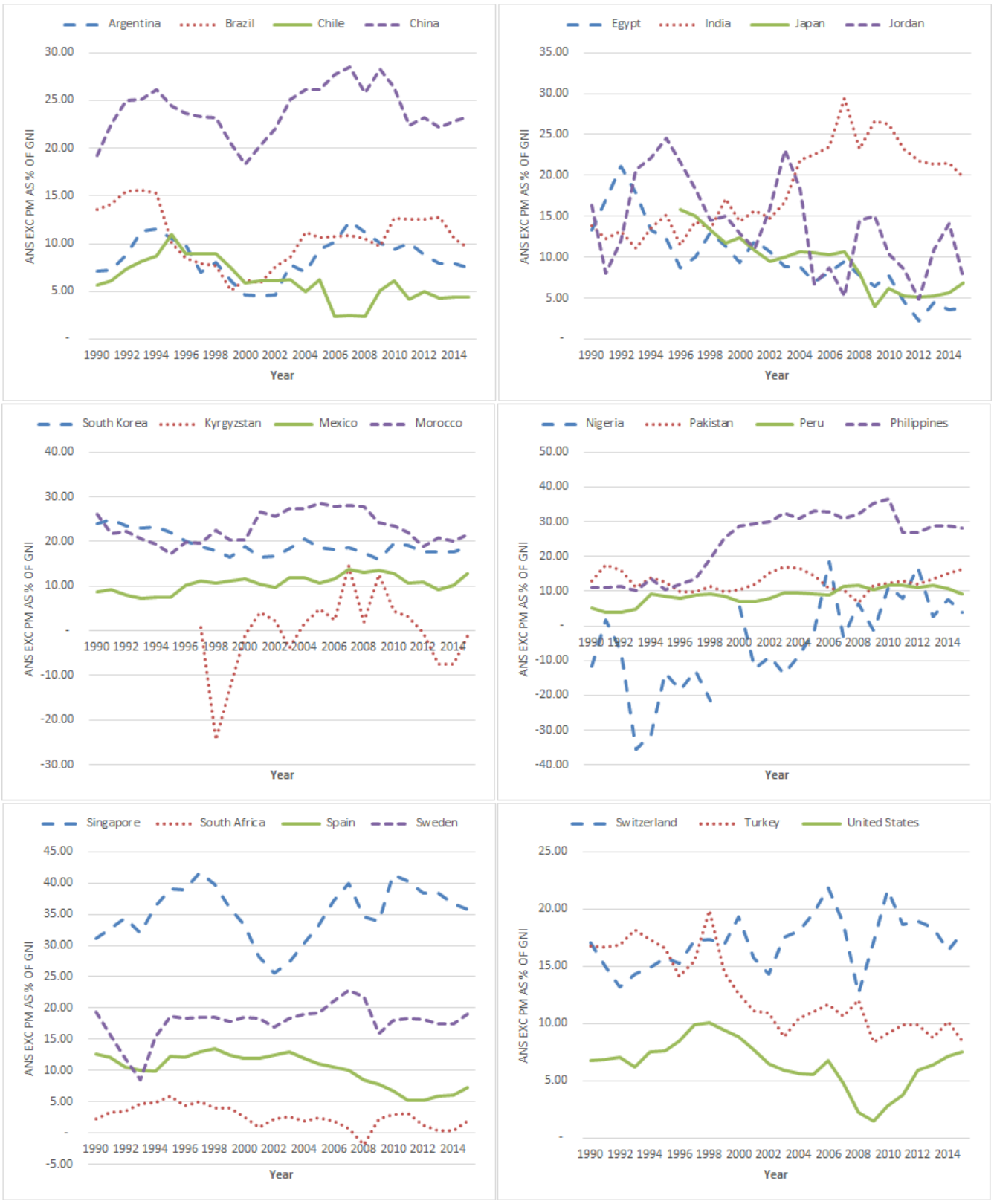
Before going into further interpretation, it is important to note two key characteristics of ANS: (1) it has been emphasised that ANS is a comprehensive sustainability measure for infinite time horizons (Blum, McLaughlin, & Hanley, 2013, Ferreira, Hamilton, & Vincent, 2008, Ferreira & Vincent, 2005, Greasley & Madsen, 2016, Greasley et al., 2014, Hanley et al., 2016); (2) levels of ANS have been following cyclical patterns in many countries. This is observed for the

18 R. Di Tella, MacCulloch, & Oswald (2001) finds that inflation has a negative effect on SWB for European countries for the period 1975–1991, whereas the results for US are not clear. Welsch & Kühling (2016) find that lower inflation rates reduced the negative effect of the economic crisis, while Novak & Pahor (2017) has found that inflation rate does not have a significant effect on subjective well-being.

countries shown in Figure 1. It is clear from the trends that countries which started with higher levels of ANS at the time of wave 2 (the initial wave in our models) faced a decline over the following decade before starting to rise again.

Keeping these facts in mind, it is likely that governments of the countries which spend more on the welfare of people in the short-run, have lower national savings rates and have lower initial ANS (Ma & Yi, 2010, Parker, 1999, Schor, 1999, Yang & Jianfeng, 2007). Over short time horizons, these countries may achieve higher life-satisfaction of their citizens as they boost near-term welfare at the expense of building longer-term capital. Over the longer time horizons (i.e., our group 3 with its 20 years' time period), countries that have low initial ANS may subsequently have to cut back on welfare related expenditure in order to rebuild their capital, and this results in lower long-term SWB. This is consistent with the direction of our results across all four groups. In two of our six cases, our group 3 (20 year) results are significantly positive, consistent with the relationship expected from theory. Our other group 3 (longer time horizon) coefficients, while positive, are not significantly different from zero which may reflect the still short time horizon in our data relative to that needed to truly capture the positive well-being impacts of higher ANS over the very long-run.

Figure 1: Trends of ANS excluding PM as % GNI of countries included in the analysis



Source: Plotted from the ANS data downloaded from World Bank's WDI database.

Table 6: Group 1 (Wave 2 and 4)

	Dependent variable: SWB	
	OLS	
	ANS INC PM	ANS EXC PM
	(1)	(2)
age	-0.08*** (0.01)	-0.08*** (0.01)
age_squared	0.001*** (0.0001)	0.001*** (0.0001)
age_na	-1.94*** (0.43)	-1.92*** (0.43)
sex_Female	0.12*** (0.04)	0.12*** (0.04)
ms_Divorced	-0.63*** (0.11)	-0.64*** (0.11)
ms_Single	-0.57*** (0.10)	-0.57*** (0.10)
ms_Widowed	-0.30*** (0.06)	-0.31*** (0.06)
ms_Missing	-0.17 (0.47)	-0.17 (0.47)
es_Unemployed	0.004 (0.09)	-0.0001 (0.09)
es_Housewife	0.24*** (0.06)	0.24*** (0.06)
es_Student	-0.27*** (0.06)	-0.26*** (0.06)
es_Retired	-0.69*** (0.07)	-0.69*** (0.07)
es_Other	-0.36** (0.15)	-0.36** (0.15)
es_Missing	-0.09 (0.19)	-0.09 (0.19)
in_second step	0.07 (0.09)	0.07 (0.09)
in_Third step	0.26*** (0.09)	0.26*** (0.09)
in_Fourth step	0.72*** (0.09)	0.72*** (0.09)
in_Fifth step	1.01*** (0.09)	1.01*** (0.09)
in_Sixth step	1.28*** (0.10)	1.28*** (0.10)
in_Seventh step	1.49*** (0.10)	1.48*** (0.10)
in_Eigth step	1.75*** (0.10)	1.74*** (0.10)
in_Nineth step	1.75*** (0.12)	1.75*** (0.12)
in_Tenth step	1.84*** (0.13)	1.84*** (0.13)
in_Missing	1.20*** (0.10)	1.20*** (0.10)
ed_Primary	0.36*** (0.08)	0.35*** (0.08)
ed_Secondary	0.32*** (0.08)	0.31*** (0.08)
ed_University	0.32*** (0.09)	0.32*** (0.09)
ed_Missing	0.52*** (0.17)	0.51*** (0.17)
swb_t0	0.47*** (0.04)	0.45*** (0.04)
ANS_inc_pm	-0.03*** (0.002)	
ANS_exc_pm		-0.04*** (0.002)
Unemp	-0.04*** (0.003)	-0.04*** (0.003)
Inflation_rate	0.0004 (0.0005)	0.0003 (0.0005)
log(GNI_PPP)	0.59*** (0.03)	0.56*** (0.03)
Constant	-0.68* (0.42)	-0.23 (0.42)
Observations	17,733	17,733
R^2	0.14	0.14
Adjusted R^2	0.14	0.14
Residual Std. Error	2.37	2.37
F Statistic	86.89***	87.26***

Note: *p**p***p<0.01; Each of the macro variables (SWB, ANS, Unemployment, inflation rate, log (GNI-PPP)) are as at the initial wave.

Table 7: Group 2 (Wave 2 and 5)

	Dependent variable: SWB	
	OLS	
	ANS INC PM	ANS EXC PM
	(1)	(2)
age	-0.04*** (0.01)	-0.04*** (0.01)
age_squared	0.0004*** (0.0001)	0.0004*** (0.0001)
age_na	-2.61*** (0.94)	-2.57*** (0.95)
sex_Female	0.12*** (0.04)	0.12*** (0.04)
sex_Missing	-0.90 (1.35)	-0.87 (1.36)
ms_Divorced	-0.45*** (0.08)	-0.46*** (0.08)
ms_Single	-0.44*** (0.09)	-0.45*** (0.09)
ms_Widowed	-0.22*** (0.05)	-0.22*** (0.05)
ms_Missing	0.21 (0.31)	0.22 (0.31)
es_Unemployed	0.04 (0.08)	0.04 (0.07)
es_Housewife	0.07 (0.06)	0.05 (0.06)
es_Student	-0.38*** (0.06)	-0.37*** (0.06)
es_Retired	-0.53*** (0.07)	-0.52*** (0.07)
es_Other	-0.68*** (0.12)	-0.66*** (0.12)
es_Missing	-0.48*** (0.11)	-0.46*** (0.11)
in_second step	0.21** (0.09)	0.22** (0.09)
in_Third step	0.33*** (0.08)	0.33*** (0.08)
in_Fourth step	0.54*** (0.08)	0.55*** (0.08)
in_Fifth step	0.80*** (0.08)	0.81*** (0.08)
in_Sixth step	1.04*** (0.08)	1.05*** (0.08)
in_Seventh step	1.29*** (0.09)	1.30*** (0.09)
in_Eigth step	1.35*** (0.09)	1.36*** (0.09)
in_Nineth step	1.36*** (0.14)	1.35*** (0.14)
in_Tenth step	1.24*** (0.14)	1.21*** (0.14)
in_Missing	0.73*** (0.08)	0.69*** (0.08)
ed_Primary	0.37*** (0.08)	0.37*** (0.08)
ed_Secondary	0.47*** (0.08)	0.46*** (0.08)
ed_University	0.34*** (0.08)	0.34*** (0.08)
ed_Missing	0.01 (0.25)	0.02 (0.25)
swb_t0	-0.32*** (0.04)	-0.37*** (0.05)
ANS_inc_pm	-0.04*** (0.004)	
ANS_exc_pm		-0.05*** (0.004)
Unemp	-0.03*** (0.004)	-0.04*** (0.004)
Inflation_rate	0.001*** (0.0001)	0.001*** (0.0001)
log(GNI_PPP)	0.40*** (0.02)	0.37*** (0.02)
Constant	6.54*** (0.34)	7.39*** (0.36)
Observations	16,831	16,831
R^2	0.11	0.12
Adjusted R^2	0.11	0.11
Residual Std. Error	2.11	2.11
F Statistic	63.99***	65.27***

See note to Table 5

Table 8: Group 3 (Wave 2 and 6)

	Dependent variable: SWB	
	OLS	
	ANS INC PM	ANS EXC PM
	(1)	(2)
age	-0.02*** (0.01)	-0.02*** (0.01)
age_squared	0.0002*** (0.0001)	0.0002*** (0.0001)
age_na	0.65 (0.41)	0.64 (0.41)
sex_Female	0.01 (0.03)	0.01 (0.03)
sex_Missing	-0.44 (0.84)	-0.45 (0.84)
ms_Divorced	-0.28*** (0.08)	-0.28*** (0.08)
ms_Single	-0.27*** (0.08)	-0.27*** (0.08)
ms_Widowed	-0.20*** (0.04)	-0.20*** (0.04)
ms_Missing	-1.10*** (0.39)	-1.10*** (0.39)
es_Unemployed	-0.03 (0.07)	-0.03 (0.07)
es_Housewife	0.04 (0.05)	0.04 (0.05)
es_Student	0.002 (0.06)	0.001 (0.06)
es_Retired	-0.33*** (0.05)	-0.33*** (0.05)
es_Other	-0.29*** (0.09)	-0.29*** (0.09)
es_Missing	-0.25*** (0.06)	-0.26*** (0.06)
in_second step	0.002 (0.09)	0.002 (0.09)
in_Third step	-0.16** (0.08)	-0.16** (0.08)
in_Fourth step	0.03 (0.08)	0.03 (0.08)
in_Fifth step	0.26*** (0.08)	0.26*** (0.08)
in_Sixth step	0.51*** (0.08)	0.51*** (0.08)
in_Seventh step	0.84*** (0.08)	0.84*** (0.08)
in_Eigth step	1.27*** (0.09)	1.27*** (0.09)
in_Nineth step	1.64*** (0.11)	1.64*** (0.11)
in_Tenth step	2.12*** (0.15)	2.12*** (0.15)
in_Missing	0.54*** (0.10)	0.54*** (0.10)
ed_Primary	0.35*** (0.07)	0.36*** (0.07)
ed_Secondary	0.45*** (0.07)	0.45*** (0.07)
ed_University	0.38*** (0.08)	0.38*** (0.08)
ed_Missing	0.59* (0.34)	0.59* (0.34)
swb_t0	0.21*** (0.04)	0.22*** (0.04)
ANS_inc_pm	0.01*** (0.002)	
ANS_exc_pm		0.01*** (0.002)
Unemp	-0.04*** (0.003)	-0.04*** (0.003)
Inflation_rate	0.002*** (0.0001)	0.002*** (0.0001)
log(GNI_PPP)	0.43*** (0.02)	0.43*** (0.02)
Constant	1.96*** (0.37)	1.88*** (0.38)
Observations	21,035	21,035
R^2	0.11	0.11
Adjusted R^2	0.10	0.10
Residual Std. Error	2.08	2.09
F Statistic	72.69***	72.66***

See note to Table 5

Table 9: Group 4 (Wave 4 and 6)

	Dependent variable: SWB	
	OLS	
	ANS INC PM	ANS EXC PM
	(1)	(2)
age	-0.03*** (0.005)	-0.03*** (0.005)
age_squared	0.0004*** (0.0000)	0.0004*** (0.0000)
age_na	-0.16 (0.26)	-0.16 (0.26)
sex_Female	-0.02 (0.02)	-0.02 (0.02)
sex_Missing	-0.17 (0.85)	-0.17 (0.85)
ms_Divorced	-0.39*** (0.06)	-0.39*** (0.06)
ms_Single	-0.34*** (0.06)	-0.34*** (0.06)
ms_Widowed	-0.25*** (0.03)	-0.25*** (0.03)
ms_Missing	-0.23 (0.21)	-0.23 (0.21)
es_Unemployed	-0.04 (0.05)	-0.04 (0.05)
es_Housewife	0.10*** (0.04)	0.10*** (0.04)
es_Student	0.08 (0.05)	0.08 (0.05)
es_Retired	-0.22*** (0.05)	-0.22*** (0.05)
es_Other	-0.07 (0.07)	-0.07 (0.07)
es_Missing	0.33*** (0.05)	0.34*** (0.05)
in_second step	0.04 (0.07)	0.04 (0.07)
in_Third step	-0.01 (0.06)	-0.01 (0.06)
in_Fourth step	0.29*** (0.06)	0.29*** (0.06)
in_Fifth step	0.53*** (0.06)	0.53*** (0.06)
in_Sixth step	0.75*** (0.06)	0.75*** (0.06)
in_Seventh step	1.06*** (0.06)	1.06*** (0.06)
in_Eigth step	1.40*** (0.07)	1.40*** (0.07)
in_Nineth step	1.75*** (0.09)	1.76*** (0.09)
in_Tenth step	2.15*** (0.11)	2.15*** (0.11)
in_Missing	0.76*** (0.08)	0.76*** (0.08)
ed_Primary	0.39*** (0.05)	0.39*** (0.05)
ed_Secondary	0.47*** (0.05)	0.47*** (0.05)
ed_University	0.50*** (0.05)	0.50*** (0.05)
ed_Missing	0.54*** (0.18)	0.54*** (0.18)
swb_t0	0.41*** (0.02)	0.41*** (0.02)
ANS_inc_pm	-0.01*** (0.002)	
ANS_exc_pm		-0.005*** (0.002)
Unemp	-0.02*** (0.002)	-0.02*** (0.002)
Inflation_rate	0.01*** (0.001)	0.01*** (0.001)
log(GNI_PPP)	-0.01 (0.01)	-0.02 (0.01)
Constant	4.32*** (0.16)	4.35*** (0.16)
Observations	36,316	36,316
R^2	0.11	0.11
Adjusted R^2	0.10	0.10
Residual Std. Error	2.11	2.11
F Statistic	125.95***	125.89***

See note to Table 5

Table 10: Group 1 (Wave 2 and 4)

	Dependent variable: ΔSWB per year	
	OLS	
	ANS INC PM	ANS EXC PM
	(1)	(2)
gr_15-29 male	0.01 (0.03)	0.01 (0.03)
gr_30-44 female	-0.02 (0.03)	-0.02 (0.03)
gr_30-44 male	0.001 (0.04)	0.0005 (0.04)
gr_45-59 female	-0.01 (0.03)	-0.01 (0.03)
gr_45-59 male	-0.02 (0.03)	-0.02 (0.03)
gr_60+ female	0.02 (0.03)	0.02 (0.03)
gr_60+ male	0.04 (0.04)	0.04 (0.04)
swb_t0	-0.05*** (0.01)	-0.05*** (0.01)
ANS_inc_pm	-0.005*** (0.001)	
ANS_exc_pm		-0.01*** (0.001)
Unemp	-0.01*** (0.001)	-0.01*** (0.001)
Inflation_rate	-0.0000 (0.0002)	-0.0000 (0.0002)
log(GNI_PPP)	0.06*** (0.01)	0.06*** (0.01)
Constant	-0.17 (0.15)	-0.12 (0.15)
Observations	80	80
R^2	0.55	0.57
Adjusted R^2	0.47	0.49
Residual Std. Error	0.07	0.07
F Statistic	6.88***	7.38***

See note to Table 5

Table 11: Group 3 (Wave 2 and 6)

	Dependent variable: ΔSWB per year	
	OLS	
	ANS INC PM	ANS EXC PM
	(1)	(2)
gr_15-29 male	0.01 (0.01)	0.01 (0.01)
gr_30-44 female	-0.01 (0.01)	-0.01 (0.01)
gr_30-44 male	0.003 (0.01)	0.003 (0.01)
gr_45-59 female	-0.01 (0.01)	-0.01 (0.01)
gr_45-59 male	-0.01 (0.01)	-0.01 (0.01)
gr_60+ female	-0.02 (0.02)	-0.02 (0.02)
gr_60+ male	-0.01 (0.01)	-0.01 (0.01)
swb_t0	-0.03*** (0.004)	-0.03*** (0.004)
ANS_inc_pm	0.0003 (0.001)	
ANS_exc_pm		0.0003 (0.001)
Unemp	-0.001* (0.001)	-0.001* (0.001)
Inflation_rate	0.0001*** (0.0000)	0.0001*** (0.0000)
log(GNI_PPP)	0.02*** (0.005)	0.02*** (0.005)
Constant	0.06 (0.05)	0.06 (0.05)
Observations	86	86
R^2	0.47	0.47
Adjusted R^2	0.38	0.38
Residual Std. Error	0.03	0.03
F Statistic	5.36***	5.37***

See note to Table 5

Table 12: Group 2 (Wave 2 and 5)

	Dependent variable: ΔSWB per year	
	OLS	
	ANS INC PM	ANS EXC PM
	(1)	(2)
gr_15-29 male	-0.003 (0.01)	-0.003 (0.01)
gr_30-44 female	-0.01 (0.01)	-0.01 (0.01)
gr_30-44 male	-0.005 (0.01)	-0.005 (0.01)
gr_45-59 female	-0.03 (0.02)	-0.03 (0.02)
gr_45-59 male	-0.02 (0.02)	-0.02 (0.02)
gr_60+ female	-0.02 (0.02)	-0.02 (0.02)
gr_60+ male	-0.03 (0.02)	-0.03 (0.02)
swb_t0	-0.05*** (0.01)	-0.05*** (0.01)
ANS_inc_pm	-0.001 (0.001)	
ANS_exc_pm		-0.001* (0.001)
Unemp	-0.001 (0.001)	-0.001 (0.001)
Inflation_rate	0.0001*** (0.0000)	0.0001*** (0.0000)
log(GNI_PPP)	0.03*** (0.01)	0.03*** (0.005)
Constant	0.13** (0.06)	0.15*** (0.06)
Observations	86	86
R^2	0.62	0.63
Adjusted R^2	0.56	0.57
Residual Std. Error	0.04	0.04
F Statistic	10.12***	10.32***

See note to Table 5

Table 13: Group 4 (Wave 4 and 6)

	Dependent variable: ΔSWB per year	
	OLS	
	ANS INC PM	ANS EXC PM
	(1)	(2)
gr_15-29 male	0.01 (0.02)	0.01 (0.02)
gr_30-44 female	-0.01 (0.02)	-0.01 (0.02)
gr_30-44 male	-0.002 (0.02)	-0.002 (0.02)
gr_45-59 female	-0.02 (0.02)	-0.02 (0.02)
gr_45-59 male	-0.01 (0.02)	-0.01 (0.02)
gr_60+ female	-0.03 (0.02)	-0.03 (0.02)
gr_60+ male	-0.02 (0.02)	-0.02 (0.02)
swb_t0	-0.06*** (0.01)	-0.06*** (0.01)
ANS_inc_pm	-0.001 (0.001)	
ANS_exc_pm		-0.001 (0.001)
Unemp	-0.001 (0.001)	-0.001 (0.001)
Inflation_rate	0.001*** (0.0003)	0.001*** (0.0003)
log(GNI_PPP)	0.01 (0.01)	0.01 (0.01)
Constant	0.38*** (0.06)	0.39*** (0.06)
Observations	168	168
R^2	0.44	0.44
Adjusted R^2	0.40	0.40
Residual Std. Error	0.07	0.07
F Statistic	10.31***	10.29***

See note to Table 5

6 Conclusion

ANS (or GS, CI, CW) has been widely applied as a comprehensive measure of weak-sustainability. As such it has been used as a tool to predict aggregate objective well-being (Ferreira, Hamilton, & Vincent, 2008, Gnègnè, 2009, Greasley et al., 2014, 2016, Hanley et al., 2016). In this paper, we have focused on adopting ANS to model future individual level SWB and aggregate group changes in SWB. To the best of our knowledge, this study is the first attempt in this regard that includes controls for initial levels of SWB of a country.

We used the data for self-reported life-satisfaction and other personal traits such as age, sex, marital status, income level, and education provided by WVS in waves 2, 4, 5 and 6. This data was gathered in four groups of countries in which each country is surveyed in two different waves (i.e. four groups of countries being those surveyed in: wave 2 and 4, wave 2 and 5, wave 2 and 6, and wave 4 and 6). Individual level data was combined with macroeconomic data from the World Bank and other sources.

The key relationships that we find are as follows. Firstly, over horizons of 10 – 15 years, the level of individuals' SWB in a given period is negatively associated with ANS in the initial period, and for 9 of 12 specifications this relationship is significantly different from zero. Secondly, for a 20-year time horizon this relationship turns positive (significantly so in our OLS model 2 specifications). These results are consistent with political economy dynamics in which a country that starts off with lower ANS tends to spend more on the current welfare of people at the expense of its savings. This raises individuals' life-satisfaction in the short-term but diminishes the reserves available to raise people's well-being over longer time horizons. This shift is captured by the switch to a positive relationship over the 20-year time horizon. These results hold for both individual level and aggregate group level results. It is important to note that ANS is regarded as a sustainability measure for infinite time horizons and 20 years is still a relatively short time period to study this hypothesised long-term relationship. Lack of longer term data mean that we cannot assess the relationship over even longer time horizons. We leave this to be examined in future research as more data becomes available.

Overall, our results highlight an important political economy challenge for policies that are designed to boost sustainable outcomes (proxied, in our case, by higher ANS). Governments that act in this way may suffer in the short term (that is relevant to political cycles) relative to more profligate governments, and so potentially lose political power. This political economy challenge may help to explain why many governments do not run sustainable policies. Our 20-year time horizon results indicate that it would be beneficial to examine the relationship between ANS and SWB over longer-time horizons. Such an analysis – as data becomes available for future survey waves – would contribute to a better understanding of whether people gain intergenerationally in terms of both sustainability and well-being when governments are focused on maintaining or increasing ANS as posited by the broader literature on genuine savings and related measures.

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Appendix

Calculation of adjusted net savings (ANS)

ANS is calculated as:

$$ANS = (\ GNS - D_h + CSE - \sum R_{n,i}\ - CD\ - PM) \ / \ GNI$$

Where:

ANS Adjusted net savings

GNS Gross national savings

D_h Depreciation of fixed capital

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

$R_{n,i}$ Rent from the depletion of natural capital

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):

According to the World Bank methodology, GNS is calculated as the difference between GNI and public and private consumption plus net transfers.

Depreciation of fixed capital:

D_h 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 is used to proxy human capital investments in ANS equation. It includes current operating expenditure on education at all levels i.e. primary, secondary, tertiary, vocational etc. which include salaries and wages and excludes capital expenditures such as spending on buildings and equipment.

Rent from natural resources:

Rent from the extraction of minerals and energy resources e.g. crude oil, gas, coal etc. 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 ton of CO2 emission from Fankhauser (1994).

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.

Data appendix

Appendix Table 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 5: V22 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 5: V237 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 5: V235 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 5: V55 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 5: V241 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 5: V253 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 5: V238 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. issing: -5, -4, -3, -2, -1

Appendix Table B: Adjusted Net Savings and macro controls

Variable		Definition	Note and data processing
ANS_exc_pm	Adjusted net savings, excluding 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. This series excludes particulate emissions damage. Where Net National Saving (NNS), is calculated as the difference between gross national savings and depreciation/consumption of fixed capital; and gross national savings (GNS) are calculated as the difference between gross national income and public and private consumption plus net current transfers according to the World Bank methodology (Bolt, Matete, & Clemens, 2002).	Any country which does not have ANS data for the year it was surveyed (or immediate previous or following year) for WVS was dropped from the final dataset.
ANS_inc_pm	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. (where net national savings is as defined above)	Same as above
Unemployment	Unemployment, total (% of total labor force) (modeled ILO estimate)	Unemployment refers to the share of the labor 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.
CPI	Inflation, consumer prices (annual %)	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used.	
GNI_PPP	GNI per capita, PPP (constant 2011 international $)	GNI per capita based on purchasing power parity (PPP). PPP GNI is gross national income (GNI) converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GNI as a U.S. dollar has in the United States. GNI is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad. Data are in constant 2011 international dollars.	**Data for China was downloaded from:** http://hdr.undp.org/en/data China GNI data has the same base year

Data sources:

SWB and personal controls

Data is downloaded from World Values Survey website accessed on Monday, 12 June 2017. URLs for each wave as following:

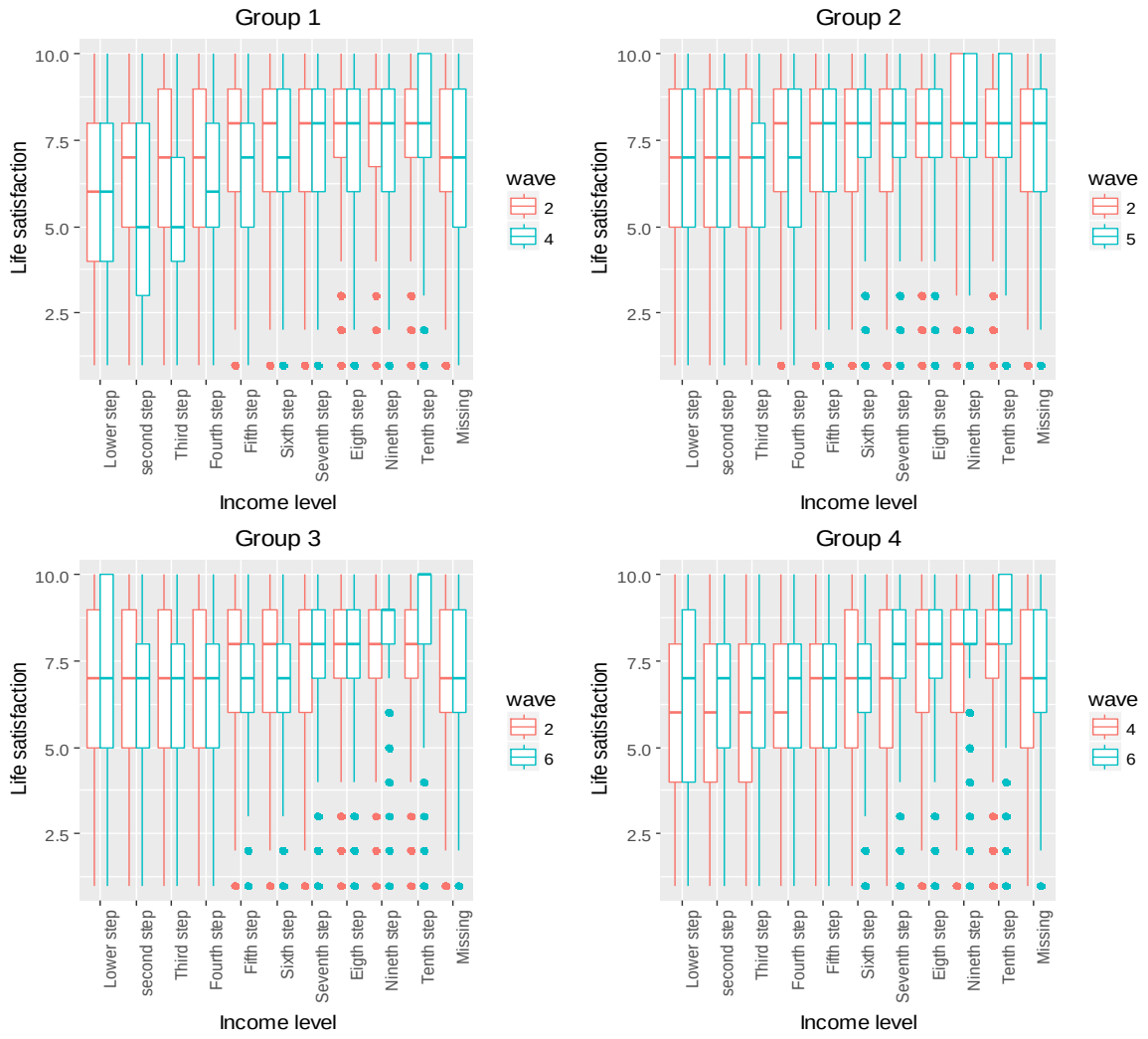
- Wave 2: http://www.worldvaluessurvey.org/WVSDocumentationWV2.jsp
- Wave 4: http://www.worldvaluessurvey.org/WVSDocumentationWV4.jsp
- Wave 5: http://www.worldvaluessurvey.org/WVSDocumentationWV5.jsp
- Wave 6: http://www.worldvaluessurvey.org/WVSDocumentationWV6.jsp

Adjusted Net Savings and macro controls

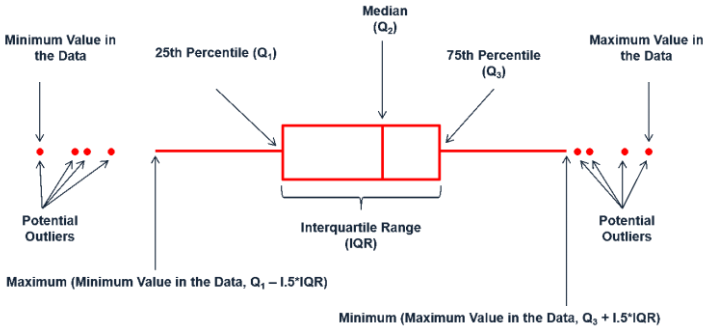
Adjusted net savings (ANS) and macro controls data is downloaded from the following links:

- http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators
- GNI-PPP data for China downloaded from http://hdr.undp.org/en/data

Appendix Figure 1: Distribution of SWB by income level in each group

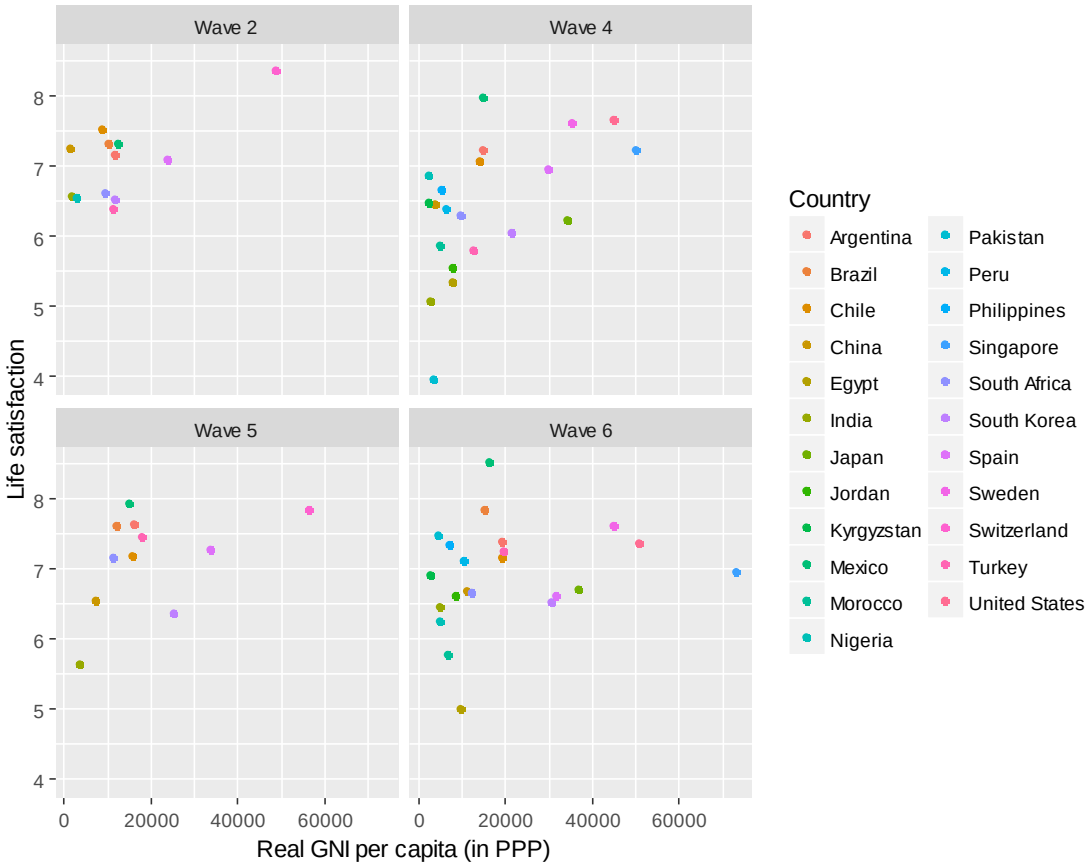


NOTE: This box plot represents the relationship between life-satisfaction and income levels by data groups and by wave within each group. A boxplot summarises minimum, 1st quartile, median, 3rd quartile and maximum values of life-satisfaction for each income step. Some outliers on the lower end of life-satisfaction in certain income steps are represented by dots. The following diagram illustrates how to read a boxplot.



Source: https://www.leansigmacorporation.com/wp/wp-content/uploads/2015/12/Box-Plot-MTB_01.png

Appendix Figure 2: Distribution of SWB by real (ppp-adjusted) GNI per capita



Appendix Table C: Adjusted Net Savings and macro controls dataset

Country Name	Year	wave	ANS_exc_pm (% of GNI)	ANS_inc_pm (% of GNI)	Unemployment (% of total labor force)	CPI (annual %)	GNI-PPP (constant 2011 international $)
Argentina	1991	w2	7.3	7.0	5.8	171.7	11,676
Argentina	1999	w4	6.1	5.9	14.1	-1.2	14,815
Argentina	2006	w5	10.2	10.1	9.4	10.9	16,077
Argentina	2013	w6	7.9	7.7	7.1	10.6	19,077
Brazil	1991	w2	14.1	13.4	10.2	432.8	10,103
Brazil	2006	w5	10.7	10.5	11.5	4.2	12,140
Brazil	2014	w6	10.5	10.3	6.8	6.3	15,077
Chile	1990	w2	5.6	5.3	5.3	26.0	8,579
Chile	2000	w4	5.9	5.7	9.2	3.8	13,905
Chile	2006	w5	2.4	2.3	7.7	3.4	15,650
Chile	2011	w6	4.2	4.1	7.1	3.3	19,187
China	1990	w2	19.2	17.9	4.9	3.1	1,487
China	2001	w4	20.2	19.5	4.5	0.7	3,883
China	2007	w5	28.5	28.0	3.8	4.8	7,258
China	2012	w6	23.2	22.7	4.5	2.6	10,981
Egypt	2001	w4	12.0	11.3	9.3	2.3	7,592
Egypt	2013	w6	4.5	3.9	13.2	9.4	9,778
India	1990	w2	13.8	10.7	4.0	9.0	1,732
India	2001	w4	15.7	13.8	3.8	3.7	2,548
India	2006	w5	23.5	22.2	4.3	6.1	3,393
India	2012	w6	21.8	20.5	3.6	9.3	4,771
Japan	2000	w4	12.4	12.2	4.7	-0.7	34,382
Japan	2010	w6	6.2	6.1	5.1	-0.7	36,685
Jordan	2001	w4	11.1	10.9	15.8	1.8	7,603
Jordan	2014	w6	14.0	13.9	11.9	2.9	8,525
Kyrgyzstan	2003	w4	-4.0	-5.0	9.9	3.0	2,166
Kyrgyzstan	2011	w6	3.3	2.6	8.5	16.5	2,610
Mexico	1990	w2	8.8	8.2	3.0	26.7	12,178
Mexico	2000	w4	11.6	11.4	2.6	9.5	14,696
Mexico	2005	w5	10.6	10.4	3.6	4.0	15,002
Mexico	2012	w6	11.0	10.8	4.9	4.1	16,293
Morocco	2001	w4	26.6	26.3	12.5	0.6	4,665
Morocco	2011	w6	22.0	21.7	8.9	0.9	6,576
Nigeria	1990	w2	-11.7	-13.7	5.9	7.4	2,753
Nigeria	2000	w4	5.3	3.3	6.7	6.9	2,388
Nigeria	2011	w6	8.0	6.6	7.3	10.8	4,970
Pakistan	2001	w4	12.0	9.3	7.8	3.1	3,442
Pakistan	2012	w6	12.1	10.4	6.0	9.7	4,589
Peru	2001	w4	7.1	6.7	7.9	2.0	6,425
Peru	2012	w6	11.0	10.8	3.6	3.7	10,257
Philippines	2001	w4	29.4	28.7	10.9	5.3	5,043
Philippines	2012	w6	26.9	26.4	7.0	3.2	7,205
Singapore	2002	w4	25.7	25.6	5.7	-0.4	50,007
Singapore	2012	w6	38.4	38.3	2.8	4.5	73,289
South Africa	1990	w2	2.2	0.5	23.9	14.3	9,552
South Africa	2001	w4	0.9	-0.2	26.2	5.7	9,615
South Africa	2006	w5	2.0	1.3	22.6	4.6	11,323
South Africa	2013	w6	0.4	-0.0	24.6	5.8	12,125
South Korea	1990	w2	23.9	23.6	2.4	8.6	11,615
South Korea	2001	w4	16.6	16.4	4.0	4.1	21,379
South Korea	2005	w5	18.7	18.6	3.7	2.8	25,315
South Korea	2010	w6	19.5	19.4	3.7	2.9	30,387
Spain	1990	w2	12.6	12.4	15.9	6.7	23,593
Spain	2000	w4	12.0	12.0	13.8	3.4	29,853

Country Name	Year	wave	ANS_exc_pm (% of GNI)	ANS_inc_pm (% of GNI)	Unemployment (% of total labor force)	CPI (annual %)	GNI-PPP (constant 2011 international $)
Spain	2007	w5	10.0	10.0	8.2	2.8	33,494
Spain	2011	w6	5.3	5.2	21.4	3.2	31,511
Sweden	1999	w4	17.9	17.9	7.6	0.5	35,171
Sweden	2011	w6	18.4	18.4	7.8	3.0	44,722
Switzerland	1989	w2	17.1	18.0	1.8	3.2	48,832
Switzerland	2007	w5	18.7	18.7	3.7	0.7	56,263
Turkey	1990	w2	16.8	15.7	8.2	60.3	11,212
Turkey	2001	w4	11.1	10.5	8.4	54.4	12,518
Turkey	2007	w5	10.7	10.4	8.9	8.8	17,730
Turkey	2011	w6	9.9	9.7	8.8	6.5	19,490
United States	1999	w4	9.4	9.3	4.2	2.2	44,910
United States	2011	w6	3.7	3.6	8.9	3.2	50,705

Appendix Table D: Summary stats WVS data

Count of individuals surveyed by country in each wave.

Data Group	Number of individuals surveyed		Data Group	Number of individuals surveyed	
Group 1	**Wave 2**	**Wave 4**	**Group 4**	**Wave 4**	**Wave 6**
Argentina	992	1,268	Argentina	1,268	1,020
Chile	1,496	1,193	Chile	1,193	988
China	996	991	China	991	2,252
India	2,461	1,980	Egypt	2,998	1,523
Mexico	1,514	1,506	India	1,980	4,054
Nigeria	997	2,022	Japan	1,316	2,381
South Africa	2,696	2,995	Jordan	1,216	1,200
South Korea	1,226	1,173	Kyrgyzstan	1,043	1,490
Spain	1,499	1,205	Mexico	1,506	2,000
Turkey	1,027	3,400	Morocco	1,251	1,173
Group 2	**Wave 2**	**Wave 5**	Nigeria	2,022	1,759
Argentina	992	995	Pakistan	1,693	1,200
Brazil	1,770	1,495	Peru	1,490	1,206
Chile	1,496	992	Philippines	1,200	1,200
China	996	1,937	Singapore	1,512	1,971
India	2,461	1,953	South Africa	2,995	3,521
Mexico	1,514	1,512	South Korea	1,173	1,189
South Africa	2,696	2,977	Spain	1,205	1,168
South Korea	1,226	1,197	Sweden	1,012	1,204
Spain	1,499	1,195	Turkey	3,400	1,601
Switzerland	1,400	1,232	United States	1,200	2,216
Turkey	1,027	1,346			
Group 3	**Wave 2**	**Wave 6**			
Argentina	992	1,020			
Brazil	1,770	1,483			
Chile	1,496	988			
China	996	2,252			
India	2,461	4,054			
Mexico	1,514	2,000			
Nigeria	997	1,759			
South Africa	2,696	3,521			
South Korea	1,226	1,189			
Spain	1,499	1,168			
Turkey	1,027	1,601			

Appendix Table E: Pseudo-panel data summary

Count of individuals surveyed by country and by group in each time-period (for pseudo-panel model)

Country	wave	15-29 female	15-29 male	30-44 female	30-44 male	45-59 female	45-59 male	60+ female	60+ male
Argentina	2	137	131	149	136	135	106	100	98
Argentina	4	195	197	196	156	142	133	142	107
Argentina	5	148	149	147	127	125	90	110	99
Argentina	6	136	146	156	134	123	102	126	97
Brazil	2	345	343	206	221	330	325		
Brazil	5	263	195	296	195	203	143	110	89
Brazil	6	245	147	290	147	242	148	148	116
Chile	2	276	262	250	231	143	135	116	83
Chile	4	163	165	225	193	135	119	104	89
Chile	5	141	122	180	134	124	103	100	88
Chile	6	105	125	150	129	146	136	100	97
China	2	122	179	118	183	119	175	39	59
China	4	108	85	229	210	133	158	33	35
China	5	172	126	396	289	324	313	160	157
China	6	241	215	364	371	312	311	227	211
Egypt	4	543	476	534	529	264	310	119	219
Egypt	6	298	124	365	147	233	129	137	90
India	2	400	533	488	464	150	170	101	155
India	4	242	298	323	440	174	239	111	145
India	5	183	253	338	438	202	274	111	151
India	6	404	553	682	851	450	530	234	319
Japan	4	138	107	205	168	185	161	175	177
Japan	6	147	146	312	299	339	295	431	412
Jordan	4	245	239	258	174	90	101	32	77
Jordan	6	140	208	255	175	152	116	53	101
Kyrgyzstan	4	218	174	200	174	89	74	70	43
Kyrgyzstan	6	254	238	246	222	207	197	52	74
Mexico	2	329	341	199	295	124	149	34	43
Mexico	4	275	277	280	237	137	147	69	79
Mexico	5	247	254	268	232	154	172	95	90
Mexico	6	395	388	331	304	182	193	93	114
Morocco	4	303	295	225	218	89	83	15	19
Morocco	6	240	242	188	178	99	110	59	57
Nigeria	2	230	306	128	216	23	58	19	17
Nigeria	4	532	564	364	354	81	91	13	23
Nigeria	6	522	470	239	288	83	91	27	39
Pakistan	4	287	284	420	314	93	194	17	84
Pakistan	6	229	227	264	241	68	123	17	31
Peru	4	303	298	250	235	176	151	32	45
Peru	6	198	211	199	183	128	110	76	101
Philippines	4	196	206	219	206	116	116	69	72
Philippines	6	133	149	226	171	148	176	93	104
Singapore	4	336	358	249	220	146	108	59	36
Singapore	6	284	290	315	251	255	206	210	127
South Africa	2	473	492	528	368	308	236	147	143
South Africa	4	512	557	503	502	329	249	152	190
South Africa	5	502	538	488	474	300	268	195	211
South Africa	6	621	695	648	597	348	333	144	135
South Korea	2	183	212	245	235	171	92	50	37
South Korea	4	176	133	221	223	162	188	22	48

Country	wave	15-29 female	15-29 male	30-44 female	30-44 male	45-59 female	45-59 male	60+ female	60+ male
South Korea	5	131	147	230	222	143	132	97	95
South Korea	6	119	127	197	200	158	168	127	93
Spain	2	196	216	233	189	176	104	217	168
Spain	4	131	145	166	169	129	123	193	149
Spain	5	136	138	159	180	124	125	180	153
Spain	6	117	114	179	185	128	120	174	151
Sweden	4	104	120	140	141	155	135	110	107
Sweden	6	167	137	118	123	151	121	199	188
Switzerland	2	133	122	252	221	158	125	215	173
Switzerland	5	57	44	192	132	197	163	231	216
Turkey	2	206	191	171	176	100	97	38	42
Turkey	4	609	637	659	608	307	292	121	163
Turkey	5	274	268	233	224	128	114	35	70
Turkey	6	240	269	322	274	173	163	89	71
United States	4	148	158	247	153	183	112	114	85
United States	6	198	192	246	244	347	324	352	313

Appendix Table F. Panel model results

Results from estimating model (1) which does not deal with the endogeneity issues, are shown in this section of the appendix. Note that the coefficient on ANS changes sign in some cases, relative to Tables 6 – 9 which do account for endogeneity, demonstrating that prior studies which use current ANS and SWB are likely to have produced biased estimates. See the Notes for Table 5.

Table F1 Group 1 (Wave 2 and 4)

	Dependent variable: SWB	
	Panel model	
	ANS INC PM	ANS EXC PM
	(1)	(2)
cr_Chile	0.01 (0.14)	0.02 (0.14)
cr_China	-3.12*** (0.27)	-3.12*** (0.27)
cr_India	-4.38*** (0.28)	-4.39*** (0.28)
cr_Mexico	0.95*** (0.22)	0.93*** (0.22)
cr_Nigeria	-3.39*** (0.26)	-3.37*** (0.26)
cr_South Africa	-2.03*** (0.24)	-2.02*** (0.24)
cr_South Korea	-0.33 (0.23)	-0.36 (0.23)
cr_Spain	0.94*** (0.14)	0.91*** (0.14)
cr_Turkey	-1.35*** (0.09)	-1.37*** (0.09)
wave4	-0.27*** (0.05)	-0.26*** (0.04)
age	-0.06*** (0.01)	-0.06*** (0.01)
age_squared	0.001*** (0.0001)	0.001*** (0.0001)
age_na	-1.28*** (0.43)	-1.28*** (0.43)
sex_Female	0.08*** (0.03)	0.08*** (0.03)
sex_Missing	-0.25* (0.15)	-0.25 (0.15)
ms_Divorced	-0.66*** (0.08)	-0.66*** (0.08)
ms_Single	-0.55*** (0.07)	-0.55*** (0.07)
ms_Widowed	-0.35*** (0.04)	-0.35*** (0.04)
ms_Missing	-0.14 (0.39)	-0.14 (0.39)
es_Unemployed	-0.08 (0.07)	-0.08 (0.07)
es_Housewife	0.21*** (0.04)	0.21*** (0.04)
es_Student	-0.10* (0.05)	-0.10** (0.05)
es_Retired	-0.68*** (0.05)	-0.68*** (0.05)
es_Other	-0.01 (0.12)	-0.02 (0.12)
es_Missing	-0.52*** (0.10)	-0.52*** (0.10)
in_second step	0.12* (0.06)	0.12* (0.06)
in_Third step	0.37*** (0.06)	0.37*** (0.06)
in_Fourth step	0.69*** (0.06)	0.69*** (0.06)
in_Fifth step	0.92*** (0.06)	0.92*** (0.06)
in_Sixth step	1.09*** (0.07)	1.08*** (0.07)
in_Seventh step	1.22*** (0.07)	1.22*** (0.07)
in_Eigth step	1.42*** (0.07)	1.41*** (0.07)
in_Nineth step	1.38*** (0.09)	1.38*** (0.09)
in_Tenth step	1.38*** (0.10)	1.38*** (0.10)

in_Missing	0.87*** (0.07)	0.87*** (0.07)
ed_Primary	0.20*** (0.07)	0.20*** (0.07)
ed_Secondary	0.41*** (0.07)	0.41*** (0.07)
ed_University	0.58*** (0.07)	0.58*** (0.07)
ed_Missing	-0.28*** (0.09)	-0.27*** (0.09)
ANS_inc_pm	0.01** (0.01)	
ANS_exc_pm		0.02*** (0.01)
Unemp	0.05** (0.02)	0.05** (0.02)
Inflation_rate	0.002* (0.001)	0.002* (0.001)
log(GNI_PPP)	-1.79*** (0.12)	-1.77*** (0.12)
Constant	24.24*** (1.14)	24.02*** (1.15)
Observations	32,637	32,637
R^2	0.13	0.13
Adjusted R^2	0.13	0.13
Residual Std. Error	2.31	2.31
F Statistic	110.57***	110.62***

Table F2 Group 2 (Wave 2 and 5)

	Dependent variable: SWB	
	Panel model	
	ANS INC PM	ANS EXC PM
	(1)	(2)
cr_Brazil	0.17* (0.09)	0.20** (0.09)
cr_Chile	-0.33*** (0.07)	-0.35*** (0.07)
cr_China	-0.70*** (0.19)	-0.42** (0.20)
cr_India	-2.05*** (0.19)	-1.78*** (0.20)
cr_Mexico	0.35*** (0.08)	0.40*** (0.08)
cr_South Africa	-0.82*** (0.17)	-0.92*** (0.17)
cr_South Korea	-0.62*** (0.11)	-0.49*** (0.11)
cr_Spain	0.43*** (0.09)	0.41*** (0.09)
cr_Switzerland	1.52*** (0.12)	1.57*** (0.13)
cr_Turkey	-0.20** (0.08)	-0.13 (0.08)
wave5	0.34*** (0.05)	0.32*** (0.05)
age	-0.03*** (0.01)	-0.03*** (0.01)
age_squared	0.0004*** (0.0001)	0.0004*** (0.0001)
age_na	-0.93 (0.79)	-0.91 (0.79)
sex_Female	0.03 (0.03)	0.04 (0.03)
sex_Missing	-1.08** (0.53)	-1.10** (0.52)
ms_Divorced	-0.61*** (0.06)	-0.61*** (0.06)
ms_Single	-0.41*** (0.06)	-0.41*** (0.06)
ms_Widowed	-0.31*** (0.04)	-0.32*** (0.04)
ms_Missing	-0.18 (0.29)	-0.17 (0.29)
es_Unemployed	-0.05 (0.06)	-0.05 (0.06)
es_Housewife	0.12*** (0.04)	0.12*** (0.04)
es_Student	-0.06 (0.05)	-0.05 (0.05)
es_Retired	-0.58*** (0.05)	-0.58*** (0.05)
es_Other	-0.34*** (0.10)	-0.34*** (0.10)

es_Missing	0.09 (0.08)	0.14* (0.08)
in_second step	0.07 (0.06)	0.07 (0.06)
in_Third step	0.19*** (0.05)	0.20*** (0.05)
in_Fourth step	0.45*** (0.05)	0.45*** (0.05)
in_Fifth step	0.59*** (0.05)	0.59*** (0.05)
in_Sixth step	0.74*** (0.06)	0.74*** (0.06)
in_Seventh step	0.98*** (0.06)	0.99*** (0.06)
in_Eigth step	1.09*** (0.07)	1.10*** (0.07)
in_Nineth step	1.04*** (0.09)	1.04*** (0.09)
in_Tenth step	0.96*** (0.09)	0.96*** (0.09)
in_Missing	0.58*** (0.06)	0.58*** (0.06)
ed_Primary	0.33*** (0.07)	0.32*** (0.07)
ed_Secondary	0.60*** (0.07)	0.59*** (0.07)
ed_University	0.67*** (0.07)	0.66*** (0.07)
ed_Missing	0.32*** (0.08)	0.30*** (0.08)
ANS_inc_pm	-0.03*** (0.01)	
ANS_exc_pm		-0.05*** (0.01)
Unemp	-0.01 (0.01)	-0.01 (0.01)
Inflation_rate	0.0002 (0.0002)	0.0003 (0.0002)
log(GNI_PPP)	-0.64*** (0.08)	-0.60*** (0.08)
Constant	13.62*** (0.73)	13.31*** (0.72)
Observations	33,908	33,908
R^2	0.10	0.10
Adjusted R^2	0.10	0.10
Residual Std. Error	2.17	2.17
F Statistic	89.81***	90.28***

Table F3 Group 3 (Wave 2 and 6)

	Dependent variable: SWB	
	Panel model	
	ANS INC PM	ANS EXC PM
	(1)	(2)
cr_Brazil	-0.02 (0.09)	-0.02 (0.09)
cr_Chile	-0.21*** (0.08)	-0.21*** (0.08)
cr_China	-2.14*** (0.16)	-2.15*** (0.16)
cr_India	-3.66*** (0.22)	-3.67*** (0.22)
cr_Mexico	0.11 (0.09)	0.11 (0.09)
cr_Nigeria	-2.97*** (0.14)	-2.98*** (0.14)
cr_South Africa	3.25*** (0.44)	3.25*** (0.43)
cr_South Korea	-1.66*** (0.12)	-1.67*** (0.12)
cr_Spain	3.66*** (0.38)	3.66*** (0.38)
cr_Turkey	-0.36*** (0.11)	-0.36*** (0.10)
wave6	0.75*** (0.07)	0.76*** (0.07)
age	-0.02*** (0.005)	-0.02*** (0.005)
age_squared	0.0003*** (0.0001)	0.0003*** (0.0001)
age_na	0.83** (0.39)	0.83** (0.39)
sex_Female	0.02 (0.03)	0.02 (0.03)

sex_Missing	-0.34 (0.53)	-0.34 (0.53)
ms_Divorced	-0.46*** (0.06)	-0.46*** (0.06)
ms_Single	-0.37*** (0.06)	-0.37*** (0.06)
ms_Widowed	-0.28*** (0.03)	-0.28*** (0.03)
ms_Missing	-0.29 (0.36)	-0.29 (0.36)
es_Unemployed	-0.07 (0.06)	-0.07 (0.06)
es_Housewife	0.08** (0.04)	0.08** (0.04)
es_Student	0.07 (0.05)	0.07 (0.05)
es_Retired	-0.48*** (0.04)	-0.48*** (0.04)
es_Other	-0.07 (0.08)	-0.07 (0.08)
es_Missing	-0.32*** (0.08)	-0.32*** (0.07)
in_second step	0.08 (0.06)	0.08 (0.06)
in_Third step	0.21*** (0.05)	0.21*** (0.05)
in_Fourth step	0.42*** (0.05)	0.42*** (0.05)
in_Fifth step	0.63*** (0.05)	0.63*** (0.05)
in_Sixth step	0.84*** (0.05)	0.84*** (0.05)
in_Seventh step	1.13*** (0.06)	1.13*** (0.06)
in_Eigth step	1.45*** (0.06)	1.45*** (0.06)
in_Nineth step	1.60*** (0.09)	1.60*** (0.09)
in_Tenth step	1.74*** (0.11)	1.74*** (0.11)
in_Missing	0.63*** (0.07)	0.63*** (0.07)
ed_Primary	0.24*** (0.06)	0.24*** (0.06)
ed_Secondary	0.42*** (0.06)	0.42*** (0.06)
ed_University	0.54*** (0.06)	0.54*** (0.06)
ed_Missing	-0.40*** (0.10)	-0.40*** (0.10)
ANS_inc_pm	0.003 (0.004)	
ANS_exc_pm		0.003 (0.004)
Unemp	-0.26*** (0.03)	-0.26*** (0.03)
Inflation_rate	0.002*** (0.0004)	0.002*** (0.0004)
log(GNI_PPP)	-1.14*** (0.08)	-1.14*** (0.08)
Constant	19.56*** (0.85)	19.57*** (0.85)
Observations	37,709	37,709
R^2	0.10	0.10
Adjusted R^2	0.10	0.10
Residual Std. Error	2.16	2.16
F Statistic	99.84***	99.84***

Table F4 Group 4 (Wave 4 and 6)

	Dependent variable: SWB	
	Panel model	
	ANS INC PM	ANS EXC PM
	(1)	(2)
cr_Chile	-0.40*** (0.08)	-0.42*** (0.08)
cr_China	-0.94*** (0.13)	-0.82*** (0.13)
cr_Egypt	-2.14*** (0.10)	-2.09*** (0.10)
cr_India	-1.44*** (0.18)	-1.30*** (0.18)
cr_Japan	-1.17*** (0.10)	-1.22*** (0.10)

cr_Jordan	-0.97*** (0.11)	-0.88*** (0.11)
cr_Kyrgyzstan	-0.84*** (0.18)	-0.79*** (0.18)
cr_Mexico	0.64*** (0.09)	0.63*** (0.09)
cr_Morocco	-0.97*** (0.17)	-0.80*** (0.17)
cr_Nigeria	-1.07*** (0.16)	-0.99*** (0.16)
cr_Pakistan	-1.61*** (0.15)	-1.49*** (0.16)
cr_Peru	-0.75*** (0.11)	-0.73*** (0.11)
cr_Philippines	-0.12 (0.17)	0.07 (0.17)
cr_Singapore	-0.54*** (0.13)	-0.46*** (0.13)
cr_South Africa	-0.04 (0.10)	0.01 (0.11)
cr_South Korea	-1.38*** (0.09)	-1.36*** (0.09)
cr_Spain	-0.09 (0.09)	-0.08 (0.09)
cr_Sweden	-0.04 (0.09)	-0.03 (0.09)
cr_Turkey	-0.65*** (0.08)	-0.64*** (0.08)
cr_United States	-0.40*** (0.12)	-0.48*** (0.11)
wave6	0.35*** (0.03)	0.33*** (0.03)
age	-0.05*** (0.004)	-0.05*** (0.004)
age_squared	0.001*** (0.0000)	0.001*** (0.0000)
age_na	-0.65*** (0.23)	-0.63*** (0.23)
sex_Female	0.05** (0.02)	0.05** (0.02)
sex_Missing	-0.49 (1.01)	-0.49 (1.00)
ms_Divorced	-0.51*** (0.05)	-0.51*** (0.05)
ms_Single	-0.32*** (0.05)	-0.32*** (0.05)
ms_Widowed	-0.25*** (0.03)	-0.25*** (0.03)
ms_Missing	-0.35** (0.17)	-0.34** (0.17)
es_Unemployed	-0.01 (0.04)	-0.01 (0.04)
es_Housewife	0.14*** (0.03)	0.14*** (0.03)
es_Student	0.01 (0.03)	0.01 (0.03)
es_Retired	-0.40*** (0.03)	-0.40*** (0.03)
es_Other	-0.04 (0.06)	-0.04 (0.06)
es_Missing	-0.32*** (0.07)	-0.33*** (0.07)
in_second step	0.12** (0.05)	0.11** (0.05)
in_Third step	0.19*** (0.05)	0.19*** (0.05)
in_Fourth step	0.53*** (0.04)	0.53*** (0.04)
in_Fifth step	0.70*** (0.04)	0.70*** (0.04)
in_Sixth step	0.95*** (0.04)	0.95*** (0.04)
in_Seventh step	1.19*** (0.05)	1.20*** (0.05)
in_Eigth step	1.44*** (0.05)	1.44*** (0.05)
in_Nineth step	1.48*** (0.06)	1.49*** (0.06)
in_Tenth step	1.75*** (0.07)	1.75*** (0.07)
in_Missing	0.82*** (0.05)	0.82*** (0.05)
ed_Primary	0.20*** (0.04)	0.20*** (0.04)
ed_Secondary	0.29*** (0.04)	0.29*** (0.04)
ed_University	0.33*** (0.04)	0.34*** (0.04)
ed_Missing	0.42*** (0.11)	0.42*** (0.11)
ANS_inc_pm	-0.02*** (0.005)	
ANS_exc_pm		-0.02*** (0.005)
Unemp	-0.06*** (0.01)	-0.07*** (0.01)
Inflation_rate	-0.01*** (0.001)	-0.01*** (0.001)
log(GNI_PPP)	0.05 (0.09)	0.10 (0.09)
Constant	7.74*** (0.83)	7.38*** (0.83)

Observations	69,980	69,980
R^2	0.14	0.14
Adjusted R^2	0.14	0.14
Residual Std. Error	2.23	2.23
F Statistic	216.85***	217.11***

Appendix Table G: Ordered logit model results

Table G1 Group 1 (Wave 2 and 4)

	Dependent variable:	
	life_satisfaction	
	ANS INC PM	ANS EXC PM
	(1)	(2)
age	-0.06*** (0.01)	-0.06*** (0.01)
age_squared	0.001*** (0.0001)	0.001*** (0.0001)
age_na	-1.49*** (0.41)	-1.48*** (0.41)
sex_Female	0.09*** (0.03)	0.09*** (0.03)
ms_Divorced	-0.45*** (0.08)	-0.45*** (0.08)
ms_Single	-0.42*** (0.07)	-0.42*** (0.07)
ms_Widowed	-0.22*** (0.04)	-0.22*** (0.04)
ms_Missing	-0.18 (0.43)	-0.18 (0.43)
es_Unemployed	0.01 (0.07)	0.01 (0.07)
es_Housewife	0.18*** (0.04)	0.18*** (0.04)
es_Student	-0.20*** (0.05)	-0.19*** (0.05)
es_Retired	-0.50*** (0.05)	-0.49*** (0.05)
es_Other	-0.27** (0.11)	-0.27** (0.11)
es_Missing	-0.02 (0.13)	-0.02 (0.13)
in_second step	0.03 (0.06)	0.03 (0.06)
in_Third step	0.17*** (0.06)	0.17*** (0.06)
in_Fourth step	0.50*** (0.06)	0.51*** (0.06)
in_Fifth step	0.71*** (0.07)	0.71*** (0.07)
in_Sixth step	0.92*** (0.07)	0.91*** (0.07)
in_Seventh step	1.05*** (0.07)	1.05*** (0.07)
in_Eigth step	1.27*** (0.08)	1.27*** (0.08)
in_Nineth step	1.29*** (0.09)	1.29*** (0.09)
in_Tenth step	1.37*** (0.10)	1.37*** (0.10)
in_Missing	0.90*** (0.07)	0.90*** (0.07)
ed_Primary	0.29*** (0.05)	0.29*** (0.05)
ed_Secondary	0.25*** (0.06)	0.25*** (0.06)
ed_University	0.22*** (0.06)	0.22*** (0.06)
ed_Missing	0.37*** (0.12)	0.37*** (0.12)
swb_t0	0.31*** (0.03)	0.29*** (0.03)
ANS_inc_pm	-0.03*** (0.002)	
ANS_exc_pm		-0.03*** (0.002)
Unemp	-0.04*** (0.002)	-0.04*** (0.002)
Inflation_rate	0.0001 (0.0004)	0.0000 (0.0004)
log(GNI_PPP)	0.45*** (0.02)	0.42*** (0.02)
Observations	17,733	17,733
Log Likelihood	-37,156.00	-37,150.73
Note:		*p**p***p<0.01

Table G2 Group 2 (Wave 2 and 5)

	Dependent variable:	
	life_satisfaction	
	ANS INC PM	ANS EXC PM
	(1)	(2)
age	-0.04*** (0.01)	-0.04*** (0.01)
age_squared	0.0004*** (0.0001)	0.0004*** (0.0001)
age_na	-2.35** (1.02)	-2.32** (1.03)
sex_Female	0.10*** (0.03)	0.10*** (0.03)
sex_Missing	-0.30 (1.27)	-0.27 (1.27)
ms_Divorced	-0.36*** (0.06)	-0.37*** (0.06)
ms_Single	-0.35*** (0.07)	-0.35*** (0.07)
ms_Widowed	-0.20*** (0.04)	-0.20*** (0.04)
ms_Missing	0.07 (0.28)	0.08 (0.28)
es_Unemployed	0.07 (0.06)	0.07 (0.06)
es_Housewife	0.08* (0.05)	0.07 (0.05)
es_Student	-0.33*** (0.05)	-0.32*** (0.05)
es_Retired	-0.41*** (0.05)	-0.40*** (0.05)
es_Other	-0.54*** (0.09)	-0.52*** (0.09)
es_Missing	-0.40*** (0.09)	-0.38*** (0.09)
in_second step	0.12* (0.06)	0.13** (0.06)
in_Third step	0.20*** (0.06)	0.21*** (0.06)
in_Fourth step	0.34*** (0.06)	0.35*** (0.06)
in_Fifth step	0.57*** (0.06)	0.58*** (0.06)
in_Sixth step	0.75*** (0.06)	0.76*** (0.06)
in_Seventh step	0.98*** (0.07)	0.99*** (0.07)
in_Eigth step	1.04*** (0.08)	1.04*** (0.08)
in_Nineth step	1.13*** (0.12)	1.12*** (0.12)
in_Tenth step	1.10*** (0.11)	1.06*** (0.11)
in_Missing	0.53*** (0.06)	0.49*** (0.06)
ed_Primary	0.31*** (0.06)	0.30*** (0.06)
ed_Secondary	0.38*** (0.06)	0.37*** (0.06)
ed_University	0.22*** (0.07)	0.22*** (0.07)
ed_Missing	-0.05 (0.22)	-0.05 (0.22)
swb_t0	-0.30*** (0.04)	-0.36*** (0.04)
ANS_inc_pm	-0.04*** (0.003)	
ANS_exc_pm		-0.05*** (0.003)
Unemp	-0.03*** (0.003)	-0.03*** (0.003)
Inflation_rate	0.001*** (0.0001)	0.001*** (0.0001)
log(GNI_PPP)	0.34*** (0.02)	0.31*** (0.02)
Observations	16,831	16,831
Log Likelihood	-33,564.99	-33,541.91
Note:		*p**p***p<0.01

Table G3 Group 3 (Wave 2 and 6)

	Dependent variable:	
	life_satisfaction	
	ANS INC PM	ANS EXC PM
	(1)	(2)
age	-0.02*** (0.01)	-0.02*** (0.01)
age_squared	0.0002*** (0.0001)	0.0002*** (0.0001)
age_na	0.62* (0.37)	0.62* (0.37)
sex_Female	0.01 (0.03)	0.01 (0.03)
sex_Missing	-0.42 (0.94)	-0.42 (0.94)
ms_Divorced	-0.24*** (0.07)	-0.24*** (0.07)
ms_Single	-0.25*** (0.07)	-0.25*** (0.07)
ms_Widowed	-0.17*** (0.04)	-0.17*** (0.04)
ms_Missing	-1.04*** (0.39)	-1.04*** (0.39)
es_Unemployed	-0.03 (0.06)	-0.03 (0.06)
es_Housewife	0.03 (0.04)	0.03 (0.04)
es_Student	-0.05 (0.06)	-0.05 (0.06)
es_Retired	-0.27*** (0.04)	-0.27*** (0.04)
es_Other	-0.22*** (0.07)	-0.22*** (0.07)
es_Missing	-0.35*** (0.06)	-0.35*** (0.06)
in_second step	-0.17*** (0.07)	-0.17*** (0.07)
in_Third step	-0.34*** (0.06)	-0.34*** (0.06)
in_Fourth step	-0.22*** (0.06)	-0.22*** (0.06)
in_Fifth step	-0.03 (0.06)	-0.03 (0.06)
in_Sixth step	0.16*** (0.06)	0.16*** (0.06)
in_Seventh step	0.44*** (0.06)	0.44*** (0.06)
in_Eigth step	0.88*** (0.07)	0.88*** (0.07)
in_Nineth step	1.24*** (0.10)	1.24*** (0.10)
in_Tenth step	2.17*** (0.13)	2.17*** (0.13)
in_Missing	0.27*** (0.08)	0.27*** (0.08)
ed_Primary	0.33*** (0.06)	0.33*** (0.06)
ed_Secondary	0.40*** (0.05)	0.40*** (0.05)
ed_University	0.34*** (0.06)	0.34*** (0.06)
ed_Missing	0.69*** (0.26)	0.69*** (0.26)
swb_t0	0.14*** (0.04)	0.14*** (0.04)
ANS_inc_pm	0.001 (0.002)	
ANS_exc_pm		0.001 (0.002)
Unemp	-0.04*** (0.002)	-0.04*** (0.002)
Inflation_rate	0.002*** (0.0001)	0.002*** (0.0001)
log(GNI_PPP)	0.37*** (0.02)	0.37*** (0.02)
Observations	21,035	21,035
Log Likelihood	-42,653.07	-42,653.19
Note:		*p**p***p<0.01

Table G4 Group 4 (Wave 4 and 6)

	Dependent variable:	
	life_satisfaction	
	ANS INC PM	ANS EXC PM

	(1)	(2)
age	-0.03*** (0.004)	-0.03*** (0.004)
age_squared	0.0003*** (0.0000)	0.0003*** (0.0000)
age_na	-0.27 (0.25)	-0.27 (0.25)
sex_Female	-0.02 (0.02)	-0.02 (0.02)
sex_Missing	-0.24 (0.96)	-0.24 (0.96)
ms_Divorced	-0.32*** (0.05)	-0.32*** (0.05)
ms_Single	-0.26*** (0.05)	-0.26*** (0.05)
ms_Widowed	-0.21*** (0.03)	-0.21*** (0.03)
ms_Missing	-0.25 (0.21)	-0.25 (0.21)
es_Unemployed	-0.04 (0.04)	-0.04 (0.04)
es_Housewife	0.13*** (0.03)	0.13*** (0.03)
es_Student	0.03 (0.04)	0.03 (0.04)
es_Retired	-0.17*** (0.04)	-0.17*** (0.04)
es_Other	-0.04 (0.06)	-0.04 (0.06)
es_Missing	0.26*** (0.05)	0.26*** (0.05)
in_second step	-0.09* (0.05)	-0.09* (0.05)
in_Third step	-0.17*** (0.05)	-0.17*** (0.05)
in_Fourth step	0.04 (0.04)	0.04 (0.04)
in_Fifth step	0.23*** (0.04)	0.23*** (0.04)
in_Sixth step	0.39*** (0.04)	0.39*** (0.04)
in_Seventh step	0.66*** (0.05)	0.66*** (0.05)
in_Eigth step	1.01*** (0.05)	1.01*** (0.05)
in_Nineth step	1.38*** (0.08)	1.38*** (0.08)
in_Tenth step	2.13*** (0.09)	2.13*** (0.09)
in_Missing	0.46*** (0.06)	0.46*** (0.06)
ed_Primary	0.35*** (0.04)	0.35*** (0.04)
ed_Secondary	0.42*** (0.04)	0.42*** (0.04)
ed_University	0.45*** (0.04)	0.45*** (0.04)
ed_Missing	0.49*** (0.16)	0.50*** (0.16)
swb_t0	0.37*** (0.01)	0.37*** (0.01)
ANS_inc_pm	-0.01*** (0.001)	
ANS_exc_pm		-0.01*** (0.001)
Unemp	-0.01*** (0.002)	-0.01*** (0.002)
Inflation_rate	0.01*** (0.001)	0.01*** (0.001)
log(GNI_PPP)	-0.04*** (0.01)	-0.04*** (0.01)
Observations	36,316	36,316
Log Likelihood	-74,125.48	-74,126.72

Note: *p**p***p<0.01

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