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

A1 Controlling for the trend component of output

A1.1 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:

$$s_{i,t} = \gamma y_{i,t} + \lambda_i + \eta_t + \epsilon_{i,t}. \tag{A1}$$

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

$$y_{i,t} = C_{i,t} + T_{i,t}. \tag{A2}$$

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

$$s_{i,t} = \gamma_C C_{i,t} + \gamma_T T_{i,t} + \lambda_i + \eta_t + \epsilon_{i,t}, \tag{A3}$$

which can be written as

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

and, further, as

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

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., $\gamma_T - \gamma_C = -\gamma_C$).

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, γ_T = 0), if growth falls short of trend growth, this shortfall is a foregone gain instead of a loss.

A1.2 Short-run

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

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

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

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

which can be written as

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

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.

A2 Eurobarometer data

Eurobarometer surveys have included the life satisfaction question at least once a year starting from 1975.[1] 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, 44.2bis, 44.3OVR, 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. Surveys from 57.1 to 84.1 and the surveys 44.2bis and 44.3OVR are included as separate files from the Gesis website. The rest of the surveys are included via The Mannheim Eurobarometer Trend File. 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.

[1] We 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.
Source: Eurobarometer surveys (https://zacat.gesis.org/webview/)