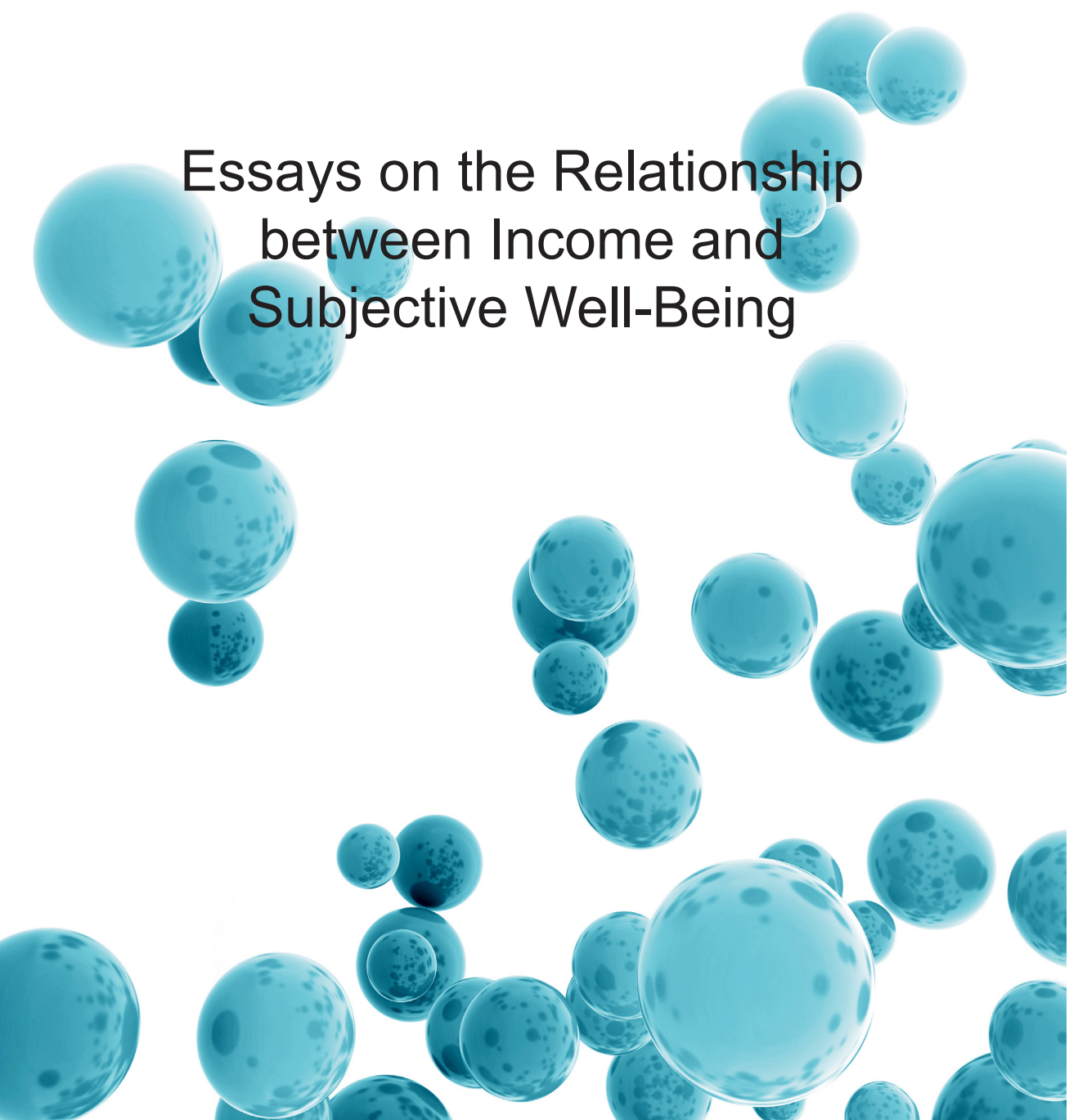


MATTI HOVI

Essays on the Relationship between Income and Subjective Well-Being





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Subjective Well-Being



ACADEMIC DISSERTATION

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MATTI HOVI

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Tampere, September 2018

Matti Hovi

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Chapter 2, “Mind the gap? Business cycles and subjective well-being”, co-authored by Jani-Petri Laamanen has been published in *Applied Economic Letters*; it is reprinted here with the permission of Taylor & Francis.

Abstract

Knowledge about factors associated with well-being are important for individuals and for policymakers. For this reason, researchers in many fields have studied the determinants of subjective well-being using survey data. One of the most studied questions during the last forty years has been the existence of a time series relationship between subjective well-being and income, or, at the macro-level, subjective well-being and GDP. This relationship has been studied using different data sets and econometric specifications. The conclusions from different model specifications can be conflicting and thus lead to different policy implications.

This thesis consists of an introductory chapter and four empirical essays on subjective well-being. The introductory chapter discusses empirical models that are used in the literature to examine the relationship between income and subjective well-being. The main focus in the introductory chapter is to study the theoretical implications behind these empirical models. Most of the models discussed in the introductory chapter are utilised in the empirical essays.

The first essay examines the relationship between output fluctuations and subjective well-being over time. It is shown that fluctuations around the trend component of output have more explanatory power than the level of output. Furthermore, this essay also contributes to the discussion about the Easterlin paradox by showing that the trend component of output is not associated with the level of subjective well-being over time.

The second and third essays examine hedonic adaptation and loss aversion in the relationship between income and subjective well-being. The second essay utilises the longest continuous panel data available at the macro-level (Eurobarometer) to examine how positive and negative changes in output are differently associated with subjective well-being. Furthermore, the second essay presents a model where the long- and short-run relationships between output and subjective well-being are allowed to vary between positive and negative output changes. The third essay uses longitudinal data on individuals to incorporate these asymmetries into an individual level model of subjective well-being.

The fourth essay examines the long-run relationship between macroeconomic crisis experienced in early adulthood and subjective well-being later in life. This essay focuses on the long-run effects of experiences faced at the formative ages of 18–25. Findings imply that severe macro-economic downturns experienced at this age affect subjective well-being negatively in later

life. The negative association is strongest in the lower end of a country's income distribution.

Keywords:

subjective well-being, happiness, life satisfaction, income, output, adaptation, loss aversion

Tiivistelmä

Yksilöiden hyvinvointiin liittyvien tekijöiden tunteminen on tärkeää poliittisille päätöksentekijöille sekä yksilöille itselleen. Tästä johtuen monien eri tieteenalojen tutkijat ovat tarkastelleet subjektiiviseen hyvinvointiin vaikuttavia tekijöitä kyselyaineistojen avulla. Viimeisten neljän vuosikymmenen aikana yksi tutkituimmista kysymyksistä on ollut subjektiivisen hyvinvoinnin ja tulojen (makrotasolla BKT:n) välinen yhteys aikasarja-aineistoissa. Tätä kysymystä on tutkittu eri aineistoilla ja erilaisin ekonometrisin menetelmin. Eri menetelmin saadut tutkimustulokset voivat johtaa erilaisiin johtopäätöksiin ja siten erilaisiin politiikkasuosituksiin.

Tämä väitöskirja koostuu johdantoluvusta sekä neljästä empiirisestä esseestä, jotka käsittelevät subjektiivista hyvinvointia. Johdantoluvussa keskustellaan empiirisistä malleista, joita on kirjallisuudessa käytetty tulojen ja subjektiivisen hyvinvoinnin välisen yhteyden mallintamiseen. Johdantoluvussa keskitytään erityisesti empiiristen mallien taustalla vallitseviin teoreettisiin implikaatioihin. Suurinta osaa johdantoluvussa käsitellyistä empiirisistä malleista hyödynnetään väitöskirjan empiirisissä esseissä.

Väitöskirjan ensimmäinen essee tutkii kokonaistuotannon lyhyen aikavälin vaihteluiden ja subjektiivisen hyvinvoinnin välistä yhteyttä ajassa. Esseessä osoitetaan, että trendikomponentin ympärillä havaittavalla kokonaistuotannon vaihtelulla on parempi selitysaste kuin kokonaistuotannon tasolla. Tämä essee osallistuu myös tieteelliseen keskusteluun Easterlinin paradokista osoittamalla, että kokonaistuotannon trendikomponentti ei ole yhteydessä subjektiivisen hyvinvoinnin kanssa ajassa.

Toinen ja kolmas essee tarkastelevat hedonista adaptaatiota ja tappioiden kaihtamista tulojen ja subjektiivisen hyvinvoinnin välisessä yhteydessä. Toinen essee hyödyntää pisintä saatavilla olevaa makrotason paneeliaineistoa (Eurobarometri) tutkiakseen kuinka positiiviset ja negatiiviset muutokset kokonaistuotannossa ovat eri tavoin yhteydessä subjektiiviseen hyvinvointiin. Toinen essee esittelee myös mallin, joka sallii lyhyen ja pitkän aikavälin vaikutusten erot positiivisten ja negatiivisten kokonaistuotannon muutosten välillä. Kolmas essee hyödyntää yksilötason ja pitkittäisaineistoa ja tutkii näitä epäsymmetrioita yksilötason subjektiivisen hyvinvoinnin mallilla.

Neljäs essee tarkastelee pitkän aikavälin yhteyttä varhaisaikuisuudessa koettujen talouskriisien ja myöhemmin elämässä havaitun subjektiivisen hyvinvoinnin välillä. Esse keskittyy kokemuksiin, jotka on koettu ikävuosina 18–25. Esseen löydökset viittaavat siihen, että tässä iässä koetut

syvät makrotaloudelliset taantumet vaikuttavat myöhemmin elämässä koettuun subjektiiviseen hyvinvointiin negatiivisesti. Negatiivinen yhteys on voimakkain niillä yksilöillä, jotka kuuluvat maansa alhaisimpiin tulodeksiileihin.

Avainsanat:

subjektiivinen hyvinvointi, onnellisuus, elämäntyytyväisyys, tulot, kokonaistuotanto, adaptaatio, tappioiden kaihtaminen

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Chapter 1

Introduction

1.1 The relationship between subjective well-being and income over time

One of the most important tasks of economics is to explain human well-being. Knowledge about the factors associated with well-being can offer powerful tools for enhancing the quality of life of individuals and nations. Empirical studies that use survey data on subjective well-being (SWB) play a crucial role in providing information about these associations. Consequently, the number of empirical studies on SWB has skyrocketed in the last four decades (Dolan, Peasgood, and White, 2008; Diener, 2013; Clark, 2018). One of the most studied questions is the existence of a time series relationship between SWB and GDP, or, at the individual level, SWB and income. One of the reasons why this particular relationship is of interest to researchers is because the results can affect public policy. For example, Stevenson and Wolfers (2008) note that the non-existence of this relationship can have significant implications for economic policy.

Easterlin (1974) was the first to show that GDP growth does not necessarily translate into higher average SWB within a country over time. Because a positive relationship between income and SWB exists across countries and across individuals at a point in time, the finding of a null relationship between the variables over time has become to be known as the Easterlin paradox (Easterlin et al., 2010).¹ After decades of empirical studies, there is still no clear consensus on whether the time series relationship exists or not;

¹I use the word “income” to refer to both the explanatory variable used in macro-level studies (GDP per capita) and the variables used in micro-level studies (individual income or household income).

i.e., the paradox exists (see, for example, Sacks, Stevenson, and Wolfers, 2012; Easterlin, 2013; Veenhoven and Vergunst, 2014; Easterlin, 2016).

Compared to their peers in the past, today's well-being researchers share a common advantage: the available data series are much longer. This holds for both country averages attained from repeated cross-section surveys as well as longitudinal individual level data. Comprehensive panel data sets allow for a more accurate statistical testing and the use of more flexible modelling techniques. However, many of the studies on the relationship between SWB and income do not discuss the implications of the chosen model specification. As a result, researchers can end up with different conclusions about the relationship even when using the same data set.

As more data accumulate over the years and the implications of the used methods are discussed in detail, SWB researchers will be able to show which changes in circumstances are associated with permanent changes on the level of SWB and which are not. Such information should be valuable for decision makers designing public policy (Layard, 2005). In the case that some changes in circumstances are not associated with permanent changes in the level of SWB, the transitory effect might still be of importance for policymakers. The flow of period-to-period SWB can be used to compare the magnitudes of different SWB changes associated with different policies.

In this introduction, I discuss some of the empirical models used in studying the relationship between SWB and income. Specifically, I will focus on the theoretical implications of different model specifications. The empirical results from previous studies of SWB are not discussed in this introduction as they are discussed in detail in the four essays. The rest of this introductory chapter is organised as follows. In section 1.2, I introduce the SWB measures used in the essays and then start by discussing the implications of the simplest panel data model where the level of SWB is regressed on the level of income. In section 1.3, I move on to discuss models that allow for hedonic adaptation to income shocks but restrict the long-run relationship to zero. Section 1.4 presents the reader with a model specification that allows for hedonic adaptation and also a long-run relationship between the levels of SWB and income. In section 1.5, I focus on models where the relationship between income and SWB is allowed to be asymmetric for positive and negative changes. Section 1.6 discusses the possibilities of studying long-run relationships with cross-sectional data. Finally, section 1.7 provides a summary of the essays.

1.2 Simple empirical models of subjective well-being

1.2.1 Measures of subjective well-being

This thesis focuses on the two oft-used subjective well-being measures, happiness and life satisfaction. All the data used in the essays are based on individuals' survey responses to questions about either one or both of these measures. In the SWB literature, questions about life satisfaction are considered to measure the individual's thoughts about his or her life, whereas happiness questions are often considered to measure one aspect of the individual's emotional well-being (Kahneman and Deaton, 2010; Deaton, 2012). In this introduction, both of these well-being variables are treated as measures of experienced utility.² However, in all the essays where data on both measures is available, a separate analysis is conducted for happiness and life satisfaction. This is done because these measures are known to capture different aspects of the human experience (Deaton, 2012).

1.2.2 The level model

Let us start by discussing the simplest methods used in studying the time series relationship between income and SWB. These methods include examining the correlation coefficient between the two variables and examining the regression coefficient of one variable on another. When studying the time series relationship, the analysis is conducted for each country (individual) separately or by utilising the within-country (individual) variation only. Multiple studies have analysed the relationship between the level of SWB and the level of income with these methods (see, for example, Hagerty and Veenhoven, 2003; Di Tella, MacCulloch, and Oswald, 2003; Stevenson and Wolfers, 2008; Di Tella and MacCulloch, 2008; Di Tella, Haisken-DeNew, and MacCulloch, 2010).

Here I will focus on regression models that utilise within-country or within-

²Kahneman et al. (1997) argue that subjective evaluations or reports can be used to measure experienced utility. However, Kahneman and Krueger (2006) note that individuals' survey responses about life satisfaction and happiness are retrospective assessments. Kahneman and Krueger (2006) further argue that these answers relate to remembered utility and are subject to many errors that individuals make in their assessment. A moment to moment flow of real time experiences would be a more accurate measure for experienced utility (Kahneman and Krueger, 2006). However, if life satisfaction and happiness measure experienced utility with a random error term, their use in large samples is justified.

individual variation. For panel data, such a model can be written as

$$SWB_{i,t} = \lambda_i + \beta y_{i,t} + \epsilon_{i,t}, \quad (1)$$

where $SWB_{i,t}$ is the average subjective well-being in country i (or the reported subjective well-being of individual i) at time t , λ_i is a country-specific (or individual-specific) fixed effect, $y_{i,t}$ is the log of the level of income, and $\epsilon_{i,t}$ is the error term.³ When the log of income is used, it is assumed that the marginal utility of income is decreasing. This assumption is often made in empirical studies of SWB (see, for example, Luttmer, 2005; Stevenson and Wolfers, 2008; Di Tella, Haisken-DeNew, MacCulloch, 2010).

Assume that SWB data is generated by equation (1) with $\epsilon_{i,t}$ being an independently and identically distributed error term with zero mean. This implies that each change in the level of income is immediately associated with a level change in SWB and that, in the absence of further changes in income, the level SWB stays constant (apart from the random variation generated by $\epsilon_{i,t}$). This kind of relationship between the two variables is presented for a single time series in solid grey and black lines in figure 1. For simplicity, I assume in the figure that $\epsilon_{i,t} = 0$ for every time period.

The solid lines in figure 1 illustrate how the model in equation (1) assumes that each change in the level of income has a long-run association with the level of SWB. As a result, the level equation is often used when aiming to estimate the long-run relationship between the variables. However, even if the long-run relationship between the levels of the two variables does not exist, estimating equation (1) with data that has a short time series dimension can result in a statistically significant estimate for β . Indeed, an early study by Banerjee et al. (1986) shows that estimating the level equation may yield biased results on the long-run relationship, and the bias can increase when moving towards shorter time series. In our context, the bias can be particularly large if SWB is associated with short-run variation in income. Easterlin et al. (2010) note that this may lead to confusion and the short-run relationship between the variables may be interpreted as evidence of the long-run relationship. If there is a short-run component in the variation of income, its share of the overall variance of income can be large in short time series.

³Models of SWB often include a set of control variables. For example, it is customary to include time or wave fixed effects to control for the differences between surveys. When I discuss the relationship between the level of SWB and the level of income, I assume that all the relevant covariates are controlled for.

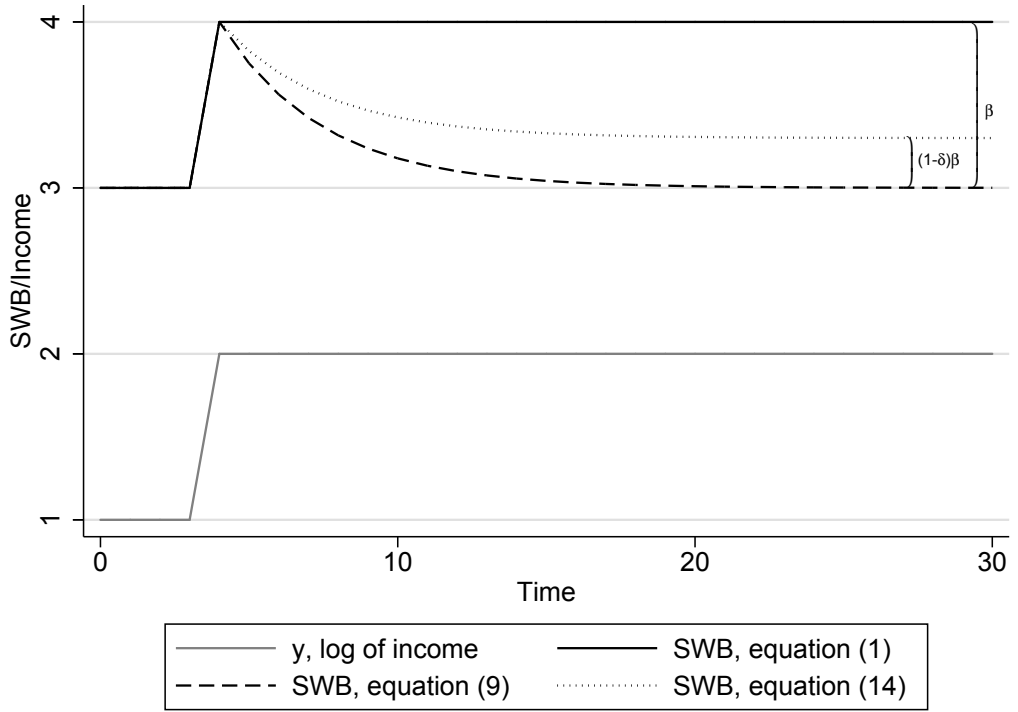


Figure 1: The dynamic relationship between SWB and income with generated data. The solid grey line describes the level of stimulus, measured by log of income. The solid, dashed, and dotted black lines depict the dynamic SWB effect of a unit change in the log of income. It is assumed that $\alpha = 0.25$. δ is assumed to equal 0, 1, and 0.7 for solid, dashed, and dotted black lines, respectively.

1.2.3 Controlling for a linear trend

Some studies have included a country-specific linear time trend in the SWB-income regression (see, for example, Di Tella, MacCulloch, and Oswald, 2003). Such models identify the relationship between SWB and income from the variation around a linear trend in income. Another source of confusion about the long-run relationship may arise when SWB growth is regressed on income growth (see, for example, Sacks, Stevenson, and Wolfers, 2012; Easterlin, 2016). The implications of the results from regressions using differenced variables depend on the inclusion of country-specific (or individual-specific) fixed effects. The reader should note that differencing equation (1) wipes out the fixed effect. Including a country-specific (or individual-specific) constant in a regression with differenced variables, on the other hand, controls for a linear trend in the level of income. If SWB is not trending, the left-hand side variation utilised in the estimation stays intact when these fixed effects are included. Thus, a difference model with fixed effects may examine the relationship between SWB changes and those income changes that exceed or fall below the average growth rate of income. Furthermore, if no constant terms are included in the differenced equation and income is upward sloping, the coefficient estimate β may nevertheless be determined based on the short-run relationship between the variables. This happens when the share of the variation around a linear trend is large compared to overall variation in income.⁴ As a result, the risk of misinterpretation is largest when the time series are short.

To conclude, the short-run relationship can be confused with the long-run relationship both when using the level model and when using the difference model. For this reason, the difference between the short-run relationship and the long-run relationship between the variables should be analysed systematically using trends of the income variable instead of general time trends. Furthermore, such analysis should be conducted using the longest time series available. This would help researchers to understand the time series relationship between SWB and the different components of income.

⁴If SWB is only associated with the variation around the trend in income, the large share of this short-run variation from the overall variation in the income series will bias the estimate of β toward the short-run relationship. This happens both when the income series has a deterministic trend and when the income series is a random walk with a drift.

1.3 Introducing dynamics into the model

Regressing the level of SWB on the level of income or the level of GDP and individual/country fixed effects provides an interesting first look at the relationship between these variables over time. However, some studies go further and model the dynamic SWB effect of an income change (see, for example, Di Tella, MacCulloch, 2008; Di Tella, Haisken-DeNew, MacCulloch, 2010; Wunder, 2012; Vendrik, 2013). In the empirical literature, such models examine the process of hedonic adaptation in SWB. Before assessing the implications of different empirical models of adaptation, let us discuss the theoretical assumptions associated with these models.

1.3.1 Adaptation level theory

Helson (1964) argued that, over time, adaptation could cause individuals not to sense the effects of the initial change in stimulus level, or adaptation could cause the quality of the stimulus to become neutral. Helson (1964) focused on sensory adaptation; that is, adaptation to changes in the level of brightness, for example. Kahneman and Tversky (1979) extend this argument to non-sensory attributes, such as wealth, for example. In this introduction, the level of stimulus is measured by the level of income. The quantitative model of adaptation introduced by Helson (1964) assumes an adaptation level that changes in response to changes in the stimulus level. Using this idea, SWB can be formulated so that it depends on the difference between the current stimulus level and the adaptation level (Frederick and Loewenstein, 1999).⁵

A common additional assumption in models of adaptation is that after a change in the level of stimulus SWB eventually returns to an individual specific set-point level (Lucas et al., 2004). If one assumes that SWB is linear in the gap between the log of current income and the log of the adaptation level of income, the SWB equation of individual i is

$$SWB_{i,t} = \lambda_i + \beta(y_{i,t} - AL_{i,t}), \quad (2)$$

where $y_{i,t}$ is the log of the level of income, $AL_{i,t}$ is the log of the adaptation level of income, and λ_i is used in determining the individual specific set-point level of SWB. The assumption about the functional form implies decreasing

⁵Frederick and Loewenstein (1999) write the model using the hedonic state of the individual (u) as the left-hand side variable, but in this introduction, I write all the models using SWB as the left-hand side variable.

marginal utility in absolute income. The concavity of utility in absolute income is a common assumption in empirical models that incorporate a shifting adaptation level (Wunder, 2012; Vendrik, 2013).

The standard adaptation level model assumes shifting adaptation levels over time; i.e., a permanent increase in the stimulus level gradually increases the level of stimulus that the individual perceives as neutral (Frederick and Loewenstein, 1999). In Helson's (1964) formulation, each past level of stimulus is weighted equally when calculating $AL_{i,t}$. A commonly used formulation of the adaption level assigns more weight to stimulus experienced recently than to stimulus experienced in the distant past (Frederick and Loewenstein, 1999). Specifically, the formulation assumes geometrically declining weights that sum up to one. Following Frederick and Loewenstein (1999) this can be written as

$$AL_{i,t} = \alpha y_{i,t-1} + (1 - \alpha)AL_{i,t-1}. \quad (3)$$

In period t , the weight assigned to the stimulus level experienced in period $t - k$ is $\alpha(1 - \alpha)^{k-1}$. Thus, the speed of adaptation is determined by the parameter α . When α is close to 1, the adaptation level adjusts quickly to changes in the level of stimulus. In contrast, when α is close to 0, the adaption level adjusts very slowly after a change in the level of stimulus.

To derive an estimable model of SWB and income, I follow Wunder (2012) and take differences of equations (2) and (3) to get

$$\Delta SWB_{i,t} = \beta(y_{i,t} - y_{i,t-1}) - \beta(AL_{i,t} - AL_{i,t-1}) \quad (4)$$

and

$$\Delta AL_{i,t} = \alpha(y_{i,t-1} - AL_{i,t-1}). \quad (5)$$

Combining these yields

$$\Delta SWB_{i,t} = \beta\Delta y_{i,t} - \beta\alpha(y_{i,t-1} - AL_{i,t-1}). \quad (6)$$

Adding and subtracting $\alpha\lambda_i$ from the right-hand side and utilising the fact that

$$SWB_{i,t-1} = \lambda_i + \beta(y_{i,t-1} - AL_{i,t-1}) \quad (7)$$

gives

$$SWB_{i,t} = (1 - \alpha)SWB_{i,t-1} + \beta\Delta y_{i,t} + \lambda_i\alpha. \quad (8)$$

If we assume that shocks, which are uncorrelated with y and with each other, affect SWB each period, we can write equation (2) as

$$SWB_{i,t} = \lambda_i + \beta(y_{i,t} - AL_{i,t}) + \epsilon_{i,t}, \quad (9)$$

where $\epsilon_{i,t}$ is an independently and identically distributed error term with zero mean. With this assumption, the transformed equation (8) includes an error term of the form $\epsilon_{i,t} - (1 - \alpha)\epsilon_{i,t-1}$, which is negatively autocorrelated when $\alpha < 1$. In terms of the model, it implies that each disturbance in the original error term ($\epsilon_{i,t}$) is immediately adapted to. Thus, the negative autocorrelation in the error term of the transformed equation ensures that each shock ($\epsilon_{i,t}$) does not have any impact in the future periods. If one assumes that, the error term in the transformed equation (8) is iid it implies that individuals adapt to all changes in circumstances with the same speed as to income changes.

1.3.2 Using shifting adaptation levels to model SWB

Some empirical studies use formulations similar to the one presented in equation (8). For example, Wunder (2012) and Boyce et al. (2013) regress the current level of SWB on the lagged level of SWB and the current income change.⁶ In these studies, the long-run effect of income on SWB is assumed to be zero because it is assumed that after each change in the income level, the adaptation level eventually shifts to the new level of income.⁷ The dashed black line in figure 1 describes this dynamic in SWB. In figure 1, I have set $\alpha = 0.25$. This implies that in each period, adaptation reduces the remaining SWB effect of the income change by 25%.

Studies that estimate models with the lagged level of SWB in the left-hand side but no level variable for income do not allow for a long-run relationship between the variables. The simplest empirical specification presented in the previous section in equation (1) allows for a long-run relationship but does not allow for adaptation. The model presented in equation (1) assumes that there is no time varying adaptation level that reacts to changes in the level

⁶For panel models with a lagged dependent variable, short time series dimension, and individual/country-specific fixed effects, the biases resulting from using OLS estimation should be taken into account (Nickell, 1981).

⁷Some studies have theorised that the long-run null relationship between income and SWB can be a result from rising income aspirations (see, for example, Easterlin, 2003; Stutzer, 2004). If these aspirations change in tandem with the level of income in the long run, it would explain the flat time series found in SWB (Easterlin, 2001). It should be noted that equation (3) does not model income aspirations as they are modelled in the empirical literature (see, for example, Stutzer, 2004; Knight and Gunatilaka, 2010). This would require data on individuals' assessments of sufficient or good income. Adaptation level theory assumes that we can write the adaptation level as a function of past income levels whereas aspirations level models often study the role of past income as well as expectations and social reference income (for an experimental study, see McBride, 2010).

of income. In the next section, I discuss empirical models that allow for both adaptation and a long-run relationship between the levels of the variables.

1.4 Dynamic models with long-run effects

The model in equation (8) forces the adaptation process to be complete because it assumes that the adaptation level always reaches the level of stimulus in the long run. When the researcher suspects that adaptation may not be complete, he or she should use a model that also tests the long-run level relationship between the variables. This implies that the assumption about individual- or country-specific set-point levels of SWB is relaxed. In this section, I discuss two types of models that allow for this kind of relationship: distributed lag (DL) models and an autoregressive distributed lag (ARDL) models.

1.4.1 Distributed lag model

Studies that have used a DL model to estimate both the short-run and long-run SWB effects of income changes include Di Tella and MacCulloch, and Oswald, (2003); Di Tella and MacCulloch (2008); Di Tella, Haisken-DeNew, and MacCulloch (2010); and Vendrik (2013). Using the previous notation, a DL model is written as

$$SWB_{i,t} = \beta_0 y_{i,t} + \sum_{k=1}^p \beta_k y_{i,t-k} + \lambda_i + \epsilon_{i,t}, \quad (10)$$

where p marks the number of lagged levels of income included in the model. This method has different implications for the SWB-income relationship than the one presented in the previous section. First, though a DL model allows for adaptation in the effect of SWB, it does not impose geometrically declining weights. Rather, it allows for the speed of adaptation to vary from period to period. This is captured by coefficients $\beta_1, \beta_2, \dots, \beta_p$. Second, a DL model allows for the estimation of the long-run effect of income because the model includes levels of income instead of changes of income.⁸ This is in contrast to equation (8), presented in the previous section, which includes

⁸Some studies estimate models that include both differences and a level variable for income (see, for example, Di Tella, Haisken-DeNew, and MacCulloch, 2010; D'Ambrosio and Frick, 2012; De Neve et al., 2018). Such models also allow for the long-run relationship between the variables. In most cases, models with both differences and the level of income can be written using the DL formulation.

only the difference of income, thus restricting the long-run relationship to 0. In equation (10), the long-run effect of a unit change in the log of income is the sum of all level coefficients ($\sum_{k=0}^p \beta_k$).

DL models can also be assessed in terms of the adaptation level theory. If one assumes that β_0 in DL models corresponds to β in equation (2), the long-run adaptation level for income level y^* can be calculated as $-\sum_{k=1}^p \beta_k y^* / \beta_0$.⁹ In DL models, the adaptation level reaches the current income level, implying a zero long-run relationship, only if $\sum_{k=0}^p \beta_k = 0$; i.e., $\beta_0 = -\sum_{k=1}^p \beta_k$. Di Tella and MacCulloch (2008) and Di Tella, Haisken-DeNew, and MacCulloch (2010) have examined adaptation using an F-test for the sum of the lagged level coefficients. All four studies mentioned above that use DL models have tested the long-run relationship between SWB and income with an F-test for the sum of current and lagged level coefficients.

One limitation of the DL model is that the estimated adaptation process is finite. DL specification restricts the adaptation process to the time window for which lagged levels of income are included. Thus, in the presence of a slow adaptation process, using a DL model requires a long time series of the income variable. Next, I discuss models that allow for both a long adaptation process and a long-run relationship between the levels of the variables.

1.4.2 Autoregressive distributed lag model

Vendrik (2013) estimates an ARDL model in the error correction form. His model includes both the lagged level of SWB as well as the lagged level and current change of income. Also, Di Tella, MacCulloch, and Oswald (2001) use the lagged level of SWB and the current level and change of the independent variables to study the well-being effects of unemployment and inflation at the macro level. In terms of the adaptation level, such models allow that only a portion of each change in the stimulus level is transmitted as a change in the adaptation level in the long run. In the case of only partial adjustment in the adaptation level, equation (3) becomes

$$AL_{i,t} = \delta \alpha y_{i,t-1} + (1 - \alpha) AL_{i,t-1},^{10} \quad (11)$$

⁹Here, I assume also that there is no anticipation effect.

¹⁰Note that the adaptation level implied by equation (11) can also be derived from a distributed lag model with an infinite number of lagged levels with coefficients that are

where δ captures the share of the stimulus that is incorporated into the adaptation level in the long run.¹¹ If $\delta = 1$, individuals completely adapt to each change in the stimulus level over time and SWB is determined by equation (8). The dashed line in figure 1 plots the dynamic effect of a unit change in the level of stimulus when $\delta = 1$. In contrast, if $\delta = 0$, a change in the level of the stimulus has no effect on the adaptation level in any period. In such a case, SWB immediately and permanently reacts to changes in the stimulus level according to parameter β . Under the assumption that $\delta = 0$, the dynamic relationship between two variables is described by the solid lines in figure 1. In such a case, it is feasible to estimate the dynamic relationship using only the levels of the variables.¹² When δ lies between 0 and 1, individuals adapt to changes in the stimulus level but adaptation is only partial.¹³ In such a case, permanent changes in the level of the stimulus have permanent effects on the level of SWB, and equation (2) becomes

$$\Delta SWB_{i,t} = \beta(y_{i,t} - y_{i,t-1}) - \beta\alpha(\delta y_{i,t-1} - AL_{i,t-1}). \quad (12)$$

Adding and subtracting $(1 - \delta)\alpha\beta y_{i,t-1}$ and $\alpha\lambda_i$ from the right-hand side yields

$$\begin{aligned} \Delta SWB_{i,t} = & \alpha\lambda_i + \beta(y_{i,t} - y_{i,t-1}) + (1 - \delta)\alpha\beta y_{i,t-1} \\ & - \alpha[\lambda_i + \beta(y_{i,t-1} - AL_{i,t-1})]. \end{aligned} \quad (13)$$

Finally, adding $SWB_{i,t-1}$ to both sides and noticing that $\lambda_i + \beta(y_{i,t-1} - AL_{i,t-1}) = SWB_{i,t-1}$ yields

$$SWB_{i,t} = \alpha\lambda_i + (1 - \alpha)SWB_{i,t-1} + \beta\Delta y_{i,t} + (1 - \delta)\alpha\beta y_{i,t-1}. \quad (14)$$

Equation (14) assumes an adaptation process similar to the model presented in equation (8). However, when $\delta > 0$, the adaptation level does not adjust

restricted to follow the geometrically declining path imposed by α .

¹¹This extension to the adaptation level model and the estimable SWB model derived from it was done in collaboration with my co-author Jani-Petri Laamanen during our work with the second essay.

¹²Whether estimating the level model produces reliable results on the long-run relationship between the variables, however, still depends on the length of the data set and the relationship between SWB and the different components of income, as discussed in section 1.2.2.

¹³When $\delta \neq 0$, changes in the stimulus level have a permanent effect on SWB. In this introduction, I focus only on cases of adaptation where $0 < \delta < 1$. In cases where $\delta < 0$, the initial effect of the change in the stimulus level is reinforced over time. A δ parameter larger than 1 would imply an adaptation level that gradually increases more than the level of the stimulus.

to the new stimulus level after a change in the stimulus level. Only proportion δ of each permanent change in the level of stimulus is reflected in the adaptation level. Share $(1-\delta)$ of the change has a permanent impact on the level of SWB. As a result, a unit change in the stimulus level has an impact effect on SWB of the size of β and a permanent effect of $(1-\delta)\beta$. The share of the impact effect that is adapted to in the long run is captured by the parameter δ . The dotted line in figure 1 describes this dynamic.

It should be taken into account that in all the models presented here, the trend variation in income and the variation around the trend might be differently associated with SWB. If the researcher wishes to control for the effect of the trend component in the level relationship, he or she can just include a country (individual) specific linear trend component in the regression. However, as discussed in section 1.2.2, the inclusion of country (individual) specific fixed effects absorbs the effect of average growth in income when income difference is used as an explanatory variable. Thus, if the researcher suspects that the short-run effects of different components of income differ from one another, the coefficient of income difference should be interpreted accordingly.

1.5 Asymmetries in the effects of income changes

In a seminal paper, Kahneman and Tversky (1979) postulated that in decision-making, individuals put more weight on expected losses than expected gains of the same size. Their original idea focused on decision utility. Later, Tversky and Kahneman (1991) started discussing loss aversion in the realm of experiences of outcomes. Furthermore, Kahneman et al. make a clear distinction between the two concepts by noting that “decision utility is the weight of an outcome in a decision” whereas experienced utility (realised utility of an outcome) is something reported during or after an event (Kahneman et al., 1997, p. 375). The two measures can differ from one another (Kahneman et al., 1997). In the field of psychology, some results from lab experiments indicate that loss aversion might not exist in the realm of experienced utility (Kermer et al., 2006). Only recently, have economists started using the existing survey data on SWB to study loss aversion in experienced utility.

In this section, I discuss the methods used in empirical studies of SWB that allow for asymmetric effects for income changes. I also discuss the implications these methods have on the short- and long-run relationship between SWB and income. In this section, the adaptation level model is

not used because the different adaptation processes to positive and negative changes cannot be modeled using only one adaptation level (see Frederick and Loewenstein, 1999, for a discussion about the difficulties in using multiple adaptation levels).

Di Tella, Haisken-DeNew, and MacCulloch (2010), D'Ambrosio and Frick (2012), and Boyce et al. (2013) were among the first to look at the asymmetric SWB effects of income changes using survey data. All of these studies use individual-level data from the German Socio Economic Panel to estimate the short-run effects of positive and negative income changes. De Neve et al. (2018) were the first to study asymmetries in the effects of GDP changes using macro-level data. Their baseline model regresses the level of SWB on positive and negative output changes but does not include any variable for the level of output. Furthermore, their model does not include any lagged levels of SWB on the right-hand side. Using the previous notation, their model can be written as

$$SWB_{i,c,t} = \lambda_i + \beta \Delta y_{c,t} + \beta^- \Delta y_{c,t}^- + \epsilon_{i,c,t}, \quad (15)$$

where $SWB_{i,c,t}$ is the subjective well-being of individual i in country c in year t ; $\Delta y_{c,t}^- = \Delta y_{c,t}$ when the GDP change in country c is negative ($\Delta y_{c,t} < 0$), 0 otherwise.¹⁴

This model allows for different impact effects for positive and negative income changes but assumes immediate and complete adaptation. In each period, the current change in income determines the level of SWB. Income changes from previous periods have no effect. The model generates continuous growth in SWB only when income growth is accelerating. Specification in equation (15) also implies that SWB decreases when income growth is slowing down. This implies that, for example, a steady income decline of 2% per year generates a flat SWB time series. From the standpoint of the adaptation level theory, this model assumes that the current level of income is compared only to the previous income level.¹⁵

¹⁴De Neve et al. (2018) use positive and negative changes, $\Delta y_{c,t}^+$ and $\Delta y_{c,t}^-$, but the implications of the two specifications are identical. They also control for year-specific fixed effects along with a set of individual-level characteristics. I have not written these control variables into equation (15) because I want to direct the focus of the reader to the dynamic effects of positive and negative income changes.

¹⁵The appeal of the model is that previous income level determines both the adaptation level and the reference level according to which gains and losses are coded. However, these two might not be equal. De Neve et al. (2018) note that future research should focus on determining the reference point against which gains and losses are evaluated.

Robustness checks by De Neve et al. (2018) and studies by Di Tella, Haisken-DeNew, and MacCulloch (2010) and D’Ambrosio and Frick (2012) also report the results from a model where the level of income is controlled for. The inclusion of the level of income without the inclusion of lagged level of life satisfaction implies that the adaptation process lasts only one year. This can be easily seen if such a model is written using the DL formulation. Furthermore, when the level of income is included in equation (15), it captures the long-run effect of income changes but assumes that the long-run effect is symmetric; i.e., same for positive and negative income changes.

There are theoretical reasons for income gains and losses to be differently associated with SWB in the long run. Easterlin (2009) suggests that income aspirations might be less flexible downward than upward. This is in line with the endowment effect introduced by Kahneman et al. (1991). A fixed aspirations level implies that income decreases are associated with long-run decreases in SWB. Whether recoveries in the level of income lead to SWB increases is an open question at this point. No study has analysed the different adaptation processes to positive and negative income changes. Thus, no analysis of the different long-run associations exist, either. However, Veenendaal (2013) has found evidence regarding complete adaptation in the case of income changes in general; and Clark, D’Ambrosio, and Ghislandi (2016) have found that entering poverty has long-run effects on SWB. This evidence together calls for a systematic analysis on the short- and long-run effects of positive and negative income changes. The need for further research is also emphasised by Clark (2018), who discusses studies of adaptation and concludes that future research should examine the different well-being effects of changes of different directions.

1.6 Long-run effects in cross-sectional data

Up until this point, I have solely discussed models for panel or time series data. Some studies also examine the long-run effects of past economic circumstances at the regional level on other outcome variables using cross-sectional comparisons of individuals (Malmendier and Nagel, 2011; Giuliano and Spilimbergo, 2014; Rao, 2016). Such studies link each cross-sectional unit (individual) in the data with information on past circumstances, which depend on the birth year and region of the individual. When the data set includes information on individuals’ birth years, it allows researchers to focus on the effects of circumstances experienced at a specific age. Because

of the formative nature of the time period, researchers are especially interested in the long-run effects of experiences that take place in an individual's childhood, adolescence, or early adulthood (see, for example, Layard et al., 2014; Oreopoulos, von Wachter, and Andrew Heisz, 2012).

Identifying long-run effects of past circumstances sets some requirements for the data used. If the cross-section consists of individuals from one region or one country only, the differences in past circumstances between individuals stem from differences between birth cohorts. For example, individuals born in the 1920s faced very different circumstances when growing up than individuals who were born after the Second World War. However, the comparison between birth cohorts within one country poses a challenge to researchers who want to control for the confounding factors that are associated with the birth cohort of the individual. More can be achieved when data is available for multiple regions or countries. The data gathered by international cross-section surveys is very useful in this regard. Such data allows for controlling global cohort effects among region-specific fixed effects.

Let us now formulate a simple model for studying the relationship between SWB and past circumstances. The regression equation for examining the relationship with international repeated cross-section data can be written as

$$SWB_{i,c,t} = \beta Y_{i,c,t} + \epsilon_{i,c,t}, \quad (16)$$

where $SWB_{i,c,t}$ is the subjective well-being of individual i who is interviewed in country c at time t and $Y_{i,c,t}$ describes the circumstance that individual i experienced in country c at a given age in the past.¹⁶ A statistically significant relationship between past circumstances and the dependent variable indicates that adaptation to past circumstances is less than complete.¹⁷

Cross-sections of individuals can also be used to study the dynamic process of adaptation. One can compare the outcomes of individuals who have experienced similar circumstance at a given age but are of different age when the survey is conducted. This can be achieved by including a variable that measures the time elapsed from the given age and its interaction with the circumstances into equation (16).¹⁸ The effects of the time elapsed can

¹⁶Again, for the sake of simplicity, I have not written the relevant control variables into the equation. They can include current circumstances in country c , time-, country-, cohort-, and age-fixed effects, plus a set of individual level covariates.

¹⁷When the researcher focuses on the effects of regional circumstances at a certain age or during a certain life event, all individuals who have not passed that age or life event are excluded from the analysis (see, for example, Giuliano and Spilimbergo, 2014; Kahn, 2010; Maclean and Hill, 2015).

¹⁸Only including the interaction term is sufficient to identify the dynamic process of

be captured by a linear variable (Rao, 2016), a linear and a quadratic term, or by a set of dummy variables (Buccioli and Zarri, 2015). The model with a linear and a quadratic term can estimate an adaptation process similar to the model presented in equation (14).

The method described in this section has advantages over both individual level time series and contemporaneous cross-sections. First, the method allows researchers to identify the effects of experienced circumstances at a specific age in the very distant past. Second, using regional level variation instead of individual level variation in past circumstances alleviates the fear of reverse causality. However, researchers should be very cautious when the variation in circumstances can be correlated with some relevant region-cohort-specific omitted variable. In the recent years, this method has been applied to study relationships between economic circumstances in early adulthood and many different outcome variables (see, for example, Kahn, 2010; Oreopoulos, von Wachter, and Andrew Heisz, 2012; Giuliano and Spilimbergo, 2014; Maclean and Hill, 2015). However, there has not been any analysis on the lasting effects of early adulthood macroeconomic crises on SWB using international data.

1.7 Summaries of the essays

1.7.1 Mind the gap? Business cycles and subjective well-being

The first essay, which is a joint work with Jani-Petri Laamanen, examines the relationship between SWB and the different components of output. The essay contributes to the debate on the Easterlin paradox by studying the association between SWB and both the short-run and the long-run components of output. This essay is motivated by previous discussions and analyses in Di Tella et al. (2003), Easterlin et al. (2010) and Easterlin (2013) which point to the direction that the output's deviation from a linear trend might be associated with SWB rather than the output itself.

In this essay, we use two of the longest international macro-level data sets available, World Values Survey and Eurobarometer, to execute the analysis. The SWB variables used in the World Values Survey are life satisfaction and happiness; for Eurobarometer, life satisfaction.

We start the analysis by estimating the country-specific relative output gap using linear detrending, quadratic detrending, Baxter-King filtering and Hodrick-Prescott (HP) filtering with three alternative, commonly used

adaptation if age dummies are included as control variables.

smoothing parameters of 6.25, 100, and 400. Each detrending method produces an estimate of the output gap and the trend of output. Next, we utilise these estimates to predict SWB in a fixed effects panel setting. The results reported in this essay consist of two parts. First, we regress SWB on the different output gap measures and output itself and compare the explanatory power of the models. Our results show that output does not have the best explanatory power. Second, we include both the cyclical component and the trend component of output in the same model and show that the trend component of output is not statistically significantly associated with SWB.

Our findings suggest that the statistically significant association found in panel models of SWB and output with country fixed effects might result from a specific kind of variation in output. Specifically, the significant association between output and SWB can be found if the share of cyclical variation in the variation of the output variable is large.

1.7.2 Adaptation and loss aversion in the relationship between GDP and subjective well-being

In the second essay, also a joint work with Jani-Petri Laamanen, we examine the roles of adaptation and loss aversion in the relationship between national income and subjective well-being. Previous studies on SWB have provided results that point to the existence of hedonic adaptation and loss aversion at the micro- and macro-level. It has been found that individuals and nations adapt to changes in income and that income losses are associated with larger SWB changes than income gains of the same amount. Although there exist many studies that examine one of the two phenomena, there has not been any analysis that incorporates both of these in the same model.

Omitting one of the phenomena may cause bias when estimating the effects of the other. Furthermore, models that do not include both phenomena cannot make interpretations about how loss aversion operates in the long-run as compared to the short-run. In this essay, we use an empirical model which incorporates both adaptation and loss aversion. In particular, we introduce an extension to model presented in equation (14) by following Schorderet (2001, 2003) and Shin et al. (2014) and including negative income changes and the sum of past negative income changes in the model. With this model, we do not suffer from biases that arise when the impact of either adaptation or asymmetries is omitted.

Additionally, we use the subjective well-being data from Eurobarometer

because it is the longest continuous survey that includes an SWB question. For many of the countries, the data cover multiple recessions and recoveries. Thus, we are able to estimate adaptation processes to both positive and negative income changes.

Our findings suggest that well-being changes associated with negative changes in national income are greater than those associated with positive changes. This result has also been verified by De Neve et al. (2018). In addition, our results show that the asymmetry is observed not only in the short run but also in the long run, and it becomes more important over time. This can be explained by complete adaptation to positive changes and by less than complete adaptation to negative changes in national income.

1.7.3 Short-run and long-run asymmetries in the effects of income changes on subjective well-being: Evidence from a micro panel

The third essay, a joint project with Jani-Petri Laamanen, contributes to the existing literature of loss aversion and adaptation by studying the two phenomena simultaneously using micro-level data. This essay is the first to study the long-run asymmetries in the effects of income changes at the individual level.

We use German Socio-economic Panel data, which has the longest continuous time series of individuals' subjective well-being. This comprehensive survey data set allows for controlling many time-varying individual-level characteristics in our analysis. Most longitudinal individual-level studies on subjective well-being use this same data set. Thus, our results are easily comparable with previous results in the field.

Adaptation to income changes has been studied before using German Socio-economic Panel data. Vendrik (2013) uses an autoregressive distributed lag model to study the short- and long-run effects of changes in household income and changes in social reference income. In this essay, we first replicate the results presented by Vendrik (2013) with an updated data set. Second, we add asymmetries to Vendrik's (2013) model. We present the results from both models using three different strategies to control for the time-varying individual-level characteristics.

Our findings suggest that no asymmetries exist in the effect of income changes as they are measured by the changes in the log of annual post-government household equivalent real income. For our sample of West German individuals, income decreases do not have larger effects in the short

run or in the long run than income increases of the same magnitude. However, we conclude that a distinction about the source of the income decrease should be made when further studying the asymmetries. For example, anticipated income drops may not be associated with asymmetric effects if the reference point which is used in coding gains and losses is based on the individual's expectations, as suggested by Köszegi and Rabin (2006).

1.7.4 The lasting well-being effects of early adulthood macroeconomic crises

The fourth essay examines the relationship between early adulthood macroeconomic crises on subjective well-being later in life. This essay contributes to the existing literature which examines the different effects of the macroeconomic situation in individuals' early adulthood (see, for example, Bianchi, 2014; Giuliano and Spilimbergo, 2014; Maclean and Hill, 2015; Rao, 2016). This is the first study to provide evidence of the long-run impacts of early adulthood macroeconomic crises on individuals' subjective well-being.

In the essay, I use World Values Survey repeated cross-section data on individuals who are older than 25. I combine the World Values Survey data with Angus Maddison's historical time series data on economic output and link the survey respondents with the economic situation they faced when they were 18-25 years old. Because the focus is on the lasting well-being effects of severe economic crises, I follow Barro and Ursúa (2008) and define a crisis episode as one in which the cumulative real GDP per capita decline is 10% or more. In the analysis, I compare individuals who have experienced such a crisis at ages 18-25 to those individuals who have not.

Each respondent enters the World Values Survey data only once, so the effect of early adulthood macroeconomic crisis is identified from the variation between individuals. Specifically, I use a model similar to the one described in equation (16). The identifying variation comes from differences between birth cohorts within countries. Because the World Values Survey is an international survey, I am able to control for global cohort-, age-, and survey year-specific fixed effects.

The findings suggest that, on average, early adulthood experiences of economic crises are associated with lower levels of happiness and life satisfaction later in life. Furthermore, it appears that the negative association is strongest at the lower end of a country's income distribution.

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Chapter 2

Mind the gap? Business cycles and subjective well-being*

Matti Hovi^a and Jani-Petri Laamanen^b

Abstract

We examine the relationship between output fluctuations and within-country variation in subjective well-being using country panels. We show that the deviation of output from trend, unlike trend growth, is positively associated with well-being. The explanatory power of the business cycle is found to be better than that of the level of output.

Keywords: Subjective well-being, GDP, Business cycle, Happiness, Life satisfaction

JEL codes: O11, I31, E32

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^a University of Tampere, matti.hovi@uta.fi

^b University of Tampere, jani-petri.laamanen@uta.fi

1 Introduction

Analyses of international repeated cross-sections, such as those by Di Tella *et al.* (2003) and Stevenson and Wolfers (2008), point to a positive relationship between output and subjective well-being (SWB). However, the fact that Gross Domestic Product (GDP) is trending in virtually all countries whereas such a trend is not usually observed in SWB hints that a long-term relationship may not exist. Indeed, Easterlin (2013) shows that there is no systematic association between countries' long-run GDP growth rates and improvements in SWB. Discussions and analyses in Di Tella *et al.* (2003), Easterlin *et al.* (2010) and Easterlin (2013) point to the possibility that the deviation of output from its trend instead of output itself is associated with SWB. Our contribution is to examine this hypothesis in detail by using different measures of the relative output gap and regressing subjective well-being on each of them. We use panel data sets and model the within-country variation in SWB. The explanatory power of the output gap measures is compared to that of the log of GDP per capita.

2 Data and methods

We use Eurobarometer and combined World Values Survey/European Values Study (WVS) data. These data sets are the two most commonly used that include SWB questions and cover a long time span and various countries. The Eurobarometer data set contains observations from 34 European nations (including 24 OECD members) while the WVS sample contains observations from 78 nations (33 OECD members) around the world. In Eurobarometer, the longest time series start in 1973, and all series end in 2013. In the WVS, the time span is from 1981 to 2013. Our Eurobarometer observations are annual (no data in 1974) and there are on average 6 years between observations in our WVS data set. The real GDP per capita data are gathered from the Penn World Tables. We extend the Penn World Tables data through 2016 using growth rates calculated from the IMF World Economic Outlook (April 2015) data and forecasts.

The regression equations are of the form:

$$s_{it} = \alpha_i + \beta x_{it} + \epsilon_{it}, \quad (1)$$

where s_{it} is the population-weighted average life satisfaction or happiness in

country i in year t .^{1,2} The explanatory variable x_{it} is an output gap measure or the log of real GDP per capita, α_i is a country fixed effect and ϵ_{it} is the error term. We estimate the country-specific relative output gap using linear detrending, quadratic detrending, Baxter-King filtering and Hodrick-Prescott (HP) filtering with three alternative, commonly used smoothing parameters of 6.25, 100 and 400.³ The period selected for the detrending is 1970-2016. All models are estimated with and without year fixed effects. We also estimate models which include both the cycle component and the extracted trend component. Countries and years with only one observation are excluded because their values would be completely captured by the fixed effects.

3 Results and discussion

The estimated β coefficients and within R^2 values are reported in Table 1. Each cell in the table accounts for one model. The coefficient estimate from the model with the highest within R^2 in each column is underlined.

[Table 1 about here]

The results show that business cycles are positively associated with SWB. In only one out of the 36 models with a cycle variable, the regressor is not statistically significant at the 5% level. The cycle variable with the best explanatory power is either deviation from the linear trend or deviation from the quadratic trend. Judging from the magnitudes of the estimates, taking into account the different scale of WVS life satisfaction, the cyclical variables seem to be about as important, and sometimes more important, in the WVS sample as in the Eurobarometer sample. At this point, note that the cyclical variables also capture longer term fluctuations other than business cycles. Visually, such fluctuations are prevalent in the output time

¹Although we use WVS happiness data, we acknowledge its deficiencies pointed out by e.g. Easterlin *et al.* (2010).

²Examining the properties of the continuous Eurobarometer time series further supports the idea of regressing SWB on a detrended variable. Pesaran's (2007) test for cross-sectionally dependent panels reveals that unit roots in the SWB panel can be rejected. The lag length in the augmented Dickey-Fuller test for each country is chosen according to the Bayesian Information Criterion. The results are available upon request.

³We also tried economic growth, but its explanatory power was comparatively low. In additional analyses, we reached the same conclusions by using IMF and OECD output gap measures (for the smaller samples for which they are available).

series of relatively many WVS countries (especially developing and transition countries). Consistency of our results indicates that these fluctuations are associated with similar fluctuations in SWB. For an example of the economic significance of the estimated associations, consider column 1b. The coefficient of the best-fitting model (0.64) implies that an increase in the output gap measure by one SD increases life satisfaction by almost one half of a standard deviation.⁴

Comparing the explanatory power of the cycle variables to that of the GDP variable, we find that in none of the columns the model with the GDP variable provides the best fit. Although log of GDP per capita yields a comparatively poor fit, it has a positive and statistically significant coefficient in most cases. Under an assumption that the business cycle instead of output is what matters for SWB, this kind of results can be found if the share of cyclical variation in the variation of the GDP variable (conditional on the fixed effects) is sufficiently large. To check whether we have ignored a potentially important association between trend growth and SWB growth, we re-estimated the models with a cyclical variable and included the extracted trend component as an additional regressor. This also serves as a robustness check, because the correlations between the cycle variables and corresponding trend variables are not always zero and there might, thus, be omitted variable bias in our estimates.⁵ The results are presented in Table 2.

[Table 2 about here]

Among the best-fitting models, the coefficient for the trend component is statistically significantly positive only in the model of WVS happiness without year fixed effects and becomes negative and significant when year fixed effects are included. It should be noted that we are not the first to observe negative associations of output variables with SWB in the WVS data (see Opfinger, 2016). In general, our findings on trend growth's association with SWB are in line with those by Easterlin *et al.* (2010) and Easterlin (2013). There are only minor changes in the coefficients of the cyclical variables in the best fitting models while the statistical significances remain unchanged. This confirms the robustness of our results on the association between business cycles and subjective well-being.

⁴SDs are calculated using within-country variation.

⁵Nonzero correlations are due to different periods for detrending and estimation and because some of the detrending techniques do not require the cycle component and the trend component to be uncorrelated.

4 Conclusions

Deviation of output from its long-term trend, unlike trend growth, has explanatory power for subjective well-being within countries over time. The explanatory power is better than that of output. This reflects the fact that output series trend upward whereas such a trend is usually absent from time series of subjective well-being.

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Table 1.

Models of subjective well-being						
Dependent variable (scale):	EB satisfaction (1-4)		WVS satisfaction (1-10)		WVS happiness (1-4)	
Explanatory variable	(1a)	(1b)	(1c)	(1d)	(1e)	(1f)
Baxter-King Cycle	1.09*** (0.22)	1.20*** (0.24)	9.81*** (1.34)	6.97*** (1.67)	1.72*** (0.39)	1.27** (0.57)
R ²	0.049	0.215	0.279	0.534	0.113	0.419
HP Cycle (6.25)	0.97*** (0.20)	1.04*** (0.21)	8.06*** (1.45)	4.73*** (1.57)	1.39*** (0.46)	0.90 (0.61)
R ²	0.041	0.210	0.168	0.497	0.066	0.404
HP Cycle (100)	0.70*** (0.16)	0.58*** (0.18)	5.45*** (0.70)	3.51*** (0.83)	0.90*** (0.20)	0.65** (0.26)
R ²	0.059	0.208	0.322	0.540	0.115	0.422
HP Cycle (400)	0.63*** (0.13)	0.59*** (0.16)	4.01*** (0.51)	2.75*** (0.57)	0.69*** (0.13)	0.51*** (0.17)
R ²	0.073	0.218	0.376	0.564	0.145	0.433
Cycle (quadratic trend)	0.47*** (0.08)	0.46*** (0.12)	<u>3.01</u> *** (0.36)	<u>2.14</u> *** (0.40)	0.53*** (0.09)	0.36*** (0.11)
R ²	0.087	0.229	0.420	0.587	0.168	0.434
Cycle (linear trend)	<u>0.55</u> *** (0.12)	<u>0.64</u> *** (0.15)	2.66*** (0.38)	1.84*** (0.41)	<u>0.52</u> *** (0.09)	<u>0.36</u> *** (0.09)
R ²	0.149	0.293	0.394	0.580	0.194	0.448
ln(GDP pc)	0.11*** (0.04)	0.21* (0.11)	0.84*** (0.20)	0.60* (0.33)	0.22*** (0.05)	0.06 (0.08)
R ²	0.058	0.223	0.234	0.500	0.189	0.393
Year FEs	No	Yes	No	Yes	No	Yes
Obs.	654	654	291	291	290	290
Countries	34	34	78	78	78	78

Notes: Robust country-clustered SEs in parentheses. ***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively. All models include country FEs. The coefficient estimate of the model with the largest R² in the column is underlined.

Table 2.

Models of subjective well-being including the trend component												
Dependent variable (scale):	EB satisfaction (1-4)				WVS satisfaction (1-10)				WVS happiness (1-4)			
Explanatory variable:	Cycle	Trend	Cycle	Trend	Cycle	Trend	Cycle	Trend	Cycle	Trend	Cycle	Trend
Baxter-King	1.01*** (0.22)	0.09** (0.04)	1.04*** (0.24)	0.17 (0.11)	7.69*** (1.18)	0.52*** (0.17)	6.25*** (1.66)	0.27 (0.32)	1.03** (0.44)	0.18*** (0.05)	1.32** (0.63)	-0.02 (0.09)
R ²		0.093		0.235		0.349		0.539		0.210		0.419
HP (6.25)	0.94*** (0.20)	0.10*** (0.04)	0.96*** (0.22)	0.18 (0.11)	6.26*** (1.08)	0.68*** (0.18)	4.07*** (1.47)	0.47 (0.32)	0.91** (0.45)	0.20*** (0.05)	0.86 (0.63)	0.03 (0.09)
R ²		0.089		0.234		0.305		0.516		0.204		0.405
HP (100)	0.70*** (0.15)	0.09** (0.04)	0.56*** (0.16)	0.18 (0.12)	4.57*** (0.75)	0.42** (0.17)	3.34*** (0.89)	0.14 (0.34)	0.54** (0.24)	0.18*** (0.06)	0.72** (0.29)	-0.06 (0.09)
R ²		0.102		0.230		0.361		0.541		0.201		0.425
HP (400)	0.61*** (0.12)	0.08** (0.04)	0.55*** (0.14)	0.16 (0.12)	3.63*** (0.55)	0.28* (0.16)	2.79*** (0.59)	-0.06 (0.33)	0.48*** (0.16)	0.16*** (0.06)	0.57*** (0.17)	-0.11 (0.08)
R ²		0.107		0.233		0.391		0.564		0.207		0.440
Quadratic	0.44*** (0.08)	0.07 (0.05)	0.44*** (0.11)	0.12 (0.14)	2.88*** (0.38)	0.16 (0.15)	2.17*** (0.39)	-0.19 (0.26)	0.42*** (0.11)	0.14*** (0.05)	0.37*** (0.10)	-0.11 (0.07)
R ²		0.105		0.236		0.424		0.589		0.214		0.442
Linear	0.55*** (0.13)	0.05 (0.04)	0.65*** (0.16)	-0.05 (0.14)	2.54*** (0.40)	0.19 (0.19)	1.87*** (0.42)	-0.27 (0.35)	0.44*** (0.10)	0.13** (0.06)	0.38*** (0.09)	-0.18** (0.07)
R ²		0.161		0.294		0.400		0.584		0.228		0.467
Year FEs	No		Yes		No		Yes		No		Yes	
Obs.	654		654		291		291		290		290	
Countries	34		34		78		78		78		78	

Notes: Robust country-clustered SEs in parentheses. ***, **, * indicate statistical significance at the 1%, 5% and 10% level, respectively. All models include country FEs. The coefficient estimate of the model with the largest R² in the column is underlined.

Chapter 3

Adaptation and loss aversion in the relationship between GDP and subjective well-being

Matti Hovi^a and Jani-Petri Laamanen^b

Abstract

We examine the roles of adaptation and loss aversion in the relationship between national income and subjective well-being. Earlier studies have found that people and nations tend to adapt to changes in income, and that well-being is more sensitive to income losses than to income gains. We apply models that allow for both adaptation and asymmetries to cross-country panel data. We find evidence for both short-run and long-run loss aversion. The asymmetry becomes more important over time because the effects of income increases become statistically insignificant, whereas also the long-run effects of income decreases are significant and large.

Keywords: Subjective well-being; Life satisfaction; Adaptation; Loss aversion; GDP

JEL codes: O11, I31

^a University of Tampere, matti.hovi@uta.fi

^b University of Tampere, jani-petri.laamanen@uta.fi

Two well-established behavioural phenomena, hedonic adaptation and loss aversion, have the potential to affect the relationship between national income, or gross domestic product (GDP), and subjective well-being (SWB). Hedonic adaptation would lead the impacts of GDP changes to wear off in time, completely or partially. Loss aversion, to the extent that it is actually experienced instead of merely anticipated, would be reflected as larger well-being responses to negative GDP changes than to positive GDP changes.¹ To our knowledge, the only studies examining adaptation to GDP are Di Tella et al. (2003) and Di Tella and MacCulloch (2008). Both use repeated annual cross-sections from the Eurobarometer (EB) survey, which cover European countries over a number of years. The latter study also uses a single Gallup World Poll cross-section of individuals in a larger group of countries. Asymmetries in how well-being is affected by changes in GDP are examined by De Neve et al. (2018) using three different international repeated cross-section surveys, including EB. These papers present evidence for adaptation and asymmetries.

A second set of studies examines adaptation and loss aversion using micro-level panel data on incomes and subjective well-being. Di Tella et al. (2010) and Vendrik (2013) study adaptation to income using data from the German Socio-economic Panel (SOEP). Clark et al. (2016), also using the German panel, study adaptation to poverty and also extend their analysis to adaptation to any income drop. Di Tella et al. (2010), D'Ambrosio and Frick (2012) and Boyce et al. (2013) all study loss aversion using the German panel. Boyce et al. (2013) also use the British Household Panel Survey (BHPS). Finally, Frijters et al. (2011) use the Household, Income and Labour Dynamics in Australia (HILDA) survey and provide results on loss aversion. Similarly to the studies looking at the effects of national income, these studies find evidence for adaptation and loss aversion.² The only exception is Clark et al. (2016) study, which does not find evidence for adaptation to poverty or to any negative income change.

¹Kahneman and Tversky's (1979) original notion of loss aversion was related to decision making, but the authors later note that knowledge of to what extent, and for how long, loss aversion is actually experienced would provide a criterion for evaluation of rationality of loss aversion in decision making (Tversky and Kahneman, 1991). We study what De Neve et al. (2018) call 'macroeconomic loss aversion': differential sensitivity to positive ('macroeconomic gains') and negative ('macroeconomic losses') GDP changes.

²In contrast with the abovementioned studies finding strong loss aversion when it comes to SWB, Some studies looking at loss aversion in the laboratory context (Kermer et al., 2006) and of real investors (Merkle, 2017) suggest that a large part of loss aversion is not experienced but only anticipated.

Despite the observed importance of adaptation and loss aversion, there are no studies which allow for both of these in the same model.³ The lack of such studies has two consequences. First, it is clear that assuming away one of the phenomena may bias the results on the other. Therefore, we do not know how robust the findings on adaptation are to controlling for loss aversion and vice versa. Second, nothing is known about whether the asymmetries remain similar over time or whether adaptation to positive and/or negative changes leads to changes in the asymmetries. It has been hypothesised that adaptation to the effects of negative income changes may be different from adaptation to the effects of positive changes and some authors have called for research on the issue (e.g., Easterlin, 2009; De Neve et al., 2018). Furthermore, Clark et al. (2016) point out that income decreases that lead to poverty are a small minority of all income changes and, therefore, any results on adaptation to income changes on average may be driven by the positive changes and not be informative about adaptation to poverty. Similarly, it is not known whether the earlier results on adaptation also apply to negative national income changes because they are a minority of all changes. In this paper, we adopt an empirical model, novel in the subjective well-being literature, which incorporates both macro-level adaptation and macro-level asymmetries to study the relationship between GDP and SWB. We can, thus, avoid biases arising from ignoring one of the phenomena and provide first findings on how the asymmetry changes over time.

Earlier studies have used either distributed lag (DL) or autoregressive distributed lag (ARDL / ADL) models to allow for adaptation to a continuous income variable. To model asymmetries, studies have regressed subjective well-being on positive and negative income changes. We combine these two approaches by using nonlinear autoregressive distributed lag (NARDL) models. Our subjective well-being data come from EB surveys. The data cover more than 30 countries and include annual observations on many of the countries over three or four decades. Thus, the data cover multiple recessions and recoveries, which is ideal from the point of view of estimating asymmetries both in the short run and in the long run.⁴

³Frijters et al. (2011) go some way towards doing this by regressing life satisfaction on multiple lags of both positive and negative financial changes. The change variables are indicators of reporting a major financial improvement or a major financial worsening in the near past.

⁴At the outset, a clear distinction between *short-run / long-run effects* (as in standard time series models) and *effects of short-run income fluctuations and long-run income changes* should be made. We focus on the former, as do the studies of adaptation listed above. However, we also take into account the possibly different effects of short-run fluc-

Our results are consistent with earlier findings on the relationship between income (national or personal/household) and subjective well-being. Furthermore, the results are also consistent with the more general findings on how positive and negative economic changes are adapted to. The well-being changes associated with negative changes in national income are greater than those associated with positive changes. This asymmetry is observed both in the short run and in the long run, and it becomes more important over time. This stems from complete adaptation to positive changes and non-existent or, at best, far from complete adaptation to negative changes. In addition to confirming the earlier findings of no long-run association between economic growth and SWB (see Di Tella and MacCulloch, 2008; Easterlin, 2013; Hovi and Laamanen, 2016), we are able to show that economic crises are followed by lasting well-being decreases.

The remainder of the paper is organised as follows. Section I reviews the relevant literature, focusing on the empirical models that have been used to study adaptation and loss aversion, and lays out our empirical approach. Section II describes the data and presents the results. Section III discusses our results and examines their robustness. Section IV concludes.

1 EMPIRICAL FRAMEWORK

The GDP-SWB research

The GDP-SWB research has been inspired by Richard Easterlin's early finding that although GDP had grown over time in the US, similar growth in SWB could not be observed (Easterlin, 1974). Findings of GDP-SWB studies using cross-sections have been able to find a positive relationship and the resulting contradiction between cross-section and time-series has been labelled the 'Easterlin Paradox'. Easterlin (2016) discusses the paradox and surveys the voluminous literature. Because we analyse the time-series relationship and how adaptation and loss aversion affect it, only some points from the recent time-series literature are relevant here. For more information, the reader is advised to see Easterlin (2016) and the references cited there.

Some of the recent papers, notably Stevenson and Wolfers (2008) using multiple data sets, have found that GDP and SWB are positively associated

tuations (such as business cycles) and long-run trend growth, as some studies mentioned below do.

in time-series. Easterlin (2013, 2016) has argued that this GDP-SWB relationship is driven by a relationship between short-run fluctuations of GDP around its trend and SWB, whereas trend growth differences between countries are not associated with SWB growth differences.⁵ In such a case, trend growth is needed to keep SWB from decreasing. One can then think of trend growth as an expected macroeconomic gain, without which there will be a ‘foregone gain’ effect (see Kahneman et al., 1991).⁶ We will take the possibility of a foregone-gain effect into account when discussing our short-run results. We will also allow for a difference between the level-relationships that SWB has with the GDP trend and the fluctuations around it by controlling for the trend component of GDP in a SWB model with a GDP variable as a regressor. For more information about controlling for the trend component and the associated interpretations, see the online Appendix.

Adaptation

In the SWB literature, adaptation to changes in circumstances is usually studied by examining the short- and long-run well-being effects of these changes. In the studies of adaptation, it is considered a sign of complete adaptation if a permanent change in circumstances affects SWB in the short run but has a long-run effect of zero. In the case of less-than-complete adaptation, the short-run effect is larger than the long-run effect but the long-run effect is greater than zero.

Previous studies have examined adaptation to changes in circumstances measured by indicator variables or adaptation to changes in continuous variables, such as income. For a review of studies of the former type, see Clark et al. (2008). Our focus is on the modelling techniques similar to those used in the latter group of studies. Adaptation to changes in a continuous income variable at the micro level and at the macro level is often modelled with a finite distributed lag model (Di Tella et al., 2010; Di Tella et al., 2003; Di Tella and MacCulloch, 2008). Vendrik (2013) points out, however, that the model of adaptation can be improved in two ways by estimating ARDL models. First, ARDL models control for the effects of higher-order

⁵For a recent analysis of this issue using EB / World Values Survey, see Hovi and Laamanen (2016).

⁶Kőszegi and Rabin discuss reference-dependent preferences in the case of individual’s reference point being expectations instead of the status quo. If trend growth determined the reference point in such a model, not achieving trend growth would have a much stronger negative effect because an experience of a loss rather than a foregone gain would follow.

lags of income than the number of income lags included in the model. Second, ARDL models are able to control for adaptation to factors other than those included in the model. Also Clark (2018) in his recent survey of the SWB literature proposes including lagged dependent variable as one way to utilise panel data. Applying an ARDL model, though estimated in the error-correction form, to SOEP data, Vendrik (2013) cannot reject the hypothesis of complete adaptation to income changes over the long run even though he finds significant well-being effects from income changes in the short run. We follow Vendrik (2013) in adopting the ARDL approach but also in allowing for flexible short-run dynamics.

It should be noticed that there is a difference between adaptation at the micro level and adaptation at the macro level. In the individual-level studies of adaptation, it is important to take into account the different adaptation processes to changes in an individual's own income and to changes in the income of the individual's social reference group (Vendrik, 2013). When the analysis is conducted at the macro level, the estimate for the effect of the income variable measures the combined effect of the individual's income and the average income level in the country. However, the different timing of the two effects at the individual level may influence the estimates of adaptation at the macro level. For example, if the income of all individuals in a country increases by the same amount, the resulting change in social reference income could affect individual SWB later than the resulting change in an individual's own income. This would show up as slow adaptation to a change in average income at the macro level. Although we are not able to analyse the two micro-level effects separately, both are taken into account in our macro-level estimates. Thus, we are able to provide unbiased estimates of the short- and long-run effect of aggregate output on aggregate life satisfaction.

Loss Aversion

Loss aversion in the context of subjective well-being effects following changes in circumstances means that the effect of a positive change is smaller than the effect of a negative change of the same size. The few loss-aversion papers regressing SWB on national, personal or household income include positive and negative income changes as separate regressors (Di Tella et al., 2010; D'Ambrosio and Frick, 2012; Boyce et al., 2013; De Neve et al., 2018). All the studies find that negative changes have larger impacts than positive changes. As De Neve et al. (2018) point out, results from such analyses

are informative about the short run.⁷ To our knowledge, nothing is known about long-run asymmetries.

The long-run asymmetry does not need to be similar to the short-run asymmetry. It is clear that a long-run asymmetry is determined by the short-run asymmetry and adaptation, which may be different for positive and negative income changes. Indeed, although the aforementioned studies find evidence for complete adaptation to income changes on average, results obtained in some recent micro studies suggest that people do not adapt to negative economic changes such as income decreases (Clark et al., 2016). Because the asymmetry may be different in the long run than in the short run, regressing SWB on positive and negative income changes might not give an accurate description of what happens in the long run. For this reason, and also because not allowing for any long-run asymmetry may bias the short-run results, it is important to study asymmetries using a more flexible empirical framework.

As mentioned above, short- and long-run effects can, in general, be estimated by either DL or ARDL models. Our models which allow for both a short-run and a long-run asymmetry are ARDL models which make a distinction between positive and negative GDP changes not only in the short run, but also in the long run. To our knowledge, using a nonlinear ARDL is the only possible approach to estimate asymmetric effects of a continuous variable in the short run and in the long run.⁸ It should be noted that the short-run associations are estimated similarly in the abovementioned earlier papers and in a NARDL model. Next, we will present and estimate a simple variant of such a model to see how it relates to the models used in the earlier literature.

Empirical Model and Estimation Strategy

Our empirical model which allows for adaptation and loss aversion at the macroeconomic level is

⁷By ‘informative about the short run’, we can mean either that income changes measure short-run fluctuations, in which case information on the effects of such fluctuations is obtained, or that the coefficients of the income change variables capture the short-run effects of the income changes (as in certain representations of DL and ARDL models, such as ours). The distinction between the two cases is the distinction made in footnote 3.

⁸NARDL has become the standard approach for estimating asymmetric effects. A recent example of a country-panel study using the NARDL approach is Eberhardt and Presbitero (2015).

$$s_{i,t} = (1-\alpha)s_{i,t-1} + \beta\Delta y_{i,t} + \beta^-\Delta y_{i,t}D_{i,t} + \gamma y_{i,t-1} + \gamma^-y_{i,t-1}^- + \lambda_i + \eta_t + \epsilon_{i,t}, \quad (1)$$

where $s_{i,t}$ is the average life satisfaction and $y_{i,t}$ is the log of real GDP per capita in country i in year t . $D_{i,t}$ is a dummy variable equal to 1 if country i experienced negative growth in y in year t . The partial sum $y_{i,t-1}^- = \sum_{\tau=I_i}^{t-1} \Delta y_{i,\tau} D_{i,\tau}$ is the sum of negative changes in y from the first year of the sample (I_i for country i) until year $t-1$. Equation (1) is the autoregressive distributed lag representation of the nonlinear ARDL model originally introduced by Schorderet (2001, 2003) and later discussed at length by Shin et al. (2014).⁹ For now, the lag length is set to 1 in this baseline specification to illustrate the consequences of allowing for dynamic effects as clearly as possible; we will allow for longer lags later. Country fixed effects λ_i and year fixed effects η_t are included in all specifications. Therefore, the estimated parameters are identified from the differences in time variation between countries.¹⁰

We are interested in estimates of α , the speed of adjustment; β , the short-run effect of a positive change in y ; $\beta + \beta^-$, the short-run effect of a negative change in y ; γ/α , the long-run effect of a positive change in y ; and $(\gamma + \gamma^-)/\alpha$, the long-run effect of a negative change in y . β^- and γ^- are measures of asymmetries in the short and long run, respectively. From the perspective of our adaptation / loss aversion framework, α is the speed of adaptation.¹¹ β and $\beta + \beta^-$ are the short-run effects as estimated in the earlier loss-aversion studies mentioned in Section I. γ/α and $(\gamma + \gamma^-)/\alpha$ represent what is left of the short-run effects in the long run. To allow for the possibility that trend

⁹Schorderet's (2001, 2003) and Shin's et al. (2014) formulation of the model includes positive and negative changes ($\Delta y_{i,t}(1 - D_{i,t})$ and $\Delta y_{i,t}D_{i,t}$) and positive and negative partial sums ($\sum_{\tau=I_i}^{t-1} \Delta y_{i\tau}(1 - D_{i\tau})$ and $\sum_{\tau=I_i}^{t-1} \Delta y_{i\tau}D_{i\tau}$). It is easy to see that the two models are equivalent because $y_{i,t-1}$ is the sum of a country-specific constant and all changes in y from the beginning of the sample until $t-1$. Usefulness of our representation lies in making the coefficients of the negative-change variables measures of the asymmetries.

¹⁰We emphasise at this point that nothing in our approach guarantees that our estimates equal causal effects. Expressions such as 'the effect of' are used only to improve the readability of the text.

¹¹Notice that here the speed of adaptation is restricted to be the same (α) for positive and negative GDP changes. As we later introduce more flexibility, the speed of adaptation will be more flexibly estimated and can be different for positive and negative changes and at different temporal distances from the impact.

growth and fluctuations around the trend have different effects on SWB, we also estimate our models controlling for the country-specific linear trend component of the output variable (T_i).¹²

It is known that estimating a fixed effects model with a lagged dependent variable using ordinary least squares may yield biased results (Nickell, 1981). Therefore, in regressions in which we include the lagged dependent variable, we use the bias-corrected least squares dummy variables (LSDVC) method. The method was first developed by Kiviet (1995), and later recommended by Judson and Owen (1999) based on Monte Carlo results. We use the bias approximations for unbalanced panels by Bruno (2005).¹³

2 DATA AND ANALYSIS

Data

Estimating model (1) requires annual country-level data on well-being. The EB survey is the only international survey which includes a SWB question and has been conducted annually over several decades, thus covering multiple recessions and recoveries for many countries. The SWB question is: ‘*On the whole, are you very satisfied (4), fairly satisfied (3), not very satisfied (2) or not at all satisfied (1) with the life you lead?*’ Of course, life satisfaction is only one element of subjective well-being but it is the only one available in the EB. One could argue that other elements of subjective well-being, let alone other than the subjective elements of well-being, can be affected differently by the economy. But until long time-series of other elements of subjective well-being or methods to draw inferences about long-run relationships from either shorter series or series with gaps are available, EB data are the most useful. We have repeated cross-sections of individuals residing in 34 different European countries. We calculate annual country-level population-weighted averages of individuals’ life satisfaction using the cross-sections. We choose the surveys to be included in the following way. First, we define the EB member countries for each year. Second, in order

¹²A trend estimation period longer than our SWB data was chosen to alleviate the impact of post-2007 years on the trend estimates. Specifically, we include five years prior to the beginning of the SWB data and five years after its end. This results in the trend being estimated for 1970-2020 for most countries. For some countries, though, the output data begins after 1970, so the trend estimation period for these countries is shorter.

¹³An example of a paper adopting this bias-correction approach for an unbalanced country-panel of about the same length as ours is Bloom et al. (2007).

to improve international comparability, we select only those surveys that have been conducted in all member countries of the year. Years covered vary by country. The longest time series start in 1975, and most series end in 2015. The real GDP per capita data up to and including 2014 are taken from the Penn World Tables. We extend the Penn World Tables data through 2020 using growth rates calculated from the IMF World Economic Outlook (April 2017) data and forecasts. Only actual GDP data are used in estimating the life satisfaction models and, thus, IMF estimations and projections are used only for the GDP trend extractions. We end up with 674 country-year averages of life satisfaction which can be regressed on the explanatory variables. Table 1 reports some descriptive statistics of these observations. Our data confirm the well-known feature of SWB, that is, that variation tends to be larger between countries than within countries over time. However, the within standard deviation is almost one-third of the overall standard deviation in our data. Due to inclusion of country fixed effects in all models, it is the within variation from which the parameter estimates are identified. Because we estimate asymmetries around zero economic growth, it is useful that more than one-sixth of the real GDP per capita changes are negative.¹⁴

[Table 1 about here]

Results from Simpler Models

We start by estimating simpler models that are obtained by imposing restrictions on the parameters of model (1). This facilitates comparisons to some earlier results and comparisons of the effects of imposing different restrictions. We begin with the simplest possible model with neither adaptation nor asymmetries. We then estimate a model allowing for adaptation but not loss aversion. Next, we estimate a model with asymmetries but no adaptation. Finally, we estimate equation (1) without any restrictions on the parameters.

Table 2 presents the results. The upper panel of the table shows the estimated coefficients on the explanatory variables, and the lower panel presents the effect estimates and tests of various relevant hypotheses. The first column reports results from a simple regression with the GDP variable as the only regressor (and controlling for country fixed effects and year effects).

¹⁴More information on the data, weighting etc. is available in the online Appendix.

This model is obtained by assuming no differences between the short-run effects and the long-run effects ($\alpha = 1$, $\beta = \gamma$ and $\beta^- = \gamma^-$), implying no adaptation, and assuming no asymmetries ($\beta^- = \gamma^- = 0$). The coefficient estimate on the output variable is positive and statistically different from zero at the 5% level. Stevenson and Wolfers (2008) report a similar result using EB data and employing the same specification. The second column adds the trend component of output. The coefficient of the output variable becomes larger and statistically significant at the 1% level. The coefficient of the trend component is statistically significant and quite close in magnitude to the negative of the coefficient of the output variable. The null that the coefficient of the trend component equals the negative of the coefficient of the output variable cannot be rejected. That is, we cannot reject the hypothesis that SWB is associated with the fluctuations of output around its trend rather than with output itself in the long run. This finding is in line with the earlier studies mentioned above.

Columns 3 and 4 of Table 2 allow for adaptation but, by setting $\beta^- = \gamma^- = 0$, assume no asymmetries. The models are thus conventional ARDL models similar to the ones estimated by Vendrik (2013) using German micro data. The estimated speed of adjustment, α , is below 0.2 and significantly different from both 0 and 1.¹⁵ The short-run coefficient, that is, the immediate effect (the first-year effect or the impact effect) of the output variable, is about 0.65 and statistically significant at the 1% level in both columns 3 and 4. The long-run coefficient, however, is much smaller and not statistically significant, regardless of whether or not the trend component is controlled for. The statistical significance in the short run and insignificance in the long run is in line with the results on the effects of national income presented by Di Tella and MacCulloch (2008) and the results on the effects of household income by Di Tella et al. (2010) and Vendrik (2013).¹⁶ Clark et al. (2016) argue that the results on adaptation to all income changes are not informative about adaptation to poverty because the income drops associated with poverty entry are a small minority of all income changes. Correspondingly, negative national income changes are a minority of all national income changes. As we will see, the above result of complete adaptation to national income changes masks a significant difference between adaptation to positive

¹⁵Also an earlier study by Blanchflower (2007) finds that the coefficient of the lagged dependent variable is large, and thus, adaptation is slow, in macro data compared to what has been found in studies using micro data.

¹⁶Di Tella et al. (2003) find evidence for adaptation but conjecture that adaptation is not complete. Their EB data is relatively short (1975-1992) and they encourage future research to revisit the issue.

and negative changes.

Columns 5 and 6 present estimates from models that allow for asymmetries but not adaptation to the effects of output changes. The no-adaptation restriction means imposing $\alpha = 1$, $\beta = \gamma$ and $\beta^- = \gamma^-$. The variables of the models are the output variable and the partial sum variable which includes the past negative changes in the output variable and the current change if it is negative. The results point to statistically significant aversion to losses. The degree of loss aversion is much smaller when the trend component of output is included, partly reflecting the resulting larger coefficient on the output variable. Although trend growth is not statistically significant, we cannot reject the hypothesis that SWB is associated with the fluctuations of output rather than output in the long run.

[Table 2 about here]

The results so far point to the importance of both adaptation and asymmetries. We now proceed to estimating equation (1), which allows for both of the two phenomena. The results are presented in columns 7 and 8 of Table 2. The short-run effects of positive and negative changes in output are estimated to be almost 0.4 and about 1.4, respectively. The difference between the two parameters is statistically significant, indicating that there is significant loss aversion in the short run. The asymmetry is much more pronounced in the long run. This is because the long-run coefficient estimate on positive output changes is close to zero and the coefficient estimate on negative output changes is a bit larger than the corresponding short-run estimate. What is left from the effects of positive changes in the long run is not statistically significantly different from zero. In turn, negative changes are significantly associated with life satisfaction in the long run. Adjustment is somewhat faster compared to the models with adaptation only. As before, we cannot reject the hypothesis that trend growth does not have any effect on SWB in the long run. However, this result is not relevant because the long run effects of any positive changes are not statistically significantly different from zero. Because of this, we will discuss the findings in column 7.

Let us now turn to interpretation of the results. Clearly, the interesting questions concern the short-run and long-run SWB effects of positive and negative output changes. Furthermore, we are interested in the speed of adaptation, or, more generally, adjustment. Some care has to be taken in drawing conclusions about the short-run effects of output changes because

the explanatory variable Δy is the sum of the change in the log of the real GDP's cycle component (ΔC) and the change in its trend component (ΔT). Because ΔT is, in the case of a linear trend, a country-specific constant, its effect is absorbed by the country fixed effect. Thus, the estimate of the short run effect of a positive change in output is an estimate of the effect of a change in the cycle component.¹⁷ When assessing the short run effect of an output change, we need to make an assumption about the effect of trend growth. There are two natural candidates for the effect: The effect of a change in the trend component in the short run is either equal to the estimated effect of a change in the cycle component, or the effect is equal to zero.¹⁸ The former assumption is routinely made in the context of ARDL models, but it is important to emphasise that the assumption made does not affect the results or interpretations on the long run in any way. Yet, it is interesting from the point of view of SWB analyses because it affects the interpretation of the short-run effects and, thus, adaptation. Therefore, we must examine the short run effects of GDP changes separately under the two assumptions.

Figure 1 presents two graphs of the short-run and long-run effects of the log of real GDP changes. The graph on the left assumes that the short-run effects of a change in the cycle component and in the trend component are equal. The graph on the right assumes that trend growth has a zero effect. In these graphs, we set trend growth to 2.1%, which is the average trend growth in our sample. The graph on the left points to adaptation to positive changes in output. So does the graph on the right once one takes into account the insignificance of the long run effect of a positive change. Notice that the graph on the right is in line with the idea that trend growth is classified as a foregone gain in the short run. Thus, trend growth is needed to keep SWB constant. This means that an economy not growing has a negative effect on SWB, but since trend growth is a foregone gain, the effect is not as strong as in the case of a loss. The foregone-gain effect is adapted to in the long run. Losses, that is, negative changes in GDP, have visibly larger effects than GDP gains both in the short run and in the long run. The effects are mostly of similar magnitude, so we do not observe significant adaptation to losses. Overall, our results suggest that there is

¹⁷See the online Appendix for a more thorough and formal discussion of these issues.

¹⁸A way to get information on the plausibility of the two assumptions is to rely on between-country variation. We regressed the average SWB in the sample countries on trend growth rate, and the resulting coefficient is negative and insignificant. This result points to the effect of trend growth being zero.

adaptation to the effects of positive changes in output. Negative changes, the effects of which are larger than those of positive changes, are not adapted to.

[Figure 1 about here]

Our results so far come from our baseline NARDL specification (1), which is restrictive in the sense that no lags beyond the first are included. This means that we do not observe how the effects evolve over time. Moreover, our results suffer from omitted variables biases if the excluded lag variables are relevant and are correlated with the variables in the current model. In what follows, we augment model (1) by including more lags to it.

Results from a More Flexible Model

To allow for flexible short-run dynamics, previous studies examining adaptation to income changes have controlled for more lags of the explanatory variable. For example, Vendrik (2013) includes two lagged differences of the income variable in his ARDL model of life satisfaction. Lagged values of the explanatory variable have also been controlled for in models of SWB by Di Tella et al. (2003), Di Tella and MacCulloch (2008) and Di Tella et al. (2010). These studies have estimated DL models in which each additional lagged level of the income variable allows for more flexibility in the short run but also a longer dynamic SWB process following an income change. In this section, we follow standard practice in estimating ARDL models by adding lagged first-differences of both the explanatory variable and the dependent variable into model (1). The number of lagged differences to be included is chosen according to the following model selection procedure. We start by estimating a model of the general form

$$\begin{aligned}
 s_{i,t} = (1 - \alpha)s_{i,t-1} &+ \sum_{j=0}^{q-1} (\beta_j \Delta y_{i,t-j} + \beta_j^- \Delta y_{i,t-j} D_{i,t-j}) + \sum_{j=1}^{p-1} \phi_j \Delta s_{i,t-j} \\
 &+ \gamma \sum_{\tau=I_i}^{t-1} \Delta y_{i,\tau} + \gamma^- \sum_{\tau=I_i}^{t-1} \Delta y_{i,\tau} D_{i,\tau} + \lambda_i + \eta_t + \epsilon_{i,t},
 \end{aligned} \tag{2}$$

where $q = 4$ and $p = 4$. We first test the joint significance of β_3 and β_3^- and the significance of ϕ_3 .¹⁹ We then drop the variables associated with insignificance at the 10% level and re-run the model. Again, the significances

¹⁹We want to minimise the loss of panel observations and thus set the maximum lag

of the longest lags are tested for and the redundant variables are dropped. This procedure is repeated until both the β and β^- for the longest lag of the GDP variables and ϕ for the longest lag of the life satisfaction variable are statistically significant. Following this procedure, we end up estimating a model with two lagged differences of output and three lagged differences of SWB. The results from estimating this model are reported in the second column of Table 3. For comparison purposes, we have re-estimated the model in column 7 of Table 2 using the smaller sample, and the results are presented in the first column of Table 3. It can be observed from the first column that the results for the smaller sample are very similar to the results for the full sample.

[Table 3 about here]

Although many of our findings remain unaltered, employing the more flexible specification reveals that the short-run dynamics cannot be satisfyingly described by the simpler specification. The lower panel of Table 3 presents the dynamic effects of GDP changes on SWB over the first ten years and the long-run effects. It can be observed that, in fact, the effect of a positive output change does not start dissipating immediately after the first-year effect. Instead, the effect reaches its maximum in the second year, i.e., year after the output change has occurred. Other macro-level studies using EB data have also found that the effect of an output change is largest in the year following the output change (Di Tella et al., 2003; Di Tella and MacCulloch, 2008). This may be because many of the EB surveys are conducted in the first half of the calendar year or because output change actually affects SWB with a lag. The effect of a positive output change is statistically significantly different from zero at the 10% level up until the ninth year after the output change. Notice that adaptation is fast so that most of it has occurred after two years from the impact. The 10th-year effect is not statistically significant, nor are the effects after that, based on further calculation.

The effects of a negative output change follow a somewhat different pattern, but as in the case of a positive output change, the first-year effect is not the largest effect. The effects become larger in the course of time, and they are statistically significantly different from zero in every year following

length for the differenced variables to 3, which means that we use GDP and life satisfaction information up to year $t - 4$. By doing this, we lose 101 observations in total from our sample. We also experimented with maximum lag lengths of 4 and 5 but ended up with similar results. These results are available upon request.

the change and also in the long run. We also tested for effect asymmetry in each year. It was found that the effect of a negative output change is statistically significantly larger than the effect of a positive output change in every year except for the second year. As can be seen from Table 3, the second-year effect of a positive output change is, in fact, slightly larger than the effect of a negative change.

As discussed earlier, we must exercise caution when interpreting the short-run results because we do not get an estimate of the short-run effect of trend growth. That is, the coefficients of the first-differenced output variables are only informative about the short-run effects of changes in the cyclical component of output. As was done in the case of Figure 1, we now use the two alternative assumptions about the effect of trend growth in the short run. The dynamic effects of a positive and negative unit change in log of real GDP per capita over the first 30 years following the output change under the two assumptions are presented in Figure 2.^{20,21} The left-hand panel makes the assumption that the short-run effect of trend growth is the same as the short-run effect of a change in the cyclical component of output. Notice that this assumption was also implicitly made above when we interpreted the effect estimates in the lower panel of Table 2 as the effects of output changes. The right-hand panel of Figure 2 in turn makes the assumption that trend growth does not have any short-run effect. Black and gray lines show the effect estimates from the augmented model in column 2 of Table 3 and, for comparison purposes, the baseline model in column 1 of Table 3, respectively. Upper lines show the effects of a positive change and lower lines show the effects of a negative change.

[Figure 2 about here]

It can be seen by comparing the left-hand and right-hand panels of Figure

²⁰Because only the cyclical component of output has a short-run effect in the right-hand panel, we need to know how much of a unit change in output is cyclical. In our sample, the mean trend growth is 72% of the mean absolute GDP change. Therefore, the cyclical component changes 0.28 for every positive ‘typical’ (unit) change in output. In turn, the cyclical component changes -1.72 for every negative ‘typical’ (unit) change. Notice, however, that in the case of a negative unit change in output, -0.72 is treated as a foregone gain and the remaining -1 is treated as a loss. We use these numbers to calculate the effects in the right-hand panel of Fig. 2. We advise the reader also to consult the online Appendix and the discussion related to Fig. 3 below to see how this works.

²¹The long-run effect of trend growth is set to equal the long-run effect of the cyclical component. This is what we found when we tried adding the trend component variable in models presented in columns 1 and 2 of Table 3.

2 that many of the conclusions do not depend on what we assume about the short-run effect of trend growth. The effects of positive GDP changes are statistically significant for almost ten years and insignificant later. Negative changes in turn have statistically significant effects in the long run as well. As mentioned above, there is a marked effect asymmetry in about all years, the only exception being the second-year effects in the left-hand panel. In the right-hand panel, there is a statistically significant asymmetry in the second year also. This is because, under the assumption of a zero effect of trend growth, trend growth does not increase SWB in the case of a positive output change but the foregone-gain effect decreases it in the case of a negative change.

We can see at least some adaptation to positive output changes in both panels if we compare the sizes of the largest effect and the long-run effect. Similarly to earlier studies, we consider the fact that the effects become statistically insignificant over time a sign of adaptation. Significant short-run effects and an insignificant long-run effect are in line with the findings presented in Section II and the findings from micro-level studies that use symmetric models (Vendrik, 2013; Di Tella et al., 2010). Whether there is adaptation to negative output changes depends on what is assumed about the short-run effect of trend growth. If we assume that trend growth has the same short-run effect as the cyclical component (left-hand panel), the effect becomes larger over time. If trend growth is assumed to have no short-run effect (right-hand panel), the short-run effects of a negative change are larger due to the foregone-gains effect and some adaptation is observed after the second year. In any case, the effects of a negative output change are relatively large and statistically significant in the short run and in the long run. The persistence of the effect of a negative output change on well-being is in line with the results presented in Section II. This result is also in line with Clark et al. (2016) who show that there is no adaptation to poverty or to any income drop at the individual level. Although the magnitude of the asymmetry varies over time and depends on the assumption made, we can say that the asymmetry becomes more important over time. This is because positive changes have statistically significant effects only in the short run but the effects of negative changes are significant over the long run as well.

The dynamic effects in Figure 2 are calculated for a ‘typical’ output change in the sense that trend growth relative to the output change is fixed to equal the average trend growth relative to the average absolute growth in the data. Let us now look at the effects of output changes of different sizes

shown in Figure 3 for the flexible model (col. 2 of Table 3). Assumptions about the effect of the trend growth in the left-hand panel and in the right-hand panel are the same as those in the left- and right-hand panels of Figures 1 and 2.²² In addition to the impact effects (gray lines) and the long-run effects (black lines), we have drawn the maximum effect (dashed line). We have determined the maximum effects based on calculating effects for ‘typical’ positive and negative output changes, i.e., for 2.9% and -2.9%, respectively. Therefore, the years in which the maximum effects occur can be identified from Figure 2 as well. The number at the end of each line denotes the lag, i.e., years passed from the output change.

[Figure 3 about here]

As in Figure 1, we can see the role of foregone gains in the right-hand panel. The short-run asymmetry is larger when we assume the foregone-gain effect, as in Figure 2. In the right-hand panel, we also observe that for output drops larger than ‘typical’ there is little to no adaptation to the maximum effect. Finally, if we use Figure 3 to assess loss aversion in the long run, we can see that there are clear asymmetries in the effects of output changes of all sizes.

The results of the NARDL models presented in this section provide new evidence on the long-run effects of positive and negative output changes. To get an idea of how significant output changes are in shaping well-being in the long run, we have calculated the SWB changes associated with one standard deviation changes in output. Based on the results in column 2 of Table 3, a one within-country standard deviation increase (decrease) in the log of real GDP per capita is associated with a life-satisfaction increase (decrease) of 0.28 (2.88) within-country standard deviations in the long run. In a previous study using EB data, Di Tella and MacCulloch (2008) show that there is no statistically significant long-run effect of an output change when the long-run effects of positive and negative output changes are assumed to be of equal size. Similar result has been found in studies using individual-level data (Di Tella et al., 2010; Vendrik, 2013). Our results show that the insignificant long-run effect holds for positive changes but not for negative changes. Our results thus indicate that the insignificant long-run effect found previously results from the insignificant long-run effect of positive

²²Because the marginal effect is independent of the size of the GDP change under the assumption made in the left-hand panels, the information in Fig. 3 is the same as that in Fig. 2 when it comes to the left-hand panels.

changes. Furthermore, by observing strikingly different long-run effects of positive and negative output changes, we are able to show that the macro-level short-run asymmetries found by De Neve et al. (2018) are persistent.

3 DISCUSSION AND ROBUSTNESS

Discussion

Our results indicate that the relationship between GDP and SWB is influenced by both adaptation to positive GDP changes and asymmetries. We also show that the short-run loss aversion observed in earlier macro- and micro-studies persists at the macro level in the long run. Thus, we can confirm many of the findings of earlier studies, each of which looks at only one of the two phenomena. Ignoring one of the phenomena has led to a failure to notice that there is no adaptation to income reductions. A notable exception is the recent paper by Clark et al. (2016) which focuses on adaptation to poverty and income reductions and is, therefore, able to find the no-adaptation result. Our findings emphasise that the correct strategy when studying the income-SWB relationship, at least at the macro level, is to allow for both adaptation and loss aversion. Results from our simpler models reveals that allowing for adaptation but ignoring asymmetries can lead one to conclude that income changes do not matter in the long run (col. 3 and 4 in Table 2). Ignoring adaptation but allowing for asymmetries, however, can lead one to ignore the possibly large variability in the effects over time (col. 5 and 6 in Table 2). Further, specifications should be flexible enough so that effect dynamics, such as the effects peaking only after some time has passed from the income change, can be observed (col. 7 in Table 2 vs. col. 2 in Table 3).

Although we are the first to document the larger long-run effects of negative than positive national income changes, results from some earlier studies point to such an asymmetry. Wolfers (2003) has shown that business cycle volatility, measured by variation in unemployment, is harmful to well-being. Our results suggest that business cycles are harmful if they are associated with at least some national income reductions. A recent paper by Clark et al. (2015) presents evidence for negative effects of poverty entries on individuals' well-being. These effects persist even after poverty exit. Similarly, our results suggest that national income reductions have negative effects in the long run, despite a period of recovery following the reductions. In addition to the above papers, Clark (2015) explains in his review that people

tend to adapt more, and more quickly, to positive than to negative events, which leads to people having a more general tendency to be loss averse in the long run.

Given our results, it is interesting to examine how they can help us understand why, as originally noted in the United States by Easterlin (1974), nations' SWB levels do not seem to grow in the long run although the economies are growing. Based on statistical insignificance of the effect of a positive GDP change in the long run, one could argue that GDP growth has a zero long-run effect on SWB. In that case, SWB does not grow over time simply because people adapt completely to national income increases. However, because GDP per capita may measure social reference income, some part of this observed macroeconomic adaptation may be due to the presumably negative effect of others' income building up over time. Vendrik's (2013) results using a German individual-level panel point to these kinds of dynamics of social comparisons, whereas the effect of one's own income dissipates over time.

Further questions arise if we take the estimated long-run effect at face value and ignore its statistical insignificance. One interesting question is whether the estimated long-run loss aversion is strong enough for the effects of the negative GDP changes in the data to offset the effects of the positive changes, thus keeping SWB from rising in the long run. For example, Easterlin (2009) and De Neve et al. (2018) have speculated about this, but ours seems to be the first analysis to provide results on the importance of loss aversion in the long run. We can apply the estimated coefficients of positive GDP changes (0.13) and negative GDP changes (1.68) taken from column 2 of Table 3 to the GDP changes in our data and see that, indeed, macroeconomic long-run loss aversion keeps SWB from rising. That is, the SWB gains from GDP growth in our sample are offset by the SWB losses from GDP reductions in our sample. Similar calculations for each country reveal that the GDP changes experienced during the sample period have made only 4 out of 34 countries better off in terms of SWB. The time-series for all of these countries are relatively short and 3 of them did not experience any GDP decreases during the sample period. In general, the effects of the GDP decreases in our sample have not been offset by SWB gains from GDP growth. However, some countries, notably France and Belgium, have been able to avoid large SWB decreases by experiencing relatively small GDP decreases during their economic crises.

Given that long-run loss aversion is so strong, another interesting question is how macroeconomic adaptation contributes to it. Put differently, are

the effects of positive and negative GDP changes such that, without any adaptation, the GDP changes in our data would actually improve SWB over the long run? To answer this question, we need to look at the maximum effects that positive and negative GDP changes have and assume that these effects are not diminished later by adaptation. It appears that the answer depends on what we assume about the short-run effect of trend growth. The estimated effects of GDP changes of different sizes under the two alternative assumptions can be seen in Figure 3. Assuming that trend growth has the same effect as deviations from it (left-hand panel), there is very little asymmetry in the maximum effects. In this case, should adaptation not diminish the effects, GDP changes lead to SWB growth in the long run. If it were assumed that trend growth has a zero effect on SWB (right-hand panel) and, therefore, that growth falling short of trend growth has a negative foregone-gain effect, the sum of positive effects would not be larger than the sum of negative effects. In this case, the result is no SWB growth in the long run, even without adaptation.

Based on the above discussion, the assumption made about the short-run effect of trend growth determines which of the two phenomena causes the non-increasing time profile of SWB: either adaptation to the positive GDP changes and no adaptation to the negative changes; or the effects of positive changes being relatively small already in the short run. Both of these would lead to the large long-run asymmetry that we find and, thus, no SWB growth over time.

Robustness checks

Below we will discuss the results from different robustness checks for the NARDL model with lagged differences of SWB and GDP. In all of the robustness checks, we have chosen the number of lagged differences to be included based on the procedure described in Section 3.3.²³

Up until this point, LSDVC has been our preferred estimation method because of the Nickell bias. However, if we use standard least squares dummy variables (LSDV), we end up with results similar to the ones reported above. In the LSDV results, the coefficient of the lagged level of life satisfaction is around 0.7, which is smaller than in the LSDVC results, but the estimates of the long-run effects of positive and negative changes in output are of similar magnitude.²⁴

²³The results discussed in this section are available from the authors upon request.

²⁴When we use LSDV, we are able to use country-clustered standard errors that are

Two features of our data set may raise concerns from the point of view of robustness of the results. First, many of the negative GDP changes in the sample occur during the post-2008 crisis, so the results may be largely driven by that crisis. However, estimations excluding the post-2007 years yield very similar results as the whole sample. Second potential source of concern may be that the sample is highly unbalanced and many of the time-series are quite short. We have tried limiting the sample to the longer time-series to reduce unbalancedness and the number of short time-series. We start with the 8 original EB member countries and then add the longest available time-series one by one until all the EU-15 countries are included. Our main result on the long-run asymmetry is robust to these changes. The long-run effect of a positive GDP change becomes statistically significant at the 10% level when only the longest 8 time-series are included, but otherwise the qualitative results on the long-run effects remain similar. Also the results of the second-year effect of a positive GDP change being larger than the immediate effect and the effect dissipating in time are replicated for the data sets that are more balanced and include, on average, longer time-series.

Some studies that examine the relationship between GDP and SWB have controlled for some individual-level or macro-level control variables such as age, gender, employment status or the rate of unemployment (Di Tella et al., 2003; Di Tella and MacCulloch, 2008; Stevenson and Wolfers, 2008; De Neve et al., 2018). Some of them do this to check the robustness of the results. Our paper belongs to the group of studies in which the focus is on the GDP-SWB relationship, and many of the control variables are seen as being determined by the economy, measured by GDP. In the case of such variables, like unemployment, the association between GDP and SWB is thus mediated through these variables.²⁵ Although our focus is not to study the transmission mechanisms by including mediator variables in our models, some other variables can be controlled for. Age and gender (controlled for by e.g. Stevenson and Wolfers, 2008 in their analyses) are examples of variables that are likely not determined by GDP but may affect SWB. We have checked the robustness of our results to controlling for age and gender. Since the variable of interest, output, only varies at the country-year level, the individual-level variables capture the effect of within country changes

not available in the LSDVC method. The choice of standard errors in LSDV does not affect the significance of the coefficients, however.

²⁵However, we tried controlling for the level of unemployment and the level of inflation using data from Eurostat and OECD, respectively. This exercise did not change our results.

in these control variables. For example, age controls can capture the effect of population aging over time. We tried controlling for age and gender by using a dependent variable from which the effects of these variables are removed.²⁶ Using this strategy, we find results almost exactly similar to the ones reported above, with no change in the significance of the reported coefficients.

When we use the LSDVC method, we have to choose the accuracy of the bias approximation and the instrument set for the initial estimator. In the LSDVC results presented above, we have used bias approximation that is accurate to order $O(T^{-1})$. Although this should, on average, account for 90% of the true bias, also approximations with higher order terms are available for situations in which the number of cross-sectional units is not very large (Bruno, 2005). Furthermore, we have used all available lags as instruments for the initial estimator. Roodman (2009) argues that using all available lags for instruments may lead to biases which can be alleviated by using less instruments and, based on author's simulations, especially doing so by collapsing the instruments. Thus, any remaining bias in our estimates could be further reduced by using a more accurate bias approximation and reducing the number of instruments. To check robustness, we have estimated the model using bias approximation that is accurate to the (maximal) order of $O(N^{-1}T^{-2})$ and reducing the number of instruments from 450 to 39 by collapsing the instruments. We also tried changing the initial estimator from difference GMM to system GMM, again with the highest order bias approximation and collapsed instruments. These analyses yielded similar estimates as were obtained without the modifications. Most importantly, the estimated short-run and long-run effects of positive and negative changes and their statistical significances are similar, so our conclusions do not change.

4 CONCLUSIONS

Earlier studies of the effects of income on subjective well-being using micro data have found evidence for adaptation and loss aversion. Other studies have found that reflections of both phenomena can be observed in the re-

²⁶To construct this new dependent variable, we regressed life satisfaction on country-year dummies controlling for three gender categories (male, female, no answer), a quartic in age, a dummy for missing age, and interactions between the gender dummies and age variables. Using the estimated coefficients of the country-year dummies from this regression, we attain the average life satisfaction for each country-year controlling for gender and age.

lationship between national income and subjective well-being. We adopted an empirical framework which allows for both adaptation and asymmetries to study the macro relationship. The approach has the advantage of avoiding biases arising from ignoring either adaptation or loss aversion. More importantly, the approach allows us to present first evidence of long-run asymmetries in the effects of national income on well-being.

Our findings are in line with what one would expect based on earlier studies. Positive changes in national income have effects on well-being in the short run but these effects wear off over time. Negative changes are incompletely, if at all, adapted to. Thus, there is a long-run asymmetry in the effects of national income changes.

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Table 1. Descriptive Statistics

Variable	N	Mean	SD	SD (within)	Min	Max
Life satisfaction (s)	674	2.99	0.34	0.10	2.02	3.71
GDP per capita in 2005 euros	674	23735	7910	5069	8632	52498
Economic growth (Δy)	674	0.019	0.032	0.031	-0.156	0.226
conditional on being positive ($\Delta y > 0$)	555	0.029	0.023	0.020	0.000	0.226
conditional on being negative ($\Delta y < 0$)	119	-0.028	0.030	0.023	-0.156	-0.001
Trend growth (ΔT)	674	0.021	0.008		0.010	0.041

Economic growth measured as the log change. Trend growth estimates based on linear time trends fitted to the log of real GDP per capita series from 1970 (or from the beginning of the series if later than 1970) to 2020.

Table 2. Models of Life Satisfaction.

	Neither		Adaptation		Asymmetry		Both	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
s_{t-1}			0.81*** (0.03)	0.81*** (0.03)			0.76*** (0.03)	0.76*** (0.03)
y_t	0.33** (0.16)	0.79*** (0.16)			0.22** (0.09)	0.49** (0.22)		
y_t^-					1.47*** (0.37)	1.25** (0.56)		
Δy_t			0.66*** (0.13)	0.67*** (0.13)			0.38** (0.15)	0.36** (0.16)
Δy_t^-							1.06*** (0.31)	1.07*** (0.31)
y_{t-1}			0.03 (0.03)	0.05 (0.06)			0.04 (0.03)	0.01 (0.07)
y_{t-1}^-							0.32*** (0.09)	0.33*** (0.10)
T_t		-0.72*** (0.24)				-0.39 (0.29)		
T_{t-1}				-0.03 (0.08)				0.03 (0.08)
α			0.19*** (0.03)	0.19*** (0.03)			0.24*** (0.03)	0.24*** (0.03)
1st-year effect of Δy	0.33** (0.16)	0.79*** (0.16)	0.66*** (0.13)	0.67*** (0.13)	0.22** (0.09)	0.49** (0.22)	0.38** (0.15)	0.36** (0.16)
Long-run effect of Δy	0.33** (0.16)	0.79*** (0.16)	0.18 (0.17)	0.28 (0.31)	0.22** (0.09)	0.49** (0.22)	0.14 (0.13)	0.06 (0.28)
1st-year effect of Δy^-					1.69*** (0.35)	1.74*** (0.43)	1.43*** (0.25)	1.42*** (0.25)
Long-run effect of Δy^-					1.69*** (0.35)	1.74*** (0.43)	1.45*** (0.36)	1.44*** (0.37)
Long-run effect of ΔT		-0.72*** (0.24)		-0.15 (0.39)		-0.39 (0.29)		0.11 (0.34)

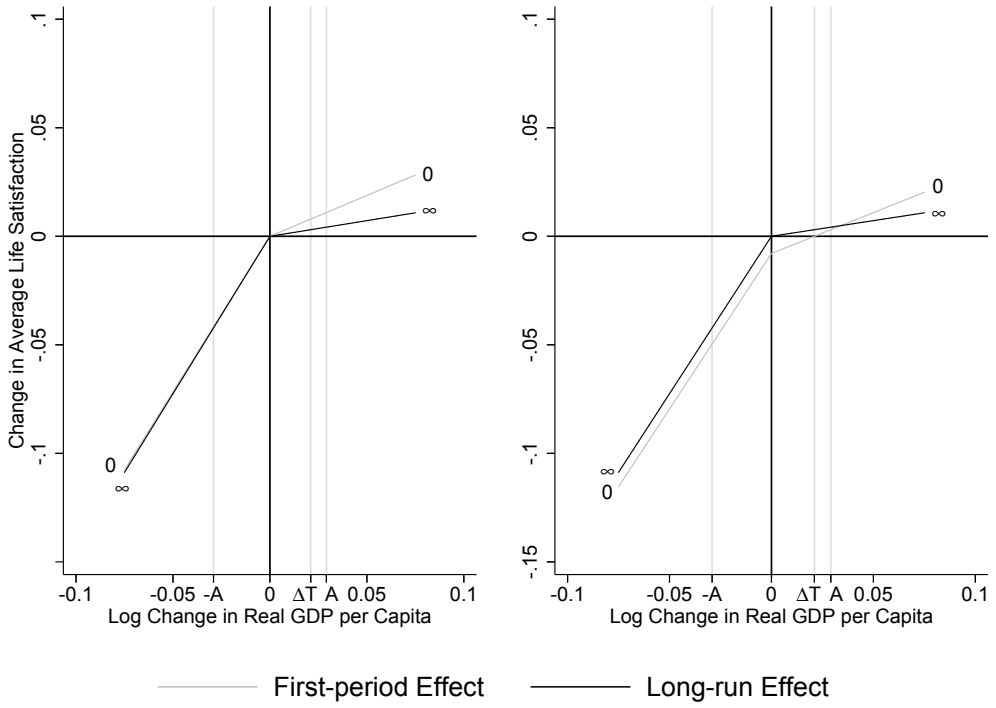
Dependent variable: country-year average of life satisfaction (s). Notation: y = log of real GDP per capita; y^- = sum of negative changes of y from the first year of the sample; Δy^- = change of y if negative, otherwise zero; T = trend component of y ; α = one minus the coefficient of s_{t-1} . OLS (cols 1, 2, 5 and 6) and bias-corrected (cols 3, 4, 7 and 8) estimates. N = 674. Country and year fixed effects included. Upper panel: the coefficient estimates. Lower panel: the estimated effects and hypothesis testing. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively. Standard errors in parentheses clustered at the country level (OLS models) or bootstrapped with 200 replications (bias-corrected models). The delta method applied where necessary.

Table 3. More Flexible Model of Life Satisfaction

	Simple (1)		Flexible (2)	
s_{t-1}	0.73***	(0.04)	0.78***	(0.03)
Δs_{t-1}			-0.13***	(0.04)
Δs_{t-2}			-0.04	(0.04)
Δs_{t-3}			0.07*	(0.05)
Δy_t	0.53***	(0.15)	0.43**	(0.17)
Δy_{t-1}			0.83***	(0.21)
Δy_{t-2}			-0.49***	(0.18)
y_{t-1}	0.04	(0.03)	0.03	(0.03)
Δy_t^-	0.98***	(0.34)	0.81**	(0.35)
Δy_{t-1}^-			-0.68*	(0.36)
Δy_{t-2}^-			0.43	(0.39)
y_{t-1}	0.43***	(0.12)	0.33**	(0.13)
1st-year effect of Δy	0.53***	(0.15)	0.43**	(0.17)
2nd-year effect of Δy	0.43***	(0.12)	1.14***	(0.20)
3rd-year effect of Δy	0.36***	(0.10)	0.32*	(0.18)
4th-year effect of Δy	0.31***	(0.09)	0.39***	(0.15)
5th-year effect of Δy	0.27***	(0.10)	0.41***	(0.14)
6th-year effect of Δy	0.24**	(0.10)	0.29**	(0.13)
7th-year effect of Δy	0.22**	(0.10)	0.27**	(0.13)
8th-year effect of Δy	0.21*	(0.11)	0.25**	(0.13)
9th-year effect of Δy	0.19*	(0.11)	0.22*	(0.13)
10th-year effect of Δy	0.19*	(0.11)	0.21	(0.13)
⋮				
Long-run effect of Δy	0.16	(0.12)	0.13	(0.15)
1st-year effect of Δy^-	1.51***	(0.11)	1.23***	(0.27)
2nd-year effect of Δy^-	1.59***	(0.12)	1.32***	(0.27)
3rd-year effect of Δy^-	1.64***	(0.26)	1.27***	(0.31)
4th-year effect of Δy^-	1.68***	(0.23)	1.45***	(0.29)
5th-year effect of Δy^-	1.71***	(0.24)	1.49***	(0.31)
6th-year effect of Δy^-	1.73***	(0.27)	1.52***	(0.35)
7th-year effect of Δy^-	1.75***	(0.30)	1.56***	(0.39)
8th-year effect of Δy^-	1.76***	(0.32)	1.58***	(0.43)
9th-year effect of Δy^-	1.77***	(0.34)	1.60***	(0.46)
10th-year effect of Δy^-	1.77***	(0.35)	1.62***	(0.49)
⋮				
Long-run effect of Δy^-	1.79***	(0.40)	1.68***	(0.60)

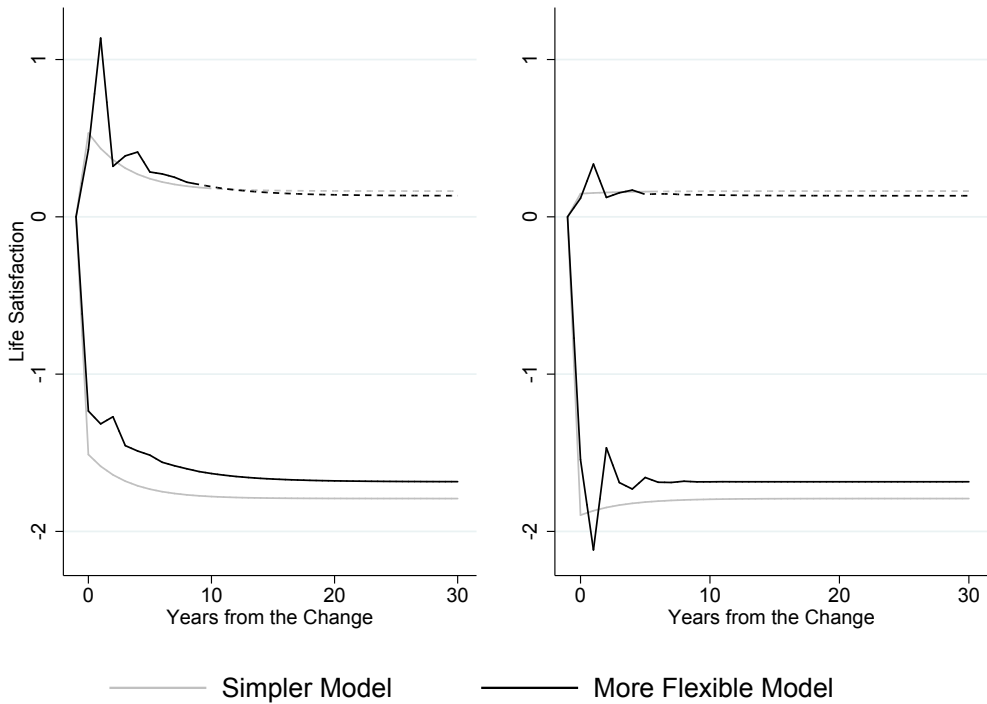
Dependent variable: country-year average of life satisfaction (s). Notation: y = log of real GDP per capita; y^- = sum of negative changes of y from the first year of the sample; Δy^- = change of y if negative, otherwise zero. Bias-corrected estimates. N = 573. Country and year fixed effects included. Upper panel: the coefficient estimates. Lower panel: the estimated effects and hypothesis testing. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively. Standard errors in parentheses bootstrapped with 200 replications. The delta method applied where necessary.

Figure 1. Effects of Log of Real GDP Per Capita Changes on Average Life Satisfaction



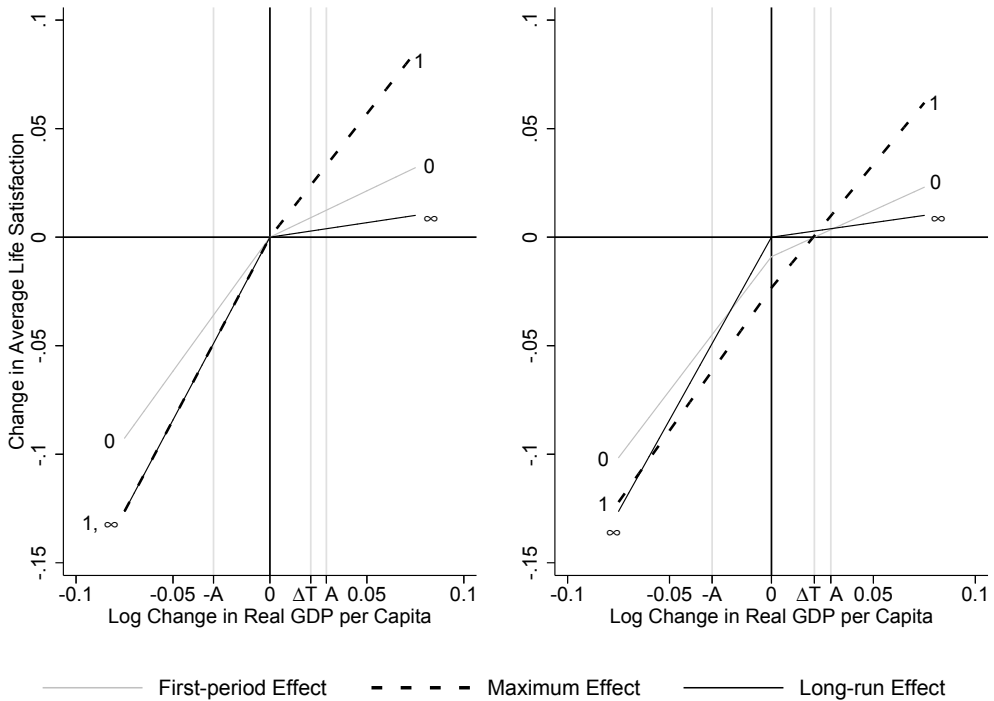
Left-hand panel: trend growth assumed to have an effect in the short run. Right-hand panel: trend growth assumed to have no effect in the short run. ΔT denotes the average trend growth of GDP in the sample (0.021) used to calculate the short-run effect sizes in the right-hand panel. A denotes the mean absolute growth of GDP in the sample (0.029). The lag associated with each line near the end of the line (the long-run effect is denoted by ∞).

Figure 2. Dynamic Effects of Real GDP Per Capita Changes on Life Satisfaction



Left-hand panel: trend growth assumed to have an effect in the short run. Right-hand panel: trend growth assumed to have no effect in the short run. Effects calculated for one-unit change of the log of real GDP per capita. In the right-hand panel, trend growth is set to about 0.72 units based on the average trend growth of GDP (0.021) being about 72% of the mean absolute growth of GDP (0.029) in the sample. Gray lines based on the results in column 1 of Table 3. Black lines based on the results in column 2 of Table 3. Solid (dashed) line indicates statistical significance (insignificance) at the 10% level.

Figure 3. Effects of Log of Real GDP Per Capita Changes on Average Life Satisfaction: More Flexible Model



Left-hand panel: trend growth assumed to have an effect in the short run. Right-hand panel: trend growth assumed to have no effect in the short run. ΔT denotes the average trend growth of GDP in the sample (0.021) used to calculate the short-run effect sizes in the right-hand panel. A denotes the mean absolute growth of GDP in the sample (0.029). The 'Maximum effect' is the largest of the estimated effects (lags from zero to infinity) calculated at mean absolute growth A , or, in the case of negative changes, $-A$. The lag associated with each line near the end of the line (the long-run effect is denoted by ∞).

ONLINE APPENDIX: ADAPTATION AND LOSS AVERSION IN THE RELATIONSHIP BETWEEN GDP AND SUBJECTIVE WELL-BEING

Controlling for the trend component of output

Long-run

Long-run effect estimates are obtained by including either the output variable (static models) or its lagged value (ARDL models) in the regression. Controlling the trend component of output (or its lag) allows trend growth and deviations from it to have different effects. Let us show this using our simplest model in which adaptation and loss aversion are not allowed for:

$$s_{i,t} = \gamma y_{i,t} + \lambda_i + \eta_t + \epsilon_{i,t}. \quad (\text{A1})$$

The output variable y is a sum of its cyclical component and trend component:

$$y_{i,t} = C_{i,t} + T_{i,t}. \quad (\text{A2})$$

If the two components have different effects on life satisfaction, the true model is

$$s_{i,t} = \gamma_C C_{i,t} + \gamma_T T_{i,t} + \lambda_i + \eta_t + \epsilon_{i,t}, \quad (\text{A3})$$

which can be written as

$$s_{i,t} = \gamma_C (y_{i,t} - T_{i,t}) + \gamma_T T_{i,t} + \lambda_i + \eta_t + \epsilon_{i,t}, \quad (\text{A4})$$

and, further, as

$$s_{i,t} = \gamma_C y_{i,t} + (\gamma_T - \gamma_C) T_{i,t} + \lambda_i + \eta_t + \epsilon_{i,t}. \quad (\text{A5})$$

Thus, including the trend component in a model with the output variable as the regressor allows the trend component and the cyclical component to have different effects on life satisfaction. Testing the statistical significance of the coefficient $(\gamma_T - \gamma_C)$ then tests the difference of the effects of the two components. For example, in an intuitive special case in which trend growth does not have any effect on life satisfaction in the long run ($\gamma_T = 0$), zero output growth has a (negative) foregone-gain effect of $-\gamma_C$. This hypothesis can be tested after estimating a model of type (A5) and testing whether the coefficient of the trend component equals the negative of the coefficient of the output variable (i.e., $\gamma_T - \gamma_C = -\gamma_C$).

It is easy to see that the same logic applies to dynamic models although in such cases, the lagged trend component is controlled for.

Let us now consider the implications of controlling for the trend component in the case of asymmetries. The model is the one that allows for asymmetries but not adaptation:

$$s_{i,t} = \gamma y_{i,t} + \gamma^- y_{i,t}^- + \lambda_i + \eta_t + \epsilon_{i,t}. \quad (\text{A6})$$

Again, dividing y into the two components and using the above manipulations gives us

$$s_{i,t} = \gamma_C y_{i,t} + (\gamma_T - \gamma_C) T_{i,t} + \gamma^- y_{i,t}^- + \lambda_i + \eta_t + \epsilon_{i,t}, \quad (\text{A7})$$

which is the original asymmetries model but controlling for the trend component. An important feature of the model is that the long-run effect of an output change approaches $(\gamma_T - \gamma_C) \Delta T_i$ as the output change approaches zero, both from the right and from the left. This is a desirable property because, although we want to allow for an asymmetry around zero growth, we do not want to allow for any discontinuities in the effect function. In the special case of trend growth having a zero (long-run) effect (that is, $\gamma_T = 0$), if growth falls short of trend growth, this shortfall is a foregone gain instead of a loss.

Again, it is easy to see that the same logic applies to dynamic models.

Short-run

Let us first look at our simplest dynamic model, that is, the one with no asymmetries and a lag length of 1:

$$s_{i,t} = (1 - \alpha) s_{i,t-1} + \beta \Delta y_{i,t} + \gamma y_{i,t-1} + \lambda_i + \eta_t + \epsilon_{i,t}. \quad (\text{A8})$$

We have already discussed controlling for the lagged level of the trend component of output. Imagine now that the effects of the cyclical and the trend component are different in the short run. Short-run effects are captured by coefficients of the differenced variables. Because trend growth is a country-specific constant and its effect is, therefore, absorbed by the country fixed effect, we cannot get an estimate of its (short-run) effect.

If Δy is decomposed into change in the cyclical component and trend growth, the model becomes

$$s_{i,t} = (1 - \alpha) s_{i,t-1} + \beta_C \Delta C_{i,t} + \beta_T \Delta T_{i,t} + \gamma y_{i,t-1} + \lambda_i + \eta_t + \epsilon_{i,t}, \quad (\text{A9})$$

which can be written as

$$s_{i,t} = (1 - \alpha)s_{i,t-1} + \beta_C \Delta y_{i,t} + (\beta_T - \beta_C) \Delta T_{i,t} + \gamma y_{i,t-1} + \lambda_i + \eta_t + \epsilon_{i,t}. \quad (\text{A10})$$

From these it can be seen that, due to the fact that trend growth cannot be included, we get the same short-run effect estimate regardless of whether we include the change in output or the change in its cyclical component as a regressor. The estimate is, in both cases, an estimate of the effect of a change in the cyclical component. This is the reason why we need to make an assumption about the short-run effect of trend growth to get an estimate of the short-run effect of an output change.

As in the long run, the short-run effect of trend growth determines the annual constant effect on life satisfaction. The short-run effects have the same properties (described above) as the long-run effects.

Eurobarometer data

Eurobarometer surveys have included the life satisfaction question at least once a year starting from 1975.²⁷ In each survey, a random sample of approximately 1 000 individuals is interviewed within each participating country. Often there is more than one survey in a year that includes the life satisfaction question. We use data only from those surveys that were conducted in every country that was a member of the Eurobarometer that year. The numbers of the Eurobarometer surveys included in our sample are: 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, 15, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 31, 31A, 32A, 32B, 33, 34.0, 36, 37.0, 38.0, 39.0, 40, 41.0, 42, 43.1, 44.0, 44.2bis, 47.1, 49, 52.0, 52.1, 53, 54.1, 55.1, 56.1, 56.2, 57.1, 58.1, 60.1, 62.0, 63.4, 66.1, 67.2, 69.2, 70.1, 71.1, 71.2, 71.3, 72.4, 73.4, 74.2, 75.3, 76.3, 77.3, 78.1, 79.3, 80.1, 82.3, 83.3 and 84.3. Table A1 reports the number of surveys we use and the number of respondents each year. The time period for which each country is included in the sample is given in the footnote of the table. To calculate annual country-level averages of life satisfaction, we use the population weights given in the survey data sets. The weights are used to make the samples representative for each country. In Eurobarometer, weighting is based on respondents' gender, age, region, and size of locality.

²⁷We cannot use the European Community Survey life satisfaction data from the year 1973. This is because there is no life satisfaction data for the year 1974 and our methods require continuous time series.

Table A1. Eurobarometer surveys and respondents

Year	Countries	Surveys	Respondents
1975	8	2	16250
1976	8	2	15696
1977	8	2	15769
1978	8	2	15727
1979	8	1	7812
1980	8	1	7778
1981	9	1	8820
1982	9	2	17158
1983	9	2	17262
1984	9	2	17434
1985	11	2	19561
1986	11	2	21372
1987	11	2	21097
1988	11	1	10635
1989	11	4	42135
1990	13	2	24400
1991	13	1	13910
1992	13	2	27931
1993	13	2	28035
1994	13	2	28319
1995	16	1	17042
1996	15	2	84863
1997	15	1	16035
1998	15	1	16032
1999	15	2	31928
2000	15	2	31864
2001	15	3	47715
2002	15	2	31805
2003	15	1	15888
2004	29	1	29187
2005	29	1	29192
2006	29	1	29017
2007	30	1	30106
2008	30	2	59961
2009	30	4	119792
2010	31	2	61225
2011	32	2	63123
2012	33	2	65104
2013	33	2	64815
2014	33	1	32518
2015	29	2	57435

Eurobarometer data used in the analyses. The data from the year when a country enters the Eurobarometer are only used as lagged values of life satisfaction in the analyses. The 674 country-years used in the estimation sample are: BEL, DNK, FRA, GBR, IRL, ITA, LUX, NLD in 1976-2015; GRC in 1982-2015; ESP, PRT in 1986-2015; DEU in 1991-2015; NOR in 1991-1995; AUT in 1996-2015; FIN, SWE in 1996-2014; BGR, CYP, CZE, EST, HRV, HUN, LTU, LVA, MLT, POL, ROU, SVK, SVN, TUR in 2005-2015; MKD in 2008-2015; ISL in 2011-2014; MNE in 2012-2015; SRB in 2013-2014.

Chapter 4

Short-run and long-run asymmetries in the effects of income changes on subjective well-being: Evidence from a micro panel*

Matti Hovi^a and Jani-Petri Laamanen^b

Abstract

Subjective well-being has been shown to be more responsive to negative than to same-sized positive income changes. These results concern the short-run effects and no evidence on long-run asymmetries has been presented in the literature. Whether the determination of individuals' well-being exhibits loss aversion is important especially because experienced loss aversion is a prerequisite for rationality of loss aversion in choice. We study the effects of positive and negative income changes on subjective well-being using micro panel data. We control for social comparison effects which have been found important in earlier studies. Contrary to earlier micro and macro studies, we find that no evidence for asymmetries can be found neither in the short-run nor in the long-run. We speculate that this may be due to heterogeneity in the reasons behind the income drops in the data.

Keywords: Subjective well-being; Life satisfaction; Income; Loss aversion; Adaptation

JEL codes: D01, D31, I31

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^a University of Tampere, matti.hovi@uta.fi

^b University of Tampere, jani-petri.laamanen@uta.fi

1 Introduction

Loss aversion in both risky and riskless choice has been studied and documented in the literature of economics and other fields since Kahneman and Tversky's (1979) original contribution. In a recent overview of research related to prospect theory, Barberis (2013) gives examples of how loss aversion has been observed to affect choice in different contexts. In turn, very little is known about how loss aversion shapes experienced utility, the hedonic experience related to the consequences of the choice, or to any change in circumstances. Kahneman et al. (1997) argue that 'decision utility', the evaluation of alternatives based on which choices are made, and experienced utility are not guaranteed to coincide. This possibility of non-coincidence makes it important to understand how experienced utility is determined. Kahneman et al. (1997) go on to argue that experienced utility is measurable by subjective evaluations or reports.

Some earlier studies have used individuals' subjective well-being (SWB) reports to study loss aversion in the experienced effects of income changes. Di Tella et al. (2010) and D'Ambrosio and Frick (2012) use the German Socio-economic Panel (GSOEP) and Boyce et al. (2013) use the GSOEP and the British Household Panel Survey (BHPS) to study loss aversion. All of these studies allow loss aversion by regressing subjective well-being variables on positive and negative income changes. This means that estimates of short-run loss aversion are produced. The analyses support the idea of loss aversion: Positive income changes are associated with smaller subjective well-being effects than similarly sized negative income changes.

None of the above econometric studies allow for long-run loss aversion. Di Tella et al. (2010) and D'Ambrosio and Frick (2012) include an income-level variable in addition to the change variables. Therefore, income is allowed to have a long-run effect but, due to inclusion of only a single positive income change variable and a single negative income change variable, asymmetric experiences can last for one year only. Similar models are estimated using gross domestic product (GDP) as the income variable by De Neve et al. (2018) and evidence for 'macroeconomic loss aversion' is found. Frijters et al. (2011), using an Australian survey, and Diriwaechter and Shvartsman (2018), modelling job satisfaction with the GSOEP data, allow for longer-lasting asymmetries but not long-run ones. These two papers use multiple lags of indicators of financial changes instead of actual income changes. To our knowledge, only Hovi and Laamanen (2017) allow for long-run loss aversion in their study of the impacts of macroeconomic changes. They find

that loss aversion persists and gets even more important over time as the effects of positive GDP changes wear off and the effects of negative GDP changes remain large and statistically significant in the long-run.

The mechanism because of which the effects of income changes may be different at different lags is hedonic adaptation. Though evidence on adaptation to positive and negative income changes is limited, some authors have conjectured that people and nations may adapt differently to positive than to negative income changes (Easterlin, 2009; De Neve et al., 2018). Some support for such a claim has been found in empirical studies. Adaptation to income changes on average seems to be close to complete (Di Tella et al., 2010; Vendrik, 2013) but adaptation to negative income changes, especially poverty entries, does not occur (Clark et al., 2016). Of course, most income changes are not negative and incomplete adaptation to them may not show up when adaptation to all income changes is studied, as pointed out by Clark et al. (2016). At the macroeconomic level, Hovi and Laamanen (2017) have found that, indeed, complete adaptation to GDP changes on average cannot be rejected but allowing for differential adaptation to increases and drops leads to the conclusion that adaptation to drops is clearly far from complete.

In this study, we estimate short-run and long-run effects of positive and negative income changes using the German Socio-economic Panel data. Differential short-run effects of positive and negative income changes and differential adaptation to positive and negative changes are allowed for. Most importantly, we present evidence on previously unexamined micro-level long-run loss aversion. The analyses also serve as tests of whether previous results on adaptation and short-run loss aversion are robust to incorporating simultaneously both adaptation and loss aversion. We employ nonlinear autoregressive distributed lag (NARDL) modelling techniques. NARDL models allow for asymmetric effects both in the short run and in the long run but are previously used in subjective well-being research only to examine the effects of GDP changes (Hovi and Laamanen, 2017).

The results indicate that there are signs of loss aversion in the experienced well-being effects of income changes. This result is in line with earlier microevidence. Such asymmetries may persist for more than one year but evidence for long-run asymmetries is not found. The results suggest that income drops on average are harmful in the long run but not more harmful than income increases on average are beneficial. Although asymmetry cannot be observed when looking at income changes in general, future analyses focusing on income changes originating in different life changes and income changes due to changes in different income components may identify cases

in which asymmetries are persistent.

The remainder of this paper is organised as follows. Section 2 introduces the data and the empirical modelling strategy. Section 3 presents the results. Section 4 discusses the results. Finally, section 5 concludes.

2 Data and the empirical approach

The German Socio-economic Panel is a dataset often used to study the determinants of subjective well-being. Earlier studies using the GSOEP data to examine either loss aversion or adaptation to income changes are Di Tella et al. (2010), D'Ambrosio and Frick (2012), Boyce et al. (2013), Vendrik (2013) and Clark et al. (2015). In the GSOEP survey, individuals are asked to assess their satisfaction in life in general. Same individuals and households are followed over time which allows for estimation of dynamic effects. The GSOEP data begins in 1985 in West Germany, so many of the time-series are long.

We use the latest release of the data which includes years 1984-2014. Table 1 presents descriptive statistics for our sample. We employ the same sample restrictions as Vendrik (2013) who also estimates autoregressive distributed lag models. Thus, we include only West German individuals who did not move from the East Germany during the sample period. This is because we want to exclude real income variation coming from different price levels in the two parts of the country. Further, we exclude those who were self-employed in any year. Only those who were German nationals in all years were included. Individuals who are younger than 27 or older than 59 are excluded for reasons related to calculating the reference-group income variable (see Vendrik, 2013).

Previous studies mentioned above have allowed for loss aversion by regressing an SWB variable on a positive income change variable and a negative income change variable (in addition to a number of controls). As stated above, this method yields estimates of the short-run effects of positive and negative income changes. Dynamic effects to model adaptation have been estimated by either distributed lags (DL) models (Di Tella et al., 2010) or autoregressive distributed lag (ARDL / ADL) models (Vendrik, 2013). An ARDL model can be modified to incorporate asymmetries such as loss aversion. Schorderet (2001, 2003) has introduced a nonlinear variant of the autoregressive distributed lag model. Shin et al. (2014) is a more recent introduction to the NARDL approach. We adopt this approach to estimate short-run and long-run effects of positive and negative income changes. A

NARDL model can be written very similarly to a standard ARDL model, the difference being that negative income change variables and a cumulative sum of the negative changes since the beginning of the data are added as regressors.¹ Formally, such a model is as follows:

$$\begin{aligned}
s_{i,t} = & (1 - \alpha)s_{i,t-1} + \sum_{j=0}^{q-1} (\beta_j \Delta y_{i,t-j} + \beta_j^- \Delta y_{i,t-j} D_{i,t-j} + \beta_j^{REF} \Delta y_{i,t-j}^{REF}) \\
& + \gamma y_{i,t-1} + \gamma^- \sum_{\tau=I_i}^{t-1} \Delta y_{i,\tau} D_{i,\tau} + \gamma^{REF} y_{i,t-1}^{REF} + \delta' x_{i,t} + \lambda_i + \eta_t + \epsilon_{i,t}
\end{aligned} \tag{1}$$

The dependent variable $s_{i,t}$ is the life satisfaction of individual i in year t . We follow Vendrik (2013) as closely as we can to determine the explanatory variables and just add the variables needed to introduce asymmetries. The only difference to Vendrik (2013) when it comes to the set of control variables (x) is that we also control for the pensioner status. This control variable is added because some of the income drops are due to retirement and we want to identify the effect of income drops and capture the (presumably positive) effect of retiring by another variable. The control variables are listed in Table 1. We also control for individual (λ_i) and year (η_t) fixed effects.

Let us now turn to the income variables that are of primary interest here. Variable $y_{i,t}$ is the log of household real annual post-government income adjusted using the OECD equivalence scale. $D_{i,t}$ is a dummy variable equal to 1 if the income change was negative from year $t - 1$ to year t . $y_{i,t}^{REF}$ is the average of income (y) in individual i 's reference group in year t . We follow Vendrik (2013) in determining individual i 's reference group as the individuals who are of the same sex, are in the same education group (four groups as defined in Vendrik, 2013) and are less than six years younger and less than six years older than individual i . The coefficients of the differenced income terms (β_j , β_j^- and β_j^{REF}) capture the short-run effects of changes in own income and reference-group income.

Parameters γ , γ^- and γ^{REF} are there to model the long-run effects of income changes. The ‘partial sum’ $y_{i,t-1}^- = \sum_{\tau=I_i}^{t-1} \Delta y_{i,\tau} D_{i,\tau}$ is the sum of negative income changes from year I_i , which is the first year for which individual i 's household's income change can be calculated from the data, until year $t - 1$.²

¹As explained by Hovi and Laamanen (2017), such a model is equivalent to the original specifications of Schorderet (2001, 2003) and, therefore, yields equivalent results.

²Usually NARDL models include positive and negative changes of y and corresponding

Table 1. Descriptive Statistics

Variable	Mean	SD	Min	Max
Life satisfaction (s)	7.28	1.63	0	10
HH equivalent real income in 2011 euros	24609	13647	11	1036558
Log change in hhequiv. real income (Δy)	0.02	0.25	-7.13	5.44
conditional on being positive ($\Delta y > 0$)	0.15	0.19	0.00	5.44
conditional on being negative ($\Delta y < 0$)	-0.15	0.22	-7.13	0.00
HH equivalent real reference income in 2011 euros	24052	6252	12203	48150
Log of asset income	5.40	1.75	-1.48	13.76
Working hours per week	30.34	18.31	0	80
Working hours per week squared	1256	969	0	6400
Working	0.80	0.40	0	1
Irregularly working	0.01	0.11	0	1
Not working, in education or training	0.01	0.07	0	1
Not working, in maternity leave	0.02	0.14	0	1
Not working, in military-community service	0.00	0.00	0	1
Not working, unemployed	0.03	0.17	0	1
Not working, other	0.13	0.34	0	1
Workin, permanent contract	0.37	0.48	0	1
Working, temporary contract	0.32	0.47	0	1
Working, no contract reported	0.11	0.32	0	1
Working experience, full-time employment	15.80	10.67	0	44.80
Working experience, part-time employment	2.71	5.34	0	40.30
Working, white collar position	0.51	0.50	0	1
Working, managerial position	0.02	0.12	0	1
Working, civil position	0.06	0.24	0	1
Working, trainee position	0.00	0.05	0	1
Working, blue collar position	0.21	0.41	0	1
Working, other position	0.00	0.03	0	1
Age squared	1995	773	729	3481
Insitutional years of education	12.31	7.00	7	18
Overnight hospital stay dummy	0.10	0.30	0	1
Number of adults in the household	2.21	0.79	1	10
Number of children in the household	0.86	1.06	0	10
Being separated, with a partner	0.01	0.07	0	1
Being separated, without a partner	0.01	0.12	0	1
Being single, with a partner	0.05	0.22	0	1
Being single, without a partner	0.09	0.28	0	1
Being divorced, with a partner	0.03	0.16	0	1
Being divorced, without a partner	0.05	0.22	0	1
Being widow, with a partner	0.00	0.06	0	1
Being widow, without a partner	0.01	0.12	0	1
Being married	0.75	0.43	0	1
Pensioner	0.03	0.17	0	1
One person household	0.09	0.29	0	1
Couple without children	0.24	0.43	0	1
Single parent	0.05	0.22	0	1
Couple with children < 17 years	0.34	0.47	0	1
Couple with children > 16 years	0.16	0.37	0	1
Couple with children <17 and >16	0.08	0.27	0	1
Multiple generation household	0.02	0.12	0	1
Household type, other	0.01	0.11	0	1
State dummies	-	-	0	1
State-specific linear time trends	-	-	0	2013

N = 76,291. For 42,035 observations $\Delta y > 0$ and for 34,256 observations $\Delta y < 0$.

Although it is common to include lagged differences of the dependent variable in an ARDL model, we follow Vendrik (2013) in restricting the number of such terms to zero and allowing for flexibility by including lagged differences of the explanatory variables. In each estimation, q is determined by first setting $q = 4$ and then dropping the longest lags if they are jointly not statistically significant. A model is then re-estimated. This procedure is repeated until the longest lags are jointly significant.

We experiment with three different control variable sets: no controls (except individual and year fixed effects), not allowing the control variables to have dynamic effects (by just including the level variables), and allowing for dynamic effects (by including as many lagged differences as there are lagged differences of the income change variables). We estimate the models both by OLS and, following Vendrik (2013), by first estimating the coefficient of the lagged dependent variable by bias-corrected least squares dummy variables (BCLSDVC) using only the longest time series. The latter strategy is to avoid Nickell bias and other small-sample biases (Vendrik, 2013). Oft-used GMM-variant of Arellano-Bond type is employed as the initial estimator. The simplest bias-approximation which already corrects for a large share of the bias is used (Bruno, 2005).

3 Results

The parameter estimates from estimating different variants of model (1) by OLS are presented in Table 2a and the implied effect estimates of household and reference income changes are presented in Table 2b. The effects are calculated and their significance testing conducted for the anticipation effect, for four first years starting from the income change and for long-run. For comparison purposes, we also present results from estimating symmetric variants of the models, ie. models which do not include the negative change variables and the negative partial-sum variable. Somewhat depending on the model, an increase in household income is associated with an increase in life satisfaction immediately and in the long run. The effect size does not vary greatly over time so we do not find evidence for adaptation to income increases. Vendrik (2013) reports similar findings using OLS as the estimation method. In every model, the anticipation effect of an income increase is positive and in all but one case it is also statistically significant.

partial sums. It can be easily shown that our model is equivalent to such a model but makes it possible to interpret the coefficients of the negative change variables as measures of asymmetries (see Hovi and Laamanen, 2017).

Answering the question of whether an increase in incomes of all increase life satisfaction requires that we take into account the effect of an income increase of others. These ‘comparison effects’ are statistically very close to zero at first but become larger, and negative, over time. This is what Vendrik (2013) also finds. As the effect of a household-income increase is close to time-invariant, a same-sized increase of incomes of a household and its reference group lead to a positive short-run effect and a long-run effect that is closer to zero. However, using different sets of control variables yield somewhat different results. Using no control variables leads to the conclusion that both short-run and long-run effects are statistically significantly positive. Allowing for static effects of the control variables has the effect of the long-run effects being statistically non-significant. If dynamic effects are allowed for, increasing of the incomes of all has no statistically significant effect neither in the short-run nor in the long-run. It seems that adding control variables leads to decreases in the sizes of the effects of household income and to increases in the sizes of the effects of reference income, in general.

It seems that allowing for asymmetries does not change the coefficients of the standard income variables (which are used to estimate the effects of positive income changes) much. Let us now turn to the estimated asymmetries. Virtually no evidence for significant loss aversion is found. The only exception is the model without control variables which estimates a statistically significantly larger immediate effect of a negative income change than of a positive change. In the two other cases in which a negative-change variable is statistically significant, the coefficient is negative, indicating that gains have larger effects than losses. As no clear evidence of asymmetries is found, household-income losses can be said to have similar effects as household-income gains. The following finding of no adaptation to income losses is in line with the results obtained by Clark et al. (2016) using the same data but a different method based on identifying, and estimating the effects of, spells of having a lower income. When we combine the estimated effects of a household-income drop with the effects of a reference-group income drop, income drops of all are adapted to similarly as income increases. It thus seems that comparison effects are the mechanism which keeps income from affecting life satisfaction in the long-run.

The magnitude of the estimated coefficient of the lagged dependent variable ranges from 0.03 to 0.10. As Vendrik (2013) points out, these estimates are likely to suffer from a downward Nickell bias and possibly other small sample biases because many of the time series are relatively short. To alle-

Table 2a. Models of life satisfaction

	(1)	(2)	(3)	(4)	(5)	(6)
s_{t-1}	0.10*** (0.01)	0.10*** (0.01)	0.09*** (0.01)	0.09*** (0.01)	0.03*** (0.01)	0.03*** (0.01)
Δy_{t+1}	0.19*** (0.03)	0.13*** (0.05)	0.16*** (0.03)	0.14*** (0.05)	0.10** (0.05)	0.10 (0.07)
Δy_t	0.45*** (0.04)	0.35*** (0.05)	0.37*** (0.04)	0.36*** (0.05)	0.26*** (0.06)	0.24*** (0.09)
Δy_{t-1}			0.05** (0.02)	0.09** (0.04)	0.07 (0.07)	0.02 (0.09)
Δy_{t-2}					0.10* (0.06)	0.18** (0.08)
Δy_{t-3}					0.09** (0.04)	0.01 (0.06)
y_{t-1}	0.45*** (0.04)	0.45*** (0.04)	0.33*** (0.05)	0.35*** (0.05)	0.19* (0.11)	0.21* (0.11)
Δy_{t+1}^{REF}	0.07 (0.16)	0.08 (0.16)	0.10 (0.16)	0.11 (0.16)	0.06 (0.24)	0.06 (0.24)
Δy_t^{REF}	0.15 (0.18)	0.16 (0.18)	0.01 (0.20)	0.01 (0.20)	-0.13 (0.30)	-0.13 (0.30)
Δy_{t-1}^{REF}			-0.01 (0.14)	-0.01 (0.14)	-0.07 (0.29)	-0.08 (0.29)
Δy_{t-2}^{REF}					-0.50* (0.28)	-0.50* (0.28)
Δy_{t-3}^{REF}					-0.42* (0.24)	-0.42* (0.24)
y_{t-1}^{REF}	-0.12 (0.15)	-0.12 (0.15)	-0.30* (0.18)	-0.30* (0.18)	-0.02 (0.31)	-0.02 (0.31)
Δy_{t+1}^-		0.10 (0.07)		0.04 (0.07)		0.01 (0.11)
Δy_t^-		0.16** (0.07)		0.01 (0.07)		0.05 (0.11)
Δy_{t-1}^-				-0.10* (0.06)		0.10 (0.11)
Δy_{t-2}^-						-0.13 (0.11)
Δy_{t-3}^-						0.17* (0.10)
y_{t-1}^-		-0.04 (0.03)		-0.03 (0.03)		-0.05 (0.08)
Observations	76291	76291	65588	65588	27047	27047

All models are estimated with OLS and include individual and year fixed effects.

Current levels of the control variables listed in Table 1 are included in columns (3) and (4). Future, current, and lagged differences and lagged levels of the control variables are controlled for in columns (5) and (6). Individual clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2b. Models of life satisfaction. Effect calculations.

	(1)	(2)	(3)	(4)	(5)	(6)
Effect of positive hh income change, year (-1)	0.19*** (0.03)	0.13*** (0.05)	0.16*** (0.03)	0.14*** (0.05)	0.10** (0.05)	0.10 (0.07)
Effect of positive hh income change, year (0)	0.46*** (0.04)	0.36*** (0.05)	0.39*** (0.04)	0.37*** (0.05)	0.27*** (0.07)	0.24*** (0.09)
Effect of positive hh income change, year (1)	0.50*** (0.04)	0.48*** (0.04)	0.42*** (0.05)	0.48*** (0.06)	0.26*** (0.08)	0.23** (0.10)
Effect of positive hh income change, year (2)	0.50*** (0.04)	0.49*** (0.05)	0.37*** (0.05)	0.40*** (0.05)	0.30*** (0.09)	0.39*** (0.11)
Effect of positive hh income change, year (3)	0.50*** (0.04)	0.49*** (0.05)	0.36*** (0.05)	0.39*** (0.05)	0.28*** (0.10)	0.23* (0.12)
Long-run effect of positive hh income change	0.50*** (0.04)	0.49*** (0.05)	0.36*** (0.05)	0.39*** (0.05)	0.19* (0.11)	0.21* (0.12)
Effect of negative hh income change, year (-1)		0.23*** (0.04)		0.17*** (0.04)		0.10 (0.07)
Effect of negative hh income change, year (0)		0.52*** (0.05)		0.38*** (0.05)		0.29*** (0.08)
Effect of negative hh income change, year (1)		0.46*** (0.05)		0.34*** (0.06)		0.28*** (0.10)
Effect of negative hh income change, year (2)		0.45*** (0.05)		0.35*** (0.05)		0.20* (0.11)
Effect of negative hh income change, year (3)		0.45*** (0.05)		0.35*** (0.06)		0.34*** (0.12)
Long-run effect of negative hh income change		0.45*** (0.05)		0.35*** (0.06)		0.16 (0.12)
Asymmetry in the effect of hh income change, year (-1)		0.10 (0.07)		0.04 (0.07)		0.01 (0.11)
Asymmetry in the effect of hh income change, year (0)		0.17** (0.07)		0.01 (0.07)		0.05 (0.11)
Asymmetry in the effect of hh income change, year (1)		-0.02 (0.04)		-0.14** (0.06)		0.04 (0.11)
Asymmetry in the effect of hh income change, year (2)		-0.04 (0.04)		-0.05 (0.04)		-0.19* (0.11)
Asymmetry in the effect of hh income change, year (3)		-0.04 (0.04)		-0.04 (0.04)		0.11 (0.11)
Long-run asymmetry in the effect of hh income change		-0.04 (0.04)		-0.04 (0.04)		-0.06 (0.08)
Effect of hh reference income change, year (-1)	0.07 (0.16)	0.08 (0.16)	0.10 (0.16)	0.11 (0.16)	0.06 (0.24)	0.06 (0.24)
Effect of hh reference income change, year (0)	0.16 (0.19)	0.17 (0.19)	0.02 (0.21)	0.02 (0.21)	-0.13 (0.31)	-0.13 (0.31)
Effect of hh reference income change, year (1)	-0.10 (0.16)	-0.10 (0.16)	-0.31 (0.22)	-0.31 (0.22)	-0.10 (0.34)	-0.10 (0.34)
Effect of hh reference income change, year (2)	-0.13 (0.17)	-0.13 (0.17)	-0.33* (0.19)	-0.33* (0.19)	-0.52 (0.35)	-0.52 (0.35)
Effect of hh reference income change, year (3)	-0.13 (0.17)	-0.13 (0.17)	-0.33* (0.19)	-0.33* (0.19)	-0.45 (0.34)	-0.45 (0.34)
Long-run effect of hh reference income change	-0.13 (0.17)	-0.13 (0.17)	-0.33* (0.19)	-0.33* (0.19)	-0.02 (0.32)	-0.02 (0.31)
Absolute effect of positive hh income change, year (-1)	0.26 (0.16)	0.20 (0.16)	0.26 (0.17)	0.24 (0.17)	0.16 (0.25)	0.16 (0.25)
Absolute effect of positive hh income change, year (0)	0.63*** (0.19)	0.53*** (0.19)	0.40* (0.21)	0.39* (0.21)	0.14 (0.31)	0.11 (0.32)
Absolute effect of positive hh income change, year (1)	0.40** (0.16)	0.38** (0.16)	0.11 (0.22)	0.17 (0.22)	0.17 (0.34)	0.13 (0.34)
Absolute effect of positive hh income change, year (2)	0.37** (0.17)	0.37** (0.17)	0.04 (0.19)	0.06 (0.19)	-0.22 (0.36)	-0.13 (0.37)
Absolute effect of positive hh income change, year (3)	0.37** (0.17)	0.37** (0.17)	0.03 (0.19)	0.05 (0.19)	-0.17 (0.36)	-0.23 (0.36)
Long-run absolute effect of positive hh income change	0.37** (0.17)	0.37** (0.17)	0.03 (0.19)	0.05 (0.19)	0.18 (0.33)	0.19 (0.33)
Absolute effect of negative hh income change, year (-1)		0.30* (0.16)		0.28 (0.17)		0.16 (0.25)
Absolute effect of negative hh income change, year (0)		0.70*** (0.19)		0.40* (0.21)		0.16 (0.32)
Absolute effect of negative hh income change, year (1)		0.36** (0.17)		0.04 (0.23)		0.17 (0.35)
Absolute effect of negative hh income change, year (2)		0.33* (0.17)		0.02 (0.19)		-0.32 (0.37)
Absolute effect of negative hh income change, year (3)		0.33* (0.17)		0.02 (0.19)		-0.11 (0.36)
Long-run absolute effect of negative hh income change		0.32* (0.17)		0.02 (0.19)		0.14 (0.33)

Dynamic effects calculated using the coefficients reported in table 2a. Delta method is applied in testing the statistical significance of the effects. Anticipation effect is reported as the effect in year -1. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

viate the biases, we will next follow Vendrik (2013) and rely on BCLSDV method in estimating the coefficient of the dependent variable. We use the longest and the second-longest possible time series to estimate the bias-corrected coefficient. We chose to use both the longest and the second-longest series to avoid losing too many degrees of freedom. Each model in tables 2a and 2b is re-estimated by forcing the coefficient of the lagged dependent variable to equal to the estimate obtained by BCLSDV. Tables 3a and 3b present the results from the re-estimated models. The first thing to note is that the coefficients of the lagged dependent variable are larger in Table 3a than in Table 2a. More specifically, the coefficients of the lagged dependent variable now range from about 0.22 to about 0.34.

Let us now turn to the estimated effects of income changes resulting from using the coefficients of the lagged dependent variable from the BCLSDV estimations. Most importantly, the earlier result of no clear evidence for asymmetries is replicated. Also the other results remain qualitatively quite similar to those discussed earlier. The only clear difference is that the estimated effects of household income changes are not statistically significant at the 10% in the models in which dynamic effects of the control variables are allowed for. It might be that some of the life changes measured by the control variables that are correlated with income changes have dynamic effects. However, the insignificance of household income changes becomes irrelevant if we consider the effects of all households' incomes changing similarly. The long-run effects of such changes are statistically insignificant because others' incomes have, again, negative effects that offset the effects of household's own income. However, we should be cautious when testing the effects of all households' income changes because, as before, the long-run effects of others' incomes are only statistically significant in the model with non-dynamic effects of control variables.

The similarities of the estimates in tables 2a and 3a, and in tables 2b and 3b, are rather surprising given that the estimated coefficients of the lagged dependent variables change a lot as they are estimated by BCLSDV instead of OLS. The similarities indicate that the result of no significant asymmetries are robust to the estimation method. The results also consistently point to Vendrik's (2013) finding that as everyone's incomes increase (decrease), subjective well-being increases (decreases) in the short-run but is unaffected in the long-run.

Table 3a. Models of life satisfaction with bias correction.

	(1)	(2)	(3)	(4)	(5)	(6)
s_{t-1}	0.34	0.34	0.28	0.27	0.22	0.22
Δy_{t+1}	0.17*** (0.03)	0.13*** (0.05)	0.14*** (0.03)	0.13*** (0.05)	0.09* (0.05)	0.11 (0.07)
Δy_t	0.39*** (0.03)	0.32*** (0.04)	0.34*** (0.04)	0.32*** (0.05)	0.24*** (0.06)	0.22*** (0.08)
Δy_{t-1}			0.05** (0.02)	0.10*** (0.04)	0.06 (0.07)	0.02 (0.09)
Δy_{t-2}					0.10* (0.05)	0.18** (0.08)
Δy_{t-3}					0.07* (0.04)	-0.01 (0.06)
y_{t-1}	0.33*** (0.03)	0.33*** (0.03)	0.24*** (0.04)	0.27*** (0.04)	0.13 (0.10)	0.15 (0.10)
Δy_{t+1}^{REF}	0.05 (0.15)	0.06 (0.15)	0.13 (0.16)	0.13 (0.16)	0.03 (0.25)	0.03 (0.25)
Δy_t^{REF}	0.08 (0.17)	0.09 (0.17)	-0.01 (0.19)	-0.01 (0.19)	-0.17 (0.29)	-0.18 (0.29)
Δy_{t-1}^{REF}			-0.04 (0.14)	-0.04 (0.14)	-0.03 (0.27)	-0.03 (0.27)
Δy_{t-2}^{REF}					-0.45* (0.26)	-0.45* (0.26)
Δy_{t-3}^{REF}					-0.35 (0.24)	-0.35 (0.24)
y_{t-1}^{REF}	-0.12 (0.12)	-0.12 (0.12)	-0.25* (0.15)	-0.25* (0.15)	-0.05 (0.27)	-0.06 (0.27)
Δy_{t+1}^-		0.07 (0.07)		0.02 (0.07)		-0.04 (0.11)
Δy_t^-		0.12* (0.06)		0.02 (0.07)		0.04 (0.11)
Δy_{t-1}^-				-0.13** (0.06)		0.08 (0.11)
Δy_{t-2}^-						-0.15 (0.11)
Δy_{t-3}^-						0.18* (0.10)
y_{t-1}^-		-0.04 (0.03)		-0.02 (0.03)		-0.05 (0.07)
Observations	76291	76291	65588	65588	27047	27047

All models are estimated with OLS and include individual and year fixed effects.

Coefficients of s_{t-1} are attained from a BCLSDV estimation using only

individuals with highest or second-highest number of observations. Current

levels of the control variables presented in table 1 are included in columns

(3) and (4). Future, current, and lagged differences and lagged levels of the

control variables are controlled for in columns (5) and (6). Individual

clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3b. Models of life satisfaction with bias correction. Effect estimates.

	(1)	(2)	(3)	(4)	(5)	(6)
Effect of positive hh income change, year (-1)	0.17*** (0.03)	0.13*** (0.05)	0.14*** (0.03)	0.13*** (0.05)	0.09* (0.05)	0.11 (0.07)
Effect of positive hh income change, year (0)	0.45*** (0.04)	0.36*** (0.05)	0.38*** (0.04)	0.36*** (0.05)	0.26*** (0.07)	0.25*** (0.09)
Effect of positive hh income change, year (1)	0.48*** (0.04)	0.45*** (0.05)	0.40*** (0.05)	0.47*** (0.06)	0.25*** (0.08)	0.22** (0.10)
Effect of positive hh income change, year (2)	0.49*** (0.05)	0.48*** (0.05)	0.35*** (0.05)	0.39*** (0.06)	0.28*** (0.10)	0.38*** (0.11)
Effect of positive hh income change, year (3)	0.50*** (0.05)	0.49*** (0.05)	0.34*** (0.05)	0.37*** (0.06)	0.27** (0.11)	0.23* (0.12)
Long-run effect of positive hh income change	0.50*** (0.05)	0.50*** (0.05)	0.34*** (0.06)	0.37*** (0.06)	0.17 (0.12)	0.19 (0.13)
Effect of negative hh income change, year (-1)		0.20*** (0.04)		0.15*** (0.04)		0.07 (0.07)
Effect of negative hh income change, year (0)		0.50*** (0.05)		0.38*** (0.05)		0.27*** (0.09)
Effect of negative hh income change, year (1)		0.46*** (0.05)		0.32*** (0.06)		0.26*** (0.10)
Effect of negative hh income change, year (2)		0.45*** (0.05)		0.33*** (0.06)		0.19* (0.11)
Effect of negative hh income change, year (3)		0.44*** (0.05)		0.33*** (0.06)		0.32** (0.12)
Long-run effect of negative hh income change		0.44*** (0.05)		0.33*** (0.06)		0.13 (0.13)
Asymmetry in the effect of hh income change, year (-1)		0.07 (0.07)		0.02 (0.07)		-0.04 (0.11)
Asymmetry in the effect of hh income change, year (0)		0.14** (0.07)		0.02 (0.07)		0.03 (0.11)
Asymmetry in the effect of hh income change, year (1)		0.01 (0.04)		-0.14** (0.06)		0.04 (0.11)
Asymmetry in the effect of hh income change, year (2)		-0.03 (0.04)		-0.06 (0.04)		-0.19* (0.11)
Asymmetry in the effect of hh income change, year (3)		-0.05 (0.04)		-0.04 (0.04)		0.09 (0.11)
Long-run asymmetry in the effect of hh income change		-0.06 (0.04)		-0.03 (0.04)		-0.07 (0.08)
Effect of hh reference income change, year (-1)	0.05 (0.15)	0.06 (0.15)	0.13 (0.16)	0.13 (0.16)	0.03 (0.25)	0.03 (0.25)
Effect of hh reference income change, year (0)	0.10 (0.19)	0.11 (0.19)	0.02 (0.20)	0.03 (0.20)	-0.17 (0.32)	-0.17 (0.32)
Effect of hh reference income change, year (1)	-0.08 (0.17)	-0.08 (0.17)	-0.28 (0.23)	-0.28 (0.23)	-0.12 (0.35)	-0.13 (0.36)
Effect of hh reference income change, year (2)	-0.15 (0.17)	-0.14 (0.17)	-0.32 (0.20)	-0.32 (0.20)	-0.53 (0.37)	-0.53 (0.37)
Effect of hh reference income change, year (3)	-0.17 (0.18)	-0.16 (0.18)	-0.33* (0.20)	-0.34* (0.20)	-0.53 (0.37)	-0.53 (0.37)
Long-run effect of hh reference income change	-0.18 (0.18)	-0.18 (0.18)	-0.34* (0.21)	-0.34* (0.20)	-0.07 (0.35)	-0.07 (0.35)
Absolute effect of positive hh income change, year (-1)	0.22 (0.15)	0.19 (0.16)	0.27* (0.16)	0.26 (0.17)	0.13 (0.25)	0.15 (0.26)
Absolute effect of positive hh income change, year (0)	0.55*** (0.19)	0.47** (0.19)	0.40* (0.21)	0.39* (0.21)	0.09 (0.33)	0.08 (0.33)
Absolute effect of positive hh income change, year (1)	0.40** (0.17)	0.37** (0.17)	0.12 (0.23)	0.19 (0.23)	0.13 (0.36)	0.09 (0.36)
Absolute effect of positive hh income change, year (2)	0.35** (0.17)	0.34* (0.17)	0.03 (0.20)	0.07 (0.20)	-0.25 (0.39)	-0.16 (0.39)
Absolute effect of positive hh income change, year (3)	0.33* (0.18)	0.33* (0.18)	0.01 (0.20)	0.04 (0.20)	-0.26 (0.38)	-0.30 (0.38)
Long-run absolute effect of positive hh income change	0.32* (0.18)	0.32* (0.18)	0.00 (0.21)	0.03 (0.21)	0.10 (0.36)	0.12 (0.36)
Absolute effect of negative hh income change, year (-1)		0.26* (0.15)		0.28* (0.16)		0.11 (0.25)
Absolute effect of negative hh income change, year (0)		0.61*** (0.20)		0.41* (0.21)		0.10 (0.33)
Absolute effect of negative hh income change, year (1)		0.38** (0.17)		0.04 (0.23)		0.13 (0.37)
Absolute effect of negative hh income change, year (2)		0.31* (0.18)		0.01 (0.20)		-0.35 (0.39)
Absolute effect of negative hh income change, year (3)		0.28 (0.18)		0.00 (0.20)		-0.21 (0.39)
Long-run absolute effect of negative hh income change		0.27 (0.18)		-0.01 (0.21)		0.05 (0.36)

Dynamic effects calculated using the coefficients reported in table 3A. Delta method is applied in testing the statistical significance of the effects. Anticipation effect is reported as the effect in year -1. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

4 Discussion

Although our results are in line with earlier findings by Vendrik (2013) on adaptation, our analyses do not replicate the short-run results of earlier micro-level asymmetry studies (Di Tella et al., 2010; D'Ambrosio and Frick, 2012; Boyce et al., 2013). Neither are our results in line with what has been found on macroeconomic loss aversion using European data sets (Hovi and Laamanen, 2017; De Neve et al., 2018). Our main argument for why results differ is that it may be that short-run and long-run well-being reactions to income changes with different reasons may be different. Such heterogeneity would make results sensitive to specification and the set of control variables.

We did some analysis on the sources of negative income changes in the sample. It is interesting to note that almost 40% of nominal income changes and more than 40% of real income changes are negative. Looking at the life changes associated with the income drops reveals that most income drops are not associated with any changes in labour market status of the individuals such as becoming unemployed. In turn, those whose labour market status remain the same (employment, retirement, unemployed and so on) from a year to the next are almost as likely to experience income decreases as those who become unemployed or retire. However, the income decreases are smaller for those whose statuses do not change. Because there might be heterogeneity in the effects of income changes for different reasons, a more careful analysis of the effects of different kinds of changes is needed. For example, effects may vary because different life changes, and the income changes related to them, may be anticipated to a different degree. A further source of income changes (at least per household member) are marriages, separations and child births. The GSOEP data include information on income by income category which would make it possible to analyse whether people are differently sensitive to gains/losses related to different income sources.

Future research should try to identify asymmetries in well-being reactions to income changes in specific situations. Further, more work is needed to understand why some micro studies find short-run asymmetries, macro studies find short-run and long-run asymmetries and, yet, we are not able to find clear evidence for asymmetries.

5 Conclusions

This paper examines the short-run and long-run asymmetries in the well-being responses to income shocks. Earlier studies have found evidence for short-run loss aversion in microdata and short-run and long-run loss aversion in macrodata. This paper is the first to look at long-run loss aversion using microdata. The results suggest that no clear evidence for short-run or long-run asymmetries can be found. However, the results are not in line with earlier studies using different model specifications and control variable sets. We, thus, feel that more work is needed to carefully model the relationships. One interesting question is related to the different sources of income variation, in particular income drops. It may be that the well-being effects depend on what is the reason for an income drop. For example, income drops related to retirement are usually well anticipated whereas those related to unemployment are always not anticipated. Looking at the data, a significant number of income decreases happen without the income recipient changing labour market status. These changes can originate from price inflation faster than earnings growth or from changes in taxation and benefits.

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Chapter 5

The Lasting Well-being Effects of Early Adulthood Macroeconomic Crises*

Matti Hovi^a

Abstract

This paper studies the effects of early adulthood macroeconomic crises on subjective well-being later in life. Using repeated cross-section data of over 90 000 individuals from the World Values Survey combined with Angus Maddison's historical data on macroeconomic circumstances, I find that experiencing a macroeconomic crisis at ages 18 to 25 is detrimental to subjective well-being. Individuals who have witnessed a large decline in real GDP in their late teens or early twenties report lower levels of well-being years later. The negative effect is largest for individuals in the bottom half of a country's income distribution.

Keywords: Subjective Well-Being, Happiness, Life satisfaction, Crisis, Recession, Adaptation

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^a University of Tampere, matti.hovi@uta.fi

1 Introduction

There is a growing empirical literature showing that recessions experienced in early adulthood affect a variety of individual-level outcomes such as preferences on redistribution (Giuliano and Spilimbergo, 2014) and job satisfaction (Bianchi, 2013). Malmendier and Nagel (2011) have shown that past recessions are associated with individuals' risk preferences later in life. Some studies have found that labour market outcomes are also less favourable for those cohorts that graduated from college or university during a bad economy (see, for example, Oyer, 2006; Kahn 2010; Oreopoulos, von Wachter, and Heisz, 2012). However, so far there is no analysis on the lasting effects of early adulthood macroeconomic crises on individual's subjective well-being (SWB).

Macroeconomic crises experienced from age 18 to 25 can affect individual well-being later in life due to both biological and economic reasons. During the years of early adulthood, the human brain is still in the process of developing, and, because of this developmental plasticity, individuals who face unfavourable environments can also experience enduring suffering in the course of their lives (Steinberg, 2014). Furthermore, Krosnick and Alwin (1989) have theorized that during these impressionable years, individual's values, attitudes and world views are formed and that they change very little in later years of adulthood. In most countries, individuals also enter the labour market between the ages of 18 and 25. Bad early experiences in the labour market can have lasting impacts on individual well-being (Bell and Blanchflower, 2011).

During times of economic turmoil, when output falls rapidly, many individuals face both unemployment and falling income. Clark, D'Ambrosio and Ghislandi (2016) show that negative changes in individual's income are associated with long lasting effects on SWB. Hovi and Laamanen (2017) have found similar results using panel data on national income and average national SWB. Clark, Georgellis, and Sanfey (2001) and Clark et al. (2008) also report lasting negative effects on SWB from experiencing unemployment. Experiences of unemployment can scar individuals to the extent that their SWB does not return to its initial level even after re-employment (Clark, Georgellis, and Sanfey, 2001; Clark et al., 2008; Knabe and Rätzl, 2011). If an individual is scarred in the early stages of his or her life, the cumulative losses in SWB during his or her life span are considerable.

This study focuses on examining the lasting well-being effects of a crisis experienced from age 18 to 25. Using repeated cross-section data of over

90 000 individual respondents to the World Values Survey combined with Angus Maddison’s historical data on macroeconomic circumstances allows us to compare the experiences between multiple birth cohorts in multiple countries. This is the first study to utilise international differences in the timing of macroeconomic crises to examine their lasting effects on individuals’ SWB. The analysis shows that there is a significant negative effect from experiencing a macroeconomic crisis between the ages of 18 and 25. The negative effect on happiness lasts for at least 20 years. Furthermore, individuals with the lowest income within a country are most affected by the crisis experience.

The paper is constructed as follows. In section 2, I describe the data sets and the empirical model used in the analysis. In section 3 I present the estimation results and in section 4 I study the robustness of the results. Section 5 concludes.

2 Data and methods

2.1 Data

I use the combined World Values Survey and European Values Study data (WVS, from here onwards). WVS is a repeated cross section study conducted in different countries around the world and it includes two questions on individual well-being: happiness, measured on a scale from 1 to 4, and life satisfaction, measured on a scale from 1 to 10. In the SWB literature, answers to happiness questions are often considered to measure individual’s emotional well-being, whereas answers to life satisfaction questions measure individual’s thoughts about his or her life (Kahneman and Deaton, 2010). Thus, incorporating both measures into the analysis allows us to assess the lasting effects of past crises on different domains of well-being. In addition to the SWB questions, the WVS collects information on respondent’s gender, relationship status, religious beliefs, educational level, employment status and position in their country’s income distribution. Following the earlier empirical literature, I use these attributes as control variables in the analysis conducted in the next section.

The WVS has been conducted since 1981 but the first questionnaires that include all of the above-mentioned questions are from 1990. Thus, the time period used in the analysis runs from 1990 to 2014. However, the WVS is not conducted annually, but in waves. There is on average six years between two questionnaires in a country. Each time the survey is conducted, about

1000 individuals are interviewed within a country. I combine the WVS data with Barro and Ursúa's (2008) data on real GDP per capita, which is based on the Angus Maddison's output time series for 40 countries. I augment Angus Maddison's real GDP per capita series with data from the World Bank's World Development Indicators (WDI) to include years 2007–2014.¹ Thus, the early effects of the most recent crisis are included in the analysis as well. The combined SWB data includes 38 countries. Two countries are excluded because of missing data in the WVS.² The use of Angus Maddison's historical time series allows us to link even the older respondents in the earliest waves of the WVS with the economic situation they faced in their youth.

To link WVS respondents with the economic circumstances in their youth, I need information about the birth cohort of each individual. Most WVS surveys gather information not only on respondent's age, but also on respondent's birth year. For each individual I calculate the birth cohort as survey year minus the reported age. If this calculated birth cohort differs by more than one from the reported birth year, then the individual is excluded from the analysis. In the surveys conducted in Brazil in 1991 and in Columbia in 2005, respondents were not asked for their birth year, but I include all individuals from these surveys in the sample and calculate their birth cohort as described above.

2.2 Baseline specification

Following Barro and Ursúa (2008), and using the peak-to-trough method, I define a crisis period as one where the cumulative real GDP per capita decline is 10% or more.³ Figure 2 in Appendix A shows the crisis years for each

¹There is no real GDP data available for Taiwan for the time period 2007–2013 in WDI. I use the IMF's World Economic Outlook data on real GDP growth to include observations for Taiwan for 2007–2013.

²The countries included in the sample are Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, Colombia, Denmark, Egypt, Finland, France, Germany, Greece, Iceland, India, Indonesia, Italy, Japan, Malaysia, Mexico, Netherlands, New Zealand, Norway, Peru, Philippines, Singapore, South Africa, South Korea, Spain, Sweden, Switzerland, Taiwan, Turkey, United Kingdom, United States, Uruguay and Venezuela. Sri Lanka cannot be included in the sample because WVS surveys have not been conducted there. Portugal, although included in the WVS, does not have all the relevant individual level variables needed for the analysis.

³The time period of the GDP decline may be several years. During this period output doesn't have to decline every year, but the overall decline in output has to be at least 10% from peak to trough.

country based on this definition. As in Giuliano and Spilimbergo (2014), I link each respondent to the macroeconomic history of his or her country by creating a dummy variable $shock_{ict}^{18-25}$ equal to one, if the individual lives in a country that experienced a crisis when the individual was 18–25 years old.⁴ The shock dummy equals one if at least one year is defined as a shock year during the time when the individual was 18–25. To assess the impact of these negative macroeconomic shocks on individual SWB, I use OLS to estimate

$$SWB_{ict} = \beta_0 + \beta_1 shock_{ict}^{18-25} + \beta_2 \Delta \ln(GDPpc)_{ct} + \beta_3 shock_{ct} + \gamma' X_{ict} + \delta_t + \psi_c + \eta_{cohort} + \eta_{age} + \psi_c * cohort_{ict} + \epsilon_{ict}, \quad (1)$$

where SWB_{ict} is the self-reported well-being of individual i in survey year t in country c , X_{ict} is a vector of individual specific control variables, δ_t , ψ_c , η_{age} , η_{cohort} control for year-, country-, age and birth-year specific fixed effects, respectively, and ϵ_{ict} is the error term.⁵ The individual level control variables included in X are: gender (1 if male), five dummies for relationship status (married, living together as married, divorced, separated, widowed, and single/never-married as the reference group), five dummies for religious denomination (muslim, orthodox, protestant, roman catholic, other, and no religious denomination as the reference group), educational level (a dummy for completing secondary school, a dummy for attaining a university level degree, and has not completed secondary school as the reference group). After estimating models with the above control variables, I also include dummies for unemployment and income deciles in X as additional controls. To control for the current macroeconomic situation, I include $\Delta \ln(GDPpc)_{ct}$, the growth rate of GDP per capita and $shock_{ct}$, a dummy equal to one if country c is experiencing a crisis during the survey year t .

The coefficient of interest, β_1 , is identified from the differences in experiences across birth cohorts within a country. The experiences that are shared globally and could affect SWB, such as World War II or technological

⁴Some, but not all, WVS questionnaires have collected information on whether or not respondents were born in the survey country. Where this information is available, I exclude all immigrants from the analysis. In those survey waves where this information is not available, I consider all respondents as natives. This generates measurement error to the shock variable and causes attenuation bias.

⁵In the estimation, I use population weights reported in WVS to make samples representative for each country-year specific population from which they are drawn. I scale the weights so that their average equals one in each country-year cell. For those country years without reported weights, each individual is weighted equally.

progress, are controlled by the cohort fixed effects. In the baseline specification, I also control for nonlinear global age trends in SWB by including age dummies in the model. Because the identifying variation comes from the differences between cohorts within a country, I want to make sure that I am not estimating the effect of some omitted country-specific cohort trend. To rule out this possibility, I also include variables $\psi_c * cohort_{ict}$ into the model. Hence, for each country, I control for a linear trend in birth cohort.

3 Results

3.1 Baseline results

Table 1 shows the results from estimating equation (1) with OLS with country-clustered standard errors. Although the dependent variables are measured on a discrete scale, all regressions are estimated using OLS. Similar results are attained with ordered probit estimation, but OLS was chosen to keep the results comparable with the existing literature.

In column 1 of table 1, happiness is regressed on the early adulthood shock dummy, and on those control variables that can not be considered as possible outcomes of the early adulthood shock. I have, therefore, excluded dummies for education, religion, relationship status, income and unemployment from the control variables presented in the previous section. Because my focus is on examining the lasting effects of macroeconomic crises on well-being, I restrict the estimation sample to include only individuals who are older than 25 at the time of the survey. The variable of interest, *shock*^{18–25}, enters with a negative coefficient estimate, which is statistically significantly different from zero at the 1% level. In column 2 of table 1, I add controls for education, religion and relationship status. All of these variables can be affected by a crisis experienced in early adulthood and, therefore, the effect on happiness may be mediated through them. However, in column 2, the point estimate is very similar in magnitude and still statistically significantly different from zero. This implies that these variables do not mediate the effect of early adulthood macroeconomic crisis on happiness.

If the findings from previous literature on labour market outcomes hold for international data, it is also possible that the effect of early adulthood macroeconomic crises is mediated through income rank, or through unemployment. In column 3 of table 1, I test this hypothesis by further adding a dummy for current unemployment and nine dummies for the current in-

Table 1: SWB and macroeconomic shocks

	(1) Happiness	(2) Happiness	(3) Happiness	(4) Satisfaction	(5) Satisfaction	(6) Satisfaction
<i>shock</i> ¹⁸⁻²⁵	-0.038*** (0.013)	-0.037*** (0.012)	-0.039*** (0.012)	-0.061* (0.035)	-0.057 (0.035)	-0.065* (0.037)
Current shock	-0.125 (0.084)	-0.128 (0.086)	-0.129 (0.080)	-0.004 (0.201)	-0.014 (0.215)	-0.037 (0.189)
$\Delta \ln(GDP_{pc})$	2.758*** (0.717)	2.762*** (0.700)	2.212*** (0.747)	7.550*** (1.492)	7.568*** (1.460)	4.928*** (1.744)
Male	-0.035** (0.014)	-0.052*** (0.014)	-0.053*** (0.013)	-0.083** (0.041)	-0.122*** (0.043)	-0.131*** (0.036)
Secondary school education		0.072*** (0.026)	0.028* (0.017)		0.241*** (0.071)	0.044 (0.035)
University level education		0.126*** (0.025)	0.040*** (0.014)		0.519*** (0.079)	0.131*** (0.042)
Unemployed			-0.172*** (0.022)			-0.547*** (0.070)
Income dummies	NO	NO	YES	NO	NO	YES
Relationship dummies	NO	YES	YES	NO	YES	YES
Religion dummies	NO	YES	YES	NO	YES	YES
Age FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES
Cohort FEs	YES	YES	YES	YES	YES	YES
Country FEs	YES	YES	YES	YES	YES	YES
(Country dummies)*cohort	YES	YES	YES	YES	YES	YES
Observations	96510	96510	96510	96957	96957	96957

All models estimated with OLS. Religion dummies include muslim, orthodox, roman catholic, protestant and other religion. Relationship status dummies include married, living together as married, divorced, separated and widowed. The omitted category is single/never married females with uncompleted secondary school and no religious denomination. Country-clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

come rank of the individual as controls.⁶ The coefficient estimate of the early adulthood shock is still statistically significant at the 1% level, and similar in magnitude. This indicates that the relationship between early adulthood macroeconomic crises and happiness does not operate through unemployment and income rank. One possible channel through which macroeconomic crises could affect happiness is lower wealth accumulation of the individuals who have experienced a macroeconomic crisis. However, lower wealth, as well as income rank and employment status, are all possible outcomes of macroeconomic crises. The aim of this study is to determine whether macroeconomic crises have lasting effects on individual SWB. Examining the possible channels through which the effect is transmitted is left for future research.

In columns 4, 5 and 6, I report the results for the same models as in the previous three columns, but with life satisfaction as the left-hand-side variable. The absolute value of the coefficients in the life satisfaction models is higher because of the different measurement scale. The point estimates exhibit only little variation when adding control variables. However, the coefficient estimate of the early adulthood macroeconomic shock is statistically significantly different from zero only at the 10% level (in columns 4 and 6). One interpretation for this result is that experiencing a crisis in early adulthood affects only individuals' emotional well-being but has no effect on their life evaluation. Another possible explanation for this is that in WVS surveys, the happiness question is always asked at the early stages of the questionnaire, whereas the life satisfaction question is often asked later in the questionnaire. Thus, there is much more variation in the preceding questions for life satisfaction, especially in the earlier waves. If this

⁶In WVS surveys, the respondents are usually given a scale with ten income brackets describing income before taxes and deductions. The brackets are based on an estimate of the survey country's current income distribution. Most country-years have 10 brackets (based on country's income deciles), but some have less. Including country-years that have, for example, the ninth bracket capturing the income of the highest income group would cause imprecision in my estimates. To be on the safe side, I have excluded all country-years that do not have all the ten income brackets represented. I include nine income decile dummies to the estimation equation, leaving the lowest decile as the reference group. The fact that I use income dummies in an analysis with multiple countries means that these variables capture the effect of income rank on SWB. Thus, the income decile dummies do not capture the effect of absolute income on SWB, but rather the effect of individual's income relative to others in that specific country-year cell (for a discussion about income rank as the measure of relative income see, for example, Mujcic and Frijters, 2012). Those individuals who have chosen not to answer questions about their income are excluded from the analysis.

results in a higher variance in the answers for the life satisfaction, it could help to explain the higher standard errors of the coefficient estimates. In fact, a comparison of the standard deviations reveals that the within country standard deviation of life satisfaction in waves 3 and 4 relative to within country standard deviation of life satisfaction in waves 5 and 6 is larger than the corresponding ratio for happiness.

When assessing the magnitude of the results I find, that a one standard deviation increase in the shock variable is associated with a decrease of 0.02 standard deviations of happiness and 0.01 standard deviations of life satisfaction at a point in time. The effect of the macroeconomic shock is 23% of the effect of being unemployed for happiness and 12% for life satisfaction. Although I assess the effect based on differences between individuals at a point in time here, it should be kept in mind that the cumulative losses in SWB for an individual over time are much larger.

The extent to which the descriptive results reported above describe the causal relationship macroeconomic crises and SWB depends on what is assumed about the selection bias. First, individuals who decide not to answer the SWB question might be those whose SWB is the lowest. If a crisis experience decreases future SWB, then this would imply that the estimated coefficients for the shock variable are biased towards zero. However, if, for some reason, those individuals who have experienced a crisis are more willing to report their low SWB levels than the rest of the population then the coefficient estimates would exaggerate the true effect.

The second cause for concern is the possibility that changes in SWB caused by experiencing a macroeconomic crisis affect the probability for individuals to emigrate. There is very little evidence of the effect of SWB on actual migration at the individual level, but there is some evidence showing that lower SWB could lead to a higher desire to migrate (Cai et al., 2014; Chindarkar, 2014; Otrachshenko and Popova, 2014). If individuals with lower SWB actually emigrate then the reported estimates are biased towards zero. It is also possible that individuals who have the highest SWB are the ones that actually emigrate. The coefficient of interest is also biased towards zero if those individuals who have not experienced a crisis and thus have higher SWB are the ones that emigrate.

Thirdly, if individuals with high SWB are more likely to live longer after experiencing a macroeconomic crisis than those individuals who have low SWB, then the coefficient estimates are expected to be biased towards zero. However, we do not have any direct evidence implying that early adulthood crises would result in higher mortality rates among people with lower

SWB. There is some evidence that experiencing a macroeconomic boom at ages 0–25 lowers mortality (Cutler, Huang and Lleras-Muney, 2016), and some evidence that macroeconomic crises in early childhood increase mortality (Van den Berg, Lindeboom and Portrait, 2006). In my estimates, I am not able to take into account the possible selection bias generated by non-response, emigration and mortality, but it seems very unlikely that the coefficient estimates would exaggerate the true effect of early adulthood macroeconomic crises on SWB.

3.2 Results on adaptation

The results discussed thus far, have shown the average effect of experiencing a crisis in early adulthood among all age groups over 25. I have assumed the same effect for individuals who have just experienced a crisis and for individuals who have experienced it, for example, 20 years ago. To relax this assumption, some studies have allowed for dynamic effects by including dummy variables or continuous variables measuring the years elapsed from the crisis (see, for example, Oreopoulos, von Wachter, and Heisz, 2012; Buccioli, Alessandro, and Zarri, 2015; Maclean and Hill, 2015; Rao, 2016).

I examine adaptation to macroeconomic crises by using both of these strategies. I start by constructing a variable $years\ passed_{ict}$ which is zero when the individual has not experienced a crisis at the ages of 18–25. If, on the other hand, an individual has experienced a crisis and the last crisis year was, for example, when individual was 23 years old, then years passed is calculated as $years\ passed_{ict} = age_{ict} - 23$. If a country has experienced a crisis in the years when the individual was 22–27 years old then for that individual the last year coded as crisis is when he or she was 25 (the highest age in the eight-year range interval) and years passed is $years\ passed_{ict} = age_{ict} - 25$.

In columns 1 and 3 of table 2, I have augmented the model from columns 3 and 6 in table 1 with a dummy variable ($D_{years \geq 20}$) which equals one when $years\ passed_{ict} \geq 20$. This model allows for adaptation when 20 years have elapsed since the last shock year. The effect of an early adulthood macroeconomic crisis in the first 19 years after the crisis is captured by the coefficient of $shock_{ict}^{18-25}$. Columns 1 and 3 show that the effect during the first 19 years after the macroeconomic shock is statistically significant, at the 1% level for happiness and at the 5% level for life satisfaction. When allowing for adaptation this way, the effect in the first 19 years is more negative than the average effect estimated in the previous section. The

Table 2: SWB and macroeconomic shocks, adaptation

	(1) Happiness	(2) Happiness	(3) Satisfaction	(4) Satisfaction
<i>shock</i> ¹⁸⁻²⁵	-0.080*** (0.028)	-0.124 (0.088)	-0.177** (0.067)	-0.302* (0.170)
<i>D_{years≥20}</i>	0.080* (0.040)		0.218** (0.095)	
<i>years passed</i>		0.007 (0.006)		0.019 (0.013)
<i>years passed</i> ²		-0.000 (0.000)		-0.000 (0.000)
Current shock	-0.136* (0.080)	-0.131 (0.078)	-0.058 (0.190)	-0.043 (0.186)
$\Delta \ln(GDPpc)$	2.185*** (0.698)	2.169*** (0.682)	4.855*** (1.634)	4.808*** (1.644)
Unemployed	-0.172*** (0.022)	-0.172*** (0.022)	-0.547*** (0.070)	-0.547*** (0.070)
Male	-0.053*** (0.013)	-0.053*** (0.013)	-0.130*** (0.036)	-0.130*** (0.036)
Secondary school education	0.028* (0.016)	0.028* (0.016)	0.043 (0.035)	0.044 (0.035)
University level education	0.040*** (0.014)	0.040*** (0.014)	0.129*** (0.042)	0.131*** (0.042)
Income dummies	YES	YES	YES	YES
Relationship dummies	YES	YES	YES	YES
Religion dummies	YES	YES	YES	YES
Age FEs	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES
Cohort FEs	YES	YES	YES	YES
Country FEs	YES	YES	YES	YES
(Country dummies)*cohort	YES	YES	YES	YES
Observations	96510	96510	96957	96957

All models estimated with OLS. Years passed indicates how many years have passed from the crisis experience. $D_{years \geq 20} = 1$ if more than 19 years have passed from the crisis experience. Religion dummies include muslim, orthodox, roman catholic, protestant and other religion. Relationship status dummies include married, living together as married, divorced, separated and widowed. The omitted category is single/never-married females with uncompleted secondary school and no religious denomination. Country-clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

coefficient of $D_{years \geq 20}$ measures the statistical significance of adaptation. If this coefficient is statistically significant, the effect of the shock after 20 years is different from what it is during the first 19 years. For happiness, adaptation is found to be statistically significant at the 10% level, whereas for life satisfaction it is found to be significant at the 5% level.

Often, adaptation is assumed to be faster, in absolute terms, right after the shock and slower as time passes (see, for example, Vendrik, 2013, for adaptation to income changes). In columns 2 and 4 of table 2, I allow for a quadratic adaptation process by including *years passed* and its square term into the model. In columns 2 and 4 of table 2, I thus estimate

$$SWB_{ict} = \beta_0 + \beta_1 shock_{ict}^{18-25} + \beta_2 \Delta \ln(GDPpc)_{ct} + \beta_3 shock_{ct} \\ + \beta_4 years\ passed + \beta_5 years\ passed^2 \\ + \gamma' X_{ict} + \delta_t + \psi_c + \eta_{cohort} + \eta_{age} + \psi_c * cohort_{ict} + \epsilon_{ict}. \quad (2)$$

The coefficient of $shock_{ict}^{18-25}$, which now measures the effect of the shock when zero years have passed from the crisis experience, is not statistically significant for happiness and significant at the 10% level for life satisfaction.⁷ The coefficients of *years passed* and *years passed*² are not separately nor jointly significant at the 10% level in either of the models. Furthermore, though not reported in the table, there is no statistically significant adaptation found for any period after the shock for happiness or life satisfaction.⁸ This suggests that it is not necessary to include these variables in the model.

Although coefficients β_4 and β_5 are not significant, I present the graphical results from estimating the effect of an early adulthood macroeconomic shock for different time periods after the crisis in figure 1. This is done to offer the reader some further insight on the average effect estimated in the previous section. In figure 1, I calculate the effect of an early adulthood crisis at t years after the crisis as $\beta_1 + \beta_4 * t + \beta_5 * t^2$. The point estimates for the effect are larger in the beginning, but the effect is statistically significant at the 5% level only after 10 years have passed since the crisis experience. The magnitudes of the effects for happiness and life satisfaction is very similar when accounting for the different measurement scale. The figure shows a somewhat faster recovery for life satisfaction than for happiness.

⁷It should be noted that there are no individuals in the sample who are currently experiencing an early-adulthood shock because the sample only includes individuals older than 25. Thus, the coefficient β_1 can be considered as that part of the effect which is common to all individuals who have experienced a crisis in early adulthood.

⁸In this model, adaptation can be tested for each period separately by testing the significance of $\beta_4 * t + \beta_5 * t^2$ with t denoting the years elapsed from the last shock year.

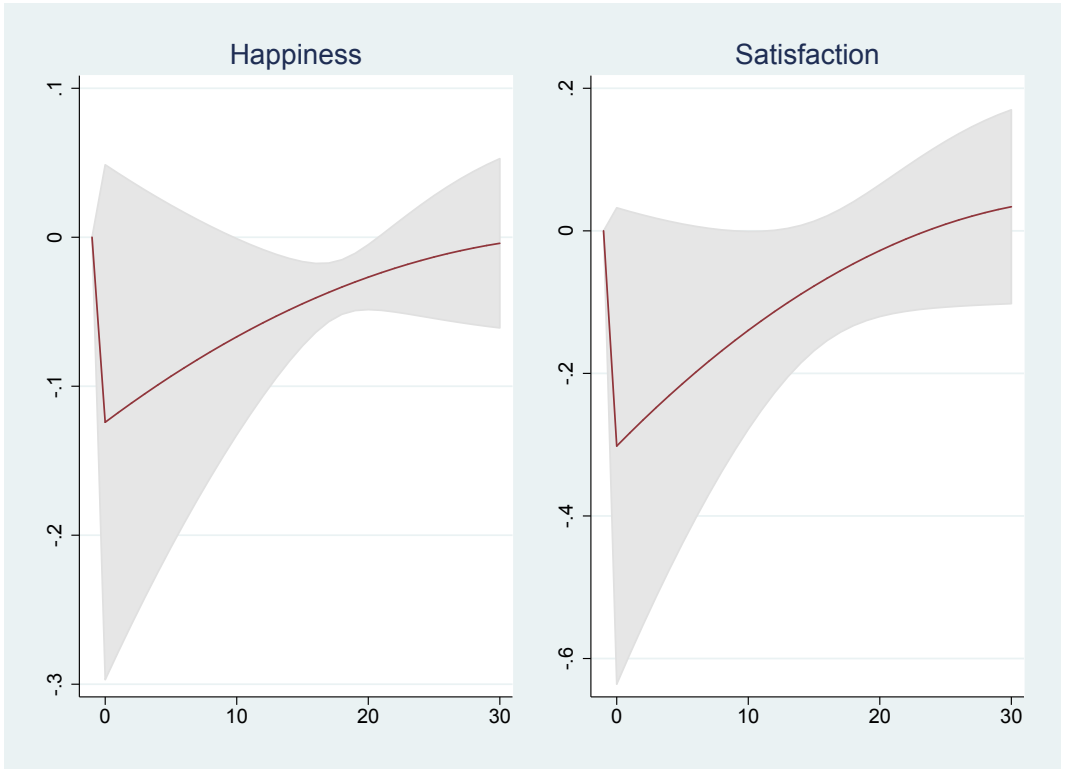


Figure 1: The effects of experiencing a macroeconomic crisis for different time periods after the crisis. The horizontal axis denotes years passed from the crisis experience. The effects on happiness are on the left panel and the effects on life satisfaction are on the right panel. The gray area shows the 95% confidence interval.

The method I use to identify the dynamic effect of crises differs from many previous studies that have looked at adaptation in SWB to different life events. In this study, the adaptation process is identified from the differences between birth cohorts within a country. Other studies have mainly used longitudinal data on individuals to study the adaptation process of SWB (Clark et al., 2008). Using repeated cross section data linked with historical output data has two advantages. First, it allows for the examination of the effects over a much longer time span. Second, this method allows us to identify the effects of experienced circumstances at a specific age, even if there is no individual level data from that age.

3.3 Heterogeneous effects

In this section, I focus on the average effects of early adulthood crises for different income deciles and also for the unemployed. Previous evidence suggests that employed individuals who graduated in a recession might, in fact, derive more satisfaction from their job, even with smaller earnings, than people who did not graduate in a recession (Bianchi, 2013). With the WVS data set, I can examine whether those low-income individuals who have experienced a macroeconomic crisis in early adulthood have higher SWB than those low income individuals who have not experienced a crisis.

To study the different associations between SWB and macroeconomic crises with WVS data, I follow Lohmann (2015) and include interaction variables in model (1). I interact the income dummies with *shock*^{18–25} and do the same for unemployment. This allows me to examine whether employed and unemployed individuals at different points in a country’s income distribution are affected differently by the macroeconomic crisis experienced in early adulthood. I also test whether those who have entered adulthood during a time of macroeconomic crisis are more sensitive or less sensitive to unemployment, and, to their own position in the income distribution.

Results from estimating the model with interaction variables are reported in table 2. All models include the same set of control variables as before. In columns 1 and 3 of table 3, I have replicated the results reported in columns 3 and 6 of table 1. I report the coefficients of the nine highest income decile dummies; the lowest-earning decile is the reference category. The coefficients of the income decile dummies in columns 1 and 3 of table 3, show that people reporting higher income rank are also happier and more satisfied with their lives.

If we now turn to column 2 of table 3, we can observe how macroeconomic

Table 3: SWB and macroeconomic shocks, interactions

	(1) Happiness	(2) Happiness	(3) Satisfaction	(4) Satisfaction
<i>shock</i> ¹⁸⁻²⁵	-0.039*** (0.012)	-0.081* (0.046)	-0.065* (0.037)	-0.113 (0.188)
2nd Income Decile	0.058* (0.031)	0.059** (0.026)	0.205 (0.126)	0.211* (0.106)
3rd Income Decile	0.095** (0.037)	0.087*** (0.031)	0.393*** (0.131)	0.391*** (0.116)
4th Income Decile	0.142*** (0.032)	0.136*** (0.026)	0.609*** (0.157)	0.613*** (0.130)
5th Income Decile	0.189*** (0.038)	0.183*** (0.033)	0.825*** (0.172)	0.831*** (0.151)
6th Income Decile	0.211*** (0.047)	0.199*** (0.035)	0.977*** (0.187)	0.970*** (0.149)
7th Income Decile	0.250*** (0.045)	0.235*** (0.034)	1.131*** (0.201)	1.113*** (0.163)
8th Income Decile	0.254*** (0.056)	0.234*** (0.041)	1.194*** (0.220)	1.135*** (0.168)
9th Income Decile	0.266*** (0.046)	0.245*** (0.035)	1.243*** (0.207)	1.175*** (0.158)
10th Income Decile	0.305*** (0.040)	0.289*** (0.036)	1.317*** (0.192)	1.292*** (0.153)
2nd Income Decile \times <i>shock</i> ¹⁸⁻²⁵		-0.009 (0.052)		-0.035 (0.167)
3rd Income Decile \times <i>shock</i> ¹⁸⁻²⁵		0.034 (0.060)		-0.001 (0.138)
4th Income Decile \times <i>shock</i> ¹⁸⁻²⁵		0.022 (0.043)		-0.036 (0.172)
5th Income Decile \times <i>shock</i> ¹⁸⁻²⁵		0.019 (0.040)		-0.051 (0.164)
6th Income Decile \times <i>shock</i> ¹⁸⁻²⁵		0.060 (0.073)		0.026 (0.251)
7th Income Decile \times <i>shock</i> ¹⁸⁻²⁵		0.071 (0.061)		0.085 (0.233)
8th Income Decile \times <i>shock</i> ¹⁸⁻²⁵		0.108 (0.088)		0.351 (0.278)
9th Income Decile \times <i>shock</i> ¹⁸⁻²⁵		0.123* (0.071)		0.471* (0.268)
10th Income Decile \times <i>shock</i> ¹⁸⁻²⁵		0.084* (0.046)		0.134 (0.264)
Unemployed	-0.172*** (0.022)	-0.193*** (0.027)	-0.547*** (0.070)	-0.589*** (0.085)
Unemployed \times <i>shock</i> ¹⁸⁻²⁵		0.080*** (0.029)		0.170* (0.084)
shock's effect for 1st decile		-0.081*		-0.113
shock's effect for 2nd decile		-0.091***		-0.148**
shock's effect for 3rd decile		-0.048**		-0.114
shock's effect for 4th decile		-0.060***		-0.149**
shock's effect for 5th decile		-0.063***		-0.164**
shock's effect for 6th decile		-0.022		-0.087
shock's effect for 7th decile		-0.010		-0.028
shock's effect for 8th decile		0.026		0.238**
shock's effect for 9th decile		0.041		0.358***
shock's effect for 10th decile		0.003		0.021

All models estimated with OLS. Income dummies based on survey country's income distribution. The omitted category is the lowest income decile. All models include controls for current shock, $\Delta \ln(GDPpc)$, gender, education, relationship status and religion. Dummies for year, country, cohort and age are included and also interactions between country dummies and continuous cohort variable. Lower panel reports the combined effect of a macroeconomic shock for each income decile separately. Country-clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

shocks in early adulthood affect happiness differently depending on the income decile of the individual. The coefficient of $shock^{18-25}$ captures the effect of an early adulthood macroeconomic crisis for employed individuals in the lowest income decile. The results indicate that early adulthood crisis experience is negatively associated with happiness among the lowest-earning employed individuals within a country. This effect is statistically significant at the 10% level.

For the second income decile, the effect of an early adulthood crisis is the sum of the coefficients of $shock^{18-25}$ and $(2nd\ Income\ Decile) \times shock^{18-25}$. As is reported in the lower panel of table 2, this sum is negative and statistically significantly different from zero for both happiness and life satisfaction. Therefore, employed individuals who are in the 2nd income decile and have experienced a crisis are less happy and less satisfied than employed individuals in the same decile who have not experienced a crisis. The effect is also statistically significantly different from zero in the 4th income decile for both happiness and life satisfaction. This differs from the results on job satisfaction by Bianchi (2013). In contrast, my findings show that employed individuals who have experienced a crisis do not report higher levels of happiness or life satisfaction when they are located at the lower end of the income distribution.

The coefficients of the income decile interactions reveal that individuals who have ended up higher in the income distribution suffer less in terms of happiness and life satisfaction from a past crisis experience. The other way to interpret these coefficients is that individuals suffer more from being at the lower income deciles if they have experienced a macroeconomic crisis in early adulthood. However, it should be noted that the coefficients of the interaction variables are only statistically significant at the 10% level for happiness for the lowest and for the two highest income deciles. For life satisfaction, the interaction variable is positive and significant at the 10% level for the ninth income decile.

These results imply that employed individuals who have experienced a macroeconomic shock in early adulthood could be more sensitive to the income of others. This is in line with Giuliano and Spilimbergo (2014), who find that experiencing a macroeconomic shock in early adulthood increases individuals' demand for redistribution and affects individuals' perceptions about the key determinants of success in life. Their results show that individuals who have experienced a crisis in early adulthood see luck as a more crucial determinant for success than hard work. This could explain why high income rank is associated with higher SWB for those who have experienced

a crisis.

Finally, let us analyse the effect of early adulthood macroeconomic crises on SWB of the unemployed. The coefficient of $\text{Unemployed} \times \text{shock}^{18-25}$ in table 5 captures the additional effect of the crisis experience on the unemployed. The positive sign of the coefficient implies that unemployed individuals are less affected by the crisis experience than employed individuals are. Individuals who have not experienced a macroeconomic crisis suffer more from current unemployment than those individuals who grew up in a crisis.

4 Robustness checks

4.1 Different thresholds for crisis

In the models presented in the previous section, I have followed Barro and Ursúa (2008) and Giuliano and Spilimbergo (2014) and assumed that macroeconomic crisis is defined by a 10% peak to trough decrease in real GDP per capita. This assumption results in a situation where most of the episodes defined as crises after the year 1950 occur in developing countries. Finland's crisis in the early 1990s and the most recent crises in Greece and Italy (starting from year 2008) are the only crises coded in developed countries after 1950. Thus, most of the crisis experiences of the younger cohorts identified are from developing countries. One way to test the robustness of the baseline results is to change the crisis threshold to allow smaller economic contractions to be coded as crises. I have used thresholds of 9%, 8%, 7%, 6% and 5% peak to trough decreases in real GDP per capita in defining the crisis period in the following robustness checks. Table 4 reports the results for the same models as the ones estimated in columns 2 and 4 of table 1 using the alternative crisis thresholds.

Table 4: SWB and macroeconomic shocks, alternative crisis definition

	(1) Happiness	(2) Happiness	(3) Happiness	(4) Happiness	(5) Happiness	(6) Satisfaction	(7) Satisfaction	(8) Satisfaction	(9) Satisfaction	(10) Satisfaction
Crisis threshold	9%	8%	7%	6%	5%	9%	8%	7%	6%	5%
<i>shock</i> ¹⁸⁻²⁵	-0.040*** (0.011)	-0.033*** (0.009)	-0.012 (0.007)	-0.012 (0.008)	-0.013 (0.008)	-0.070* (0.034)	-0.080** (0.038)	-0.052* (0.028)	-0.045 (0.030)	-0.040 (0.026)
Current shock	-0.036 (0.093)	-0.245 (0.161)	-0.245 (0.162)	-0.246 (0.162)	-0.245 (0.162)	-0.060 (0.311)	-0.331 (0.419)	-0.332 (0.418)	-0.333 (0.418)	-0.332 (0.418)
$\Delta \ln(GDP_{pc})$	2.617*** (0.901)	1.141 (0.969)	1.112 (0.970)	1.114 (0.970)	1.120 (0.970)	4.792** (2.285)	2.876 (3.156)	2.818 (3.154)	2.823 (3.156)	2.836 (3.159)
Unemployed	-0.173*** (0.022)	-0.173*** (0.022)	-0.173*** (0.021)	-0.172*** (0.022)	-0.172*** (0.022)	-0.547*** (0.070)	-0.547*** (0.070)	-0.546*** (0.070)	-0.546*** (0.070)	-0.546*** (0.070)
Male	-0.053*** (0.013)	-0.053*** (0.013)	-0.053*** (0.013)	-0.053*** (0.013)	-0.053*** (0.013)	-0.131*** (0.036)	-0.130*** (0.036)	-0.131*** (0.036)	-0.131*** (0.036)	-0.130*** (0.036)
Secondary school education	0.028 (0.017)	0.029* (0.017)	0.029* (0.017)	0.029* (0.017)	0.029* (0.017)	0.044 (0.035)	0.045 (0.035)	0.045 (0.035)	0.045 (0.035)	0.045 (0.035)
University level education	0.040*** (0.014)	0.041*** (0.014)	0.041*** (0.014)	0.041*** (0.014)	0.041*** (0.014)	0.131*** (0.042)	0.132*** (0.042)	0.132*** (0.042)	0.132*** (0.042)	0.132*** (0.042)
Income dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Relationship dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Religion dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Age FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cohort FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
(Country dummies)*cohort	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	96510	96510	96510	96510	96510	96957	96957	96957	96957	96957

All models estimated with OLS. Threshold used for defining a macroeconomic shock reported in the second row. Religion dummies include muslim, orthodox, roman catholic, protestant and other religion. Relationship status dummies include married, living together as married, divorced, separated and widowed. The omitted category is single/never-married females with uncompleted secondary school and no religious denomination. Country-clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Results in columns 1 and 2 of table 4, show that early adulthood crises defined using the 9% and 8% threshold are also statistically significantly associated with lower levels of happiness. Using a lower crisis threshold than 8%, however, results in a smaller and insignificant effect on happiness. The estimated effect on life satisfaction is also closer to zero when using smaller thresholds, but is still statistically significantly different from zero at the 10% significance level for the 7% crisis threshold. These results suggest that smaller crises experienced in early adulthood are also associated with lower SWB later in life. However, a more severe crisis in early adulthood has larger lasting impacts on SWB.

4.2 Experiencing crisis at different ages

Thus far, the focus has only been on the effects of crisis experiences in the early adulthood. It is also possible that experiencing a macroeconomic crisis at some other age has a lasting effect on individual SWB. Previous studies have not examined the age at which the scarring effect of unemployment takes place, for example. Furthermore, macroeconomic crises experienced in childhood can cause material deprivation and affect the development of an individual through a variety of channels. In this section, I assess whether experiencing a crisis at some other age is harmful to well-being later in life. Following Giuliano and Spilimbergo (2014), I have constructed six different eight-year range intervals for age (2–9, 10–17, 26–33, 34–41, 42–49, 50–57). In each column of table 5, I test the lasting effect of experiencing a crisis during one of these ages. The crisis is defined using the 10% peak to trough decrease as a threshold.

Table 5: SWB and macroeconomic shocks, alternative age ranges

	(1) Happiness	(2) Happiness	(3) Happiness	(4) Happiness	(5) Happiness	(6) Happiness	(7) Satisfaction	(8) Satisfaction	(9) Satisfaction	(10) Satisfaction	(11) Satisfaction	(12) Satisfaction
<i>shock</i> ²⁻⁹	0.003 (0.009)						-0.012 (0.022)					
<i>shock</i> ¹⁰⁻¹⁷		-0.019* (0.010)						-0.030 (0.030)				
<i>shock</i> ²⁶⁻³³			-0.020 (0.013)						-0.025 (0.046)			
<i>shock</i> ³⁴⁻⁴¹				-0.038** (0.018)						-0.030 (0.051)		
<i>shock</i> ⁴²⁻⁴⁹					-0.033 (0.030)						-0.179** (0.084)	
<i>shock</i> ⁵⁰⁻⁵⁷						-0.033 (0.026)						0.043 (0.092)
Current shock	-0.118 (0.083)	-0.122 (0.083)	-0.123* (0.067)	-0.128* (0.065)	-0.097 (0.061)	-0.143** (0.067)	0.051 (0.181)	0.050 (0.180)	-0.065 (0.219)	-0.058 (0.229)	0.028 (0.224)	-0.214 (0.212)
$\Delta \ln(GDPpc)$	2.165*** (0.776)	2.157*** (0.765)	1.940*** (0.695)	1.702** (0.636)	1.974*** (0.629)	1.258* (0.720)	4.709** (1.771)	4.652** (1.782)	5.226*** (1.800)	5.244*** (1.806)	3.935** (1.819)	1.676 (2.402)
Unemployed	-0.157*** (0.021)	-0.156*** (0.021)	-0.184*** (0.027)	-0.187*** (0.031)	-0.169*** (0.029)	-0.152*** (0.027)	-0.488*** (0.064)	-0.479*** (0.066)	-0.590*** (0.076)	-0.563*** (0.081)	-0.550*** (0.095)	-0.351*** (0.117)
Male	-0.052*** (0.012)	-0.053*** (0.012)	-0.050*** (0.013)	-0.047*** (0.014)	-0.047*** (0.015)	-0.039** (0.016)	-0.109*** (0.036)	-0.111*** (0.036)	-0.131*** (0.036)	-0.106*** (0.030)	-0.103*** (0.035)	-0.128*** (0.042)
Secondary school education	0.032* (0.016)	0.032* (0.016)	0.025 (0.017)	0.027 (0.017)	0.030* (0.017)	0.036* (0.021)	0.054 (0.034)	0.058 (0.036)	0.045 (0.050)	0.030 (0.053)	0.038 (0.049)	0.048 (0.066)
University level education	0.048*** (0.015)	0.047*** (0.015)	0.030** (0.014)	0.025 (0.015)	0.027* (0.016)	0.038* (0.020)	0.152*** (0.048)	0.154*** (0.048)	0.104** (0.044)	0.077* (0.045)	0.070 (0.047)	0.082 (0.066)
Income dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Relationship dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Religion dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Age FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Cohort FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Country FEs	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
(Country dummies)*cohort	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	118183	117174	75172	54762	37253	23181	118698	117691	75525	55013	37423	23308

All models estimated with OLS. Superscript in the shock variable denotes the age at which shock is experienced. Shock is defined using 10% peak to trough decrease in real GDP per capita in every column. Religion dummies include muslim, orthodox, roman catholic, protestant and other religion. Relationship status dummies include married, living together as married, divorced, separated and widowed. The omitted category is single/never-married females with uncompleted secondary school and no religious denomination. Country-clustered standard errors in parentheses. * $p < 0.10$,

** $p < 0.05$, *** $p < 0.01$.

Columns 1–6 and 7–12 in table 5 report the effect of experiencing a crisis at different ages on happiness and life satisfaction, respectively. Only individuals who are older than the upper bound of the interval are included in the analysis. Thus, the focus is, again, on the lasting effects of past crises.⁹ Models presented in columns 1 and 7 of table 5 have the largest samples because they include all individuals older than 9. In all of the models in table 5, I have used the 10% peak to trough decrease in real GDP per capita as the threshold for the crisis.

The results in column 2 of table 5 show that experiencing a crisis at ages 10–17 has a small negative impact on happiness, which is significant at the 10% level. Experiencing a crisis at ages 10–17 has no statistically significant effect on life satisfaction. Observing columns 5 and 10 of table 5 shows that, for individuals older than 41, there exists a significant effect of experiencing a crisis when 34–41 years old on happiness but not on life satisfaction. Experiencing a crisis at ages 42–49 has no statistically significant effect on happiness, but a significant effect on life satisfaction at the 5% level.

Together, these results suggest that experiencing a severe recession later in life has some effect on SWB. Though not reported here, the effect of a crisis experience in later life is most prominent for unemployed individuals. This would suggest that the combination of experiencing a crisis in later working life and being unemployed after the crisis is associated with lower SWB. The same does not hold for individuals who have experienced a crisis at ages 18–25. As discussed in section 3.3, the negative effect of early adulthood crisis experience is larger for the employed.

4.3 Placebo treatments

To further test the robustness of the baseline results presented in table 1, I follow Giuliano and Spilimbergo (2014) and create placebo treatments by assigning each individual with the macroeconomic history of another, randomly selected country. If this country experienced a macroeconomic shock when the individual was 18–25 years old, then the placebo shock dummy equals 1. In table 6 in appendix B, I have replicated the results presented in table 1 using the placebo shock dummy as the explanatory variable. The results show that there is no statistically significant association between the placebo shock dummy and the SWB variables. This supports the idea that the baseline model is identifying the effect of an early adulthood

⁹When examining the effects of crises experienced later in life, there is a larger share of individuals who have experienced the crisis recently.

macroeconomic crisis on SWB.

5 Conclusion

In this paper, I have shown that individuals who have experienced a severe macroeconomic crisis when they were 18–25 years old report lower levels of happiness and life satisfaction than the rest of the population. The most vulnerable individuals in terms of subjective well-being are those who end up at the lower end of the income distribution. I have also presented some evidence indicating that individuals who have experienced a macroeconomic crisis in early adulthood are more sensitive to the income of others. The role of early adulthood crisis experience as a moderator for the effect of relative income should be further examined in future studies. In addition, future research should focus on determining the specific channels through which early adulthood crisis experiences are associated with subjective well-being.

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APPENDIX A: Crisis years

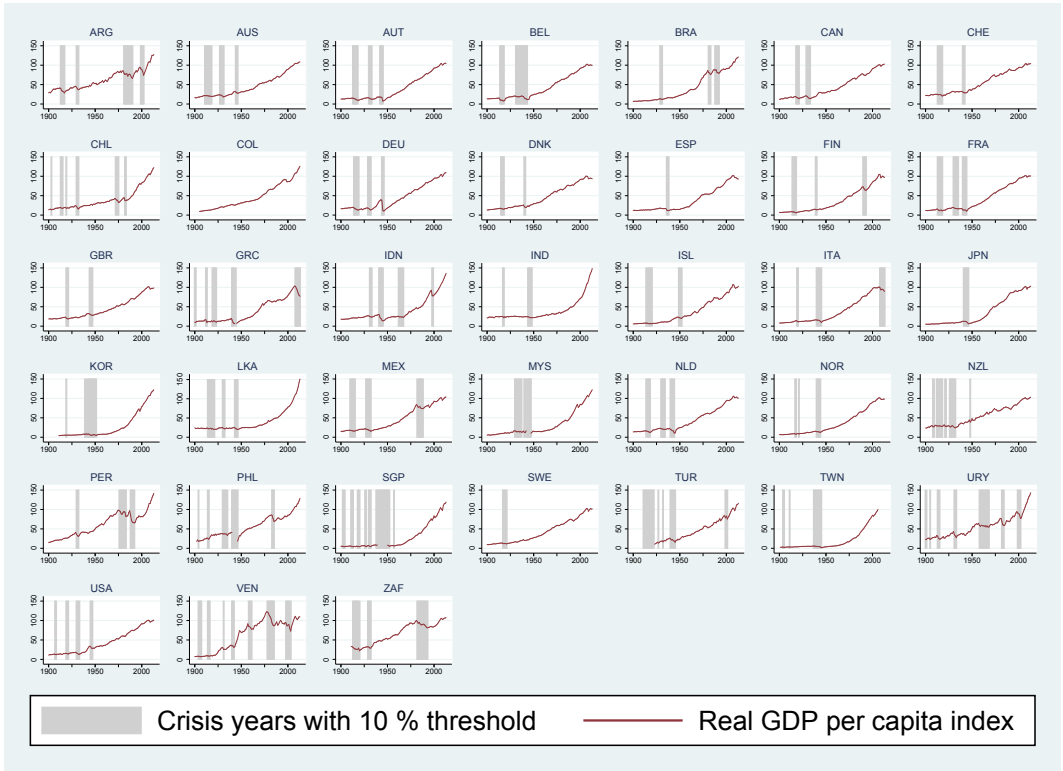


Figure 2: Crisis years using the 10% peak to trough decrease in real GDP per capita as the condition for crisis. The years considered as crisis are highlighted for the 38 sample countries. I have followed Barro and Ursúa (2008) in defining all the years when the GDP variable is missing as crisis years.

APPENDIX B: Placebo treatment

Table 6: SWB and macroeconomic shocks, placebo treatment

	(1) Happiness	(2) Happiness	(3) Happiness	(4) Satisfaction	(5) Satisfaction	(6) Satisfaction
$shock^{18-25}$	0.008 (0.005)	0.008 (0.005)	0.008 (0.005)	-0.021 (0.019)	-0.021 (0.019)	-0.022 (0.020)
Current shock	-0.122 (0.084)	-0.125 (0.086)	-0.125 (0.081)	0.002 (0.200)	-0.009 (0.214)	-0.030 (0.189)
$\Delta \ln(GDPpc)$	2.751*** (0.732)	2.755*** (0.714)	2.205*** (0.764)	7.541*** (1.508)	7.561*** (1.473)	4.918*** (1.767)
Male	-0.035** (0.014)	-0.052*** (0.014)	-0.053*** (0.013)	-0.084** (0.041)	-0.122*** (0.043)	-0.131*** (0.036)
Secondary school education		0.072*** (0.026)	0.028 (0.017)		0.241*** (0.071)	0.044 (0.035)
University level education		0.126*** (0.025)	0.040*** (0.014)		0.519*** (0.079)	0.131*** (0.043)
Unemployed			-0.172*** (0.022)			-0.546*** (0.070)
Income dummies	NO	NO	YES	NO	NO	YES
Relationship dummies	NO	YES	YES	NO	YES	YES
Religion dummies	NO	YES	YES	NO	YES	YES
Age FEs	YES	YES	YES	YES	YES	YES
Year FEs	YES	YES	YES	YES	YES	YES
Cohort FEs	YES	YES	YES	YES	YES	YES
Country FEs	YES	YES	YES	YES	YES	YES
(Country dummies)*cohort	YES	YES	YES	YES	YES	YES
Observations	96510	96510	96510	96957	96957	96957

All models estimated with OLS. Each individual is assigned with a macroeconomic history of another randomly selected country. $shock^{18-25} = 1$ if the randomly selected country experienced a 10% decrease in real GDP per capita when the individual was 18–25 years old. Country-clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$