Adaptation to income over time: A weak point of subjective well-being

Christoph Wunder
University of Bamberg

June 2008

Abstract

This paper holds the view that the intertemporal comparison of people's subjective evaluations of their lives and living conditions are only meaningful to the extent the standard of judgement is unaltered. In consequence, the inferences from an analysis of intertemporal changes in subjective well-being are restricted since it is indistinct whether such changes are caused by a variation in the living conditions or by an adjustment of standards. This is a weak point of subjective well-being measures. The present study investigates the change in the satisfaction judgements resulting from adaptation to income over time. Adaptation is understood as desensitization (sensitization) to the hedonic effect of income resulting from increases (decreases) in income. An estimator for the rate of adaptation is derived from an adaptive utility function. Using data on self-reported satisfaction with household income and global life satisfaction from the German Socio-Economic Panel Study (SOEP), it is found that adaptation leads to a reduction in the hedonic effect of income of approximately 4% (satisfaction with the household income) and 6% (life satisfaction), respectively. Calculating a compensating income variation indicates that an increase in income of roughly 2% year is fully offset by adaptation. Furthermore, the results indicate that adaptation is asymmetric: People adapt faster to increases (gains) than to decreases (losses) in income. Finally, it is found that the rate of adaptation varies with education: Respondents with a high (low) educational attainment exhibit a low (high) propensity to adapt to income.

Keywords: adaptation, financial satisfaction, subjective well-being, standard of judgement

JEL Classification: C23, I31

Corresponding author:
Christoph Wunder
University of Bamberg
Department of Economics
Feldkirchenstraße 21
D-96045 Bamberg
E-Mail: christoph.wunder@uni-bamberg.de

Acknowledgments: I would like to thank Johannes Schwarze for the critical comments and the continuous support. I am grateful to Christian Schröer for the stimulating discussions. I would also like to thank the participants of the 2007 International Society for Quality of Life Studies (ISQOLS) Conference for the helpful comments.

1 Introduction

One of the principal aims of the research on subjective well-being is to narrow the informational gap left open by objective indicators describing individuals' welfare. Undoubtedly, objective indicators, such as the growth in incomes, convey a picture of people's living conditions, but this representation remains incomplete unless the individuals' subjective evaluations differ from the objective measures. In this context, the literature produced some insightful studies that demonstrated how subjective well-being measures can be utilized to investigate questions for which an answer cannot be found (solely) on the basis of objective indicators.[1]

Economic research on subjective well-being uses survey questions "to get indications of individuals' evaluations of their life satisfaction or happiness" (Frey and Stutzer 2002, p. 405). Self reported satisfaction measures are approved to represent a judgement people make on their life or, in the case of domain satisfactions, on specific areas of their life. In order to use survey data on subjective well-being as a complementary indicator of the life situation, the evaluation has to be made with respect to a standard of judgement. Without such a standard, the judgement would be more or less arbitrary and hence meaningless.

The standard of judgement is, however, not independent of the life to be judged. It rather depends on the context in which the evaluating individual lives: Both the current circumstances of life and the expectations of the future shape the standard of judgement. Moreover, the living conditions also affect the expectations of the future. For example, an increase in income in the past is supposed to result in higher expectations of the income level at present. A prerequisite to facilitate the intertemporal comparability of satisfaction judgements is that the standard of judgement underlying the evaluation remains generally constant—at least it should not vary too much. If standards change, then the judgements given at different points in time will not be comparable. In consequence, the intertemporal comparison of well-being data is limited to the extent people adapt their expectations and aspirations that shape their standard of judgement.

[1] For example, van Praag and Baarsma (2005) use data on life satisfaction to assess the external effect caused by airport noise. Wunder et al. (2008) analyze the impact of the introduction of the euro cash changeover on financial satisfaction in Germany. The issue provoked the perception of a decreasing purchasing power, although the official price statistic provided no evidence for unusual inflation rates.

It is for that reason that it is necessary to have knowledge on the impact of the adjustment of standards on the satisfaction judgements resulting from changes in the life circumstances.

In general, the standard of judgement is not observed directly and empirical researchers have no (or only very limited) information of the underlying expectations and aspirations. However, a change in the *latent* standard of judgement is mirrored in *observed* changes in the satisfaction judgement. From it, the task for the present paper results: In the context of an evaluation of the financial situation, the dynamics of the standard of judgement can be analyzed applying a framework of adaptation to income over time. This paper addresses the question of whether and to what extent adaptation to income over time can be observed—or to put it differently: the question whether people change their standard of judgment over time. Given the individual's living conditions, i.e., controlling for socio-economic characteristics, the observed change in the intertemporal satisfaction values is interpreted as a symptom of the change in the latent standard of judgement.

The analysis is organized as follows: Section 2 provides an overview of the literature and discusses the evidence found on the relationship between income and well-being. The methodological framework is introduced in section 3. Section 4 and 5 establish the dataset from the German Socio-Economic Panel Study (SOEP) and provide the empirical results, respectively. Section 6 concludes the main findings of the paper.

2 Literature Review

Utility is a central concept in economics. In particular, consumer theory builds upon the idea that utility (or well-being) increases with income. Although this fundamental assumption is supported by a number of empirical studies, there is also evidence that the relationship between utility and income is not as clear as it seems. In a seminal study, Easterlin (1974) worked out that happiness did not rise during a period with substantial economic development in the US. His study initiated a branch of research focusing on the investigation of the causal impact of income on well-being.

An important attempt at an explanation of the rather weak impact of income on well-being started from adaptation level theory (Helson 1964). The concept of adaptation has its origins in biology where it refers to the adjustment to environmental conditions in a broad sense and in sensory physiology where it denotes the decrease in response due to a steady state stimulation. Adaptation is a deep-rooted behavioral issue and has far reaching impact on different types of behavior (cf. Frederick and Loewenstein 1999). So, the research on sexual behavior discerned habituation to sexual arousal in both males and females (cf. Meuwissen and Over 1990; Koukounas and Over 1993). In general, adaptation represents a mechanism that enables a person to adjust to changes in the environmental circumstances. With respect to happiness, the term adaptation alludes to the principle that an individual's assessment of a current level of stimulation is determined by the level of stimulation the individual was exposed to in the past (cf. Brickman and Campbell 1971). Stutzer (2004) worked out in an empirical study that adaptation to repeated stimuli forms an individual's aspirations. The extent of meeting the aspirations determines, however, a person's subjective well-being. In a recent study, Di Tella et al. (2005) provided empirical evidence for adaptation to income.

In his work on the relationship between income and happiness, Easterlin (1974) discussed the question of whether higher income is associated with higher levels of well-being. His analyses provided paradoxical results: while within-country comparisons gave a clear confirmation of a positive association between income and happiness, international comparisons did not indicate cross-sectional differences in happiness between countries with different levels of development. Besides, the research on time series data for the US showed no trend up or down in the level of happiness reported over the time period from 1946 to 1970, although income rose considerably for that period. The literature discussed this finding as the Easterlin or happiness paradox.

The result that economic growth did hardly contribute to a rise in SWB was replicated in recent research. For example, Blanchflower and Oswald (2004) found decreasing and unchanged life satisfaction over the last quarter of a century in the US and Britain, respectively. Studies for Japan, South Korea, China, and Singapur also provided a clear confirmation of the Easterlin paradox (cf. Diener and Oishi 2000). For instance, despite of a long lasting period of enormous economic growth during which Japan rose from poverty to one of the world's economic leaders, there was only a marginal change in SWB of 3 percent in that period from 1958 to 1987.

What may be an explanation of the Easterlin paradox? Easterlin himself provided an explanation following the relative income hypothesis put forward by Duesenberry (1967). This theory postulates that utility does not depend on the absolut level of a person's income (and/or consumption), but rather on the ratio of the person's income to that of other people. In consequence, an increase in an individual's income results in higher well-being only if his/her relative income position is improved. In addition, Easterlin included considerations regarding the adaptation of material aspirations in his explanation. He supposed that aspirations are correlated with the level of economic development, and that the economic progress itself drives the adaptation of aspirations. As a consequence, this process may lead to a situation in which the benefits from income growth are fully offset by the upward shift in aspirations. Easterlin (1974) stated that "the progressive accretion of household goods due to economic growth causes a continuous upward shift on consumption norms. This upward shift in standards (tastes) tends to offset the positive effect of income growth on well-being that one would expect on the basis of economic theory" (p. 116).

The relationship between income and happiness was investigated in related research with respect to the question whether and to what extent individuals adjust to their circumstances, in particular, to their financial situation and to a growth in income. In the theoretical framework of the welfare function of income (WFI), van Praag (1971) provided evidence that habituation to income results in an adjustment of aspirations (preference drift effect). Investigating the role of altering aspirations, Inglehart and Rabier (1986) worked out that a change in the objective life circumstances has only an impact on subjective well-being in the short term. In the long term persistent circumstances result in an adjustment of aspirations.

Clark et al. (2006) summarized studies on adaptation to income. A typical empirical framework for the analysis of adaptation includes an intrapersonal income comparison in the multivariate regression analysis of satisfaction data (e.g., Di Tella et al. 2005). The idea behind is that the individual has an internal reference point that is moulded from the past income stream. The approach implies that a persistent income shock is supposed to change the individual's financial situation. He/she adjusts to the novel conditions during the adaptive time interval: in a first transient reaction phase, an initial rapid change in utility occurs due to the increase in income. This additional well-being provoked by the extra money fades over time because habituation

results in a decrease in sensitivity. This first phase is followed by a new equilibrium in the steady phase in which the increased income does not induce further changes in utility. Well-being in the steady phase can either be higher than or equal to its initial level (i.e., the utility level achieved before the income shock occurred). The first case represents incomplete, the second case complete adjustment to the new circumstances.

3 A framework for the analysis of adaptation

In surveys collecting data on the socio-economic living conditions, people are, among other things, asked to subjectively assess how satisfied they are with their life as a whole or specific areas of their life. Typically, these judgements are made quantitatively in terms of values on a satisfaction scale. Unsurprisingly, economic research on subjective well-being attempts to reconstruct people's satisfaction evaluations on the basis of a utility function. Multivariate regression analysis allows to identify the factors determining an individual's well-being (or utility). The regression results can then be interpreted as estimators for the parameters of the utility function. The extent to which a given amount of income, for example, contributes to a person's well-being depends, however, on the standard of judgement applied to assess the financial situation. That is, the standards determine the size of the parameters of the well-being function, and with it the magnitude of the utility or contentment derived from the right hand side variables. Hence, it is supposed that changes in the standard are reflected in a change of the parameters of the utility function.

In the following, a framework is introduced that allows to identify such parameter changes with respect to the evaluation of income. It is assumed that the observed changes in the contribution of income to the individual's well-being given the variation in the socio-economic characteristics is a result of the underlying adjustment in the latent standard of judgement. The notion of adaptation to income is that the individual derives a decreasing (increasing) utility from a given amount of income over time when he/she expects an improvement (worsening) of the financial situation. The reasons for that is that an increase in income leads to an upward adjustment of the individual's expectations and aspirations. That is, adaptation is understood as desensitization (sensitization) to the hedonic effect of income resulting from increases (decreases) in

income. Hence, adaptation is seen as an adjustment of the standard of judgement to the living conditions and the associated expectations. This idea is consistent with a common definition which states that adaptation "refers to the reduction in the intensity of favorable and unfavorable circumstances" (Frederick and Loewenstein 1999, p. 302).

Empirical studies typically model adaptation to income as an intrapersonal income comparison. Hence, assumptions about an internal point of reference are made for calculating a comparison income. Moreover, well-being is assumed to reach a steady state (i.e., a baseline level) after a transient reaction phase. Both assumptions are not necessary for the novel approach presented in this paper. The basic idea is that adaptation to income is reflected by an exponential depreciation of income in terms of subjective well-being over time. This approach does not require the explicit formulation and numerical calculation of an internal reference point. Therefore, information upon a person's income history is not required and the data can be exploited more efficiently.

How can a measure for adaptation be incorporated into the typical well-being equation? We model the process of adaptation that reduces the effect of income on well-being over time including the term $e^{-\kappa t}$ in the utility function so that the econometric model can be written (for one individual at time t) as

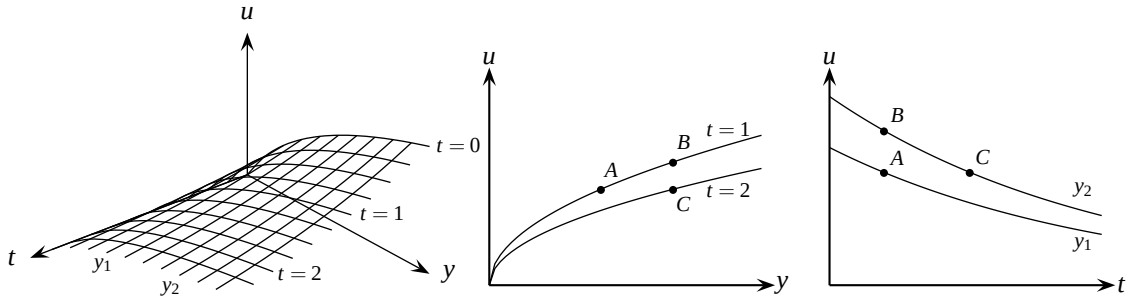
$$u = e^{-\kappa t}\alpha \ln y + \mathbf{x}'\beta + \varepsilon \ . \tag{1}$$

Utility u is determined by (the natural logarithm of) income y and further socio economic variables in the vector $\mathbf{x}$. The parameter α denotes the effect of income on well-being that would be realized if the changes in income in the past had no impact on the standard of judgement at present, i.e., it would indicate the effect on well-being if there were no adaptation. κ denotes the rate of adaptation, t indicates the time period and e is the exponential function. The functional form allows for an intertemporal variation of the impact of income on well-being without introducing an explicit reference point.[2]

[2] As the framework exhibits similarity with the discounted utility model by Samuelson (1937), it may be possible to connect time preference and adaptation, i.e., time preference may be interpreted as anticipated adaptation.

Figure 1 illustrates the shape of an adaptive utility function in the case of a desensitization ($\kappa > 0$), i.e., an upward shift in aspirations. The marginal adaptive utility of income in equation 1 is positive ($\partial u/\partial y > 0$). Therefore, additional income yields additional utility. The cross partial derivative indicates that the marginal utility is diminishing over time ($\partial^2 u/\partial y \partial t < 0$). How are changes in income considered in the model? In the case of a positive income shock (e.g., an increase in income from y_1 to y_2), the person has a higher well-being at each point in time. Utility rises from point *A* to point *B* in figure 1. However, the upward adaptation of aspirations leads to the devaluation of income ober time in terms of utility such that the initial level of utility is reached again after a certain time interval. Adaptation to the increase in income is complete in point *C*, though it is not assumed that the process stops at this point. Utility could even fall below the initial level in *A*.

Figure 1
Adaptation and the utility function over time



From these considerations on the shape of an adaptive utility function, an econometric model can be derived. The theoretical model can be set up for two periods, $t-1$ and t, as

$$u_{t-1} = e^{-\kappa(t-1)}\alpha \ln y_{t-1} + \mathbf{x}'_{t-1}\beta + \varepsilon_{t-1} \tag{2}$$

$$u_t = e^{-\kappa t}\alpha \ln y_t + \mathbf{x}'_t\beta + \varepsilon_t \tag{3}$$

The two equations describe the relationship between utility experienced and income at two distinct points in time. For instance, it follows that a one percent increase in income at time $t-1=0$ results in an increase in utility of α units whereas the same relative change in income one period later (i.e., in $t=1$) leads to an increase in utility of $e^{-\kappa}\alpha$. Evidently, an individual benefits less (in terms of utility experienced) from income one period later when $\kappa > 0$, i.e.,

in the case of an upward shift of expectations. In this context, κ can be interpreted as the rate at which the individual depreciates the income over time. It is supposed that the underlying process is one of adaptation. Hence, the parameter κ is regarded as an indicator for the rate of adaptation and can be identified by first differencing equations 2 and 3:

$$u_t - u_{t-1} = e^{-\kappa t}\alpha \ln y_t - e^{-\kappa(t-1)}\alpha \ln y_{t-1} + \Delta \mathbf{x}'\boldsymbol{\beta} + \Delta\varepsilon \tag{4}$$

$$\Delta u = \gamma_1 \ln y_t + \gamma_0 \ln y_{t-1} + \Delta \mathbf{x}'\boldsymbol{\beta} + \Delta\varepsilon \tag{5}$$

Equation 5 can be estimated by OLS. The calculation of the adaptation rate is feasible on the basis of the coefficients of the natural logarithm of the income of the two periods following each other, γ_1 and γ_0. Considering that γ_0 represents $-e^{-\kappa(t-1)}\alpha$, κ is:

$$\ln\left(-\frac{\gamma_0}{\gamma_1}\right) = \ln\left(-\frac{-e^{-\kappa(t-1)}\alpha}{e^{-\kappa t}\alpha}\right) = \ln\left(e^{\kappa}\right) = \kappa \tag{6}$$

First differencing provides also the possibility to control for individual heterogeneity because unobserved time-invariant effects are eliminated from the model. Controlling, in addition, for fixed year effects by including an overall intercept β_0 and dummy variables indicating the time periods $t = 3, \ldots, T$ in the $(T-2) \times 1$-vector $\mathbf{d}$ yields the complete econometric model:

$$\Delta u_{it} = \beta_0 + \mathbf{d}_t'\theta + \gamma_1 \ln y_{it} + \gamma_0 \ln y_{i,t-1} + \Delta \mathbf{x}_{it}'\boldsymbol{\beta} + \Delta\varepsilon_{it} \tag{7}$$

Robust standard errors were computed to correct for serial correlation in the idiosyncratic error $\Delta\varepsilon_{it}$ (cf. Wooldridge 2002).

4 Data

This paper uses data from the German Socio-Economic Panel Study (SOEP). The SOEP is a representative longitudinal study of private households in the Federal Republic of Germany that was started in 1984 (cf. Haisken-DeNew and Frick 2005). The information gathered at the first interview—and therefore the entire first wave—was completely eliminated from the dataset.

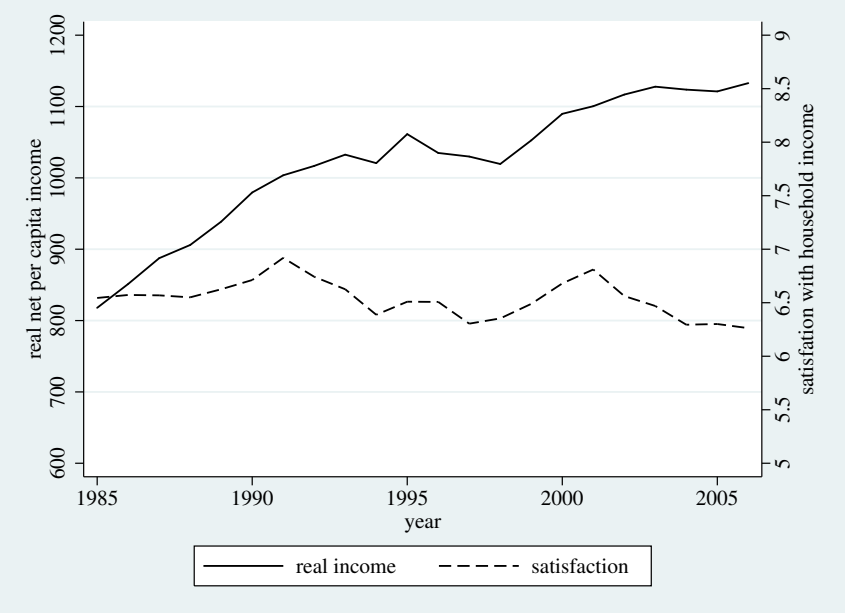
The reason for this is that the subjective data provided by the respondents—in particular, the subjective information concerning the financial contentment—may be affected by panel and/or learning effects and the answers provided at the first contact may contain extreme values more often (cf. Ehrhardt et al. 2000). Landua (1993) pointed out that the quality of the data improves after participation in several interview waves. Consequently, the sample contains information from 1985 to 2006.[3]

The respondents' utility derived from income is approximated by the satisfaction with their life and the satisfaction with the household income, respectively, which is by now a widely accepted approach among economists. Frey and Stutzer (2002), for instance, provided an overview of the integration of happiness research into economic analysis. A person's financial well-being is captured by answers on a scale from 0 (totally unhappy) to 10 (totally happy) to the following survey question: "How satisfied are you with your household income?" (Infratest Sozialforschung 2004).

Figure 2 illustrates the temporal development of monthly net household income and financial contentment for the time period between 1985 and 2006 (the figure is restricted to West German respondents). An upward trend in income is evident. Particularly in the second half of the decade of the 1980s, income rose considerably. The 1990s also exhibited a moderate upward movement. Average real household income increased from 818 euro per capita (in 1985) to 1133 per capita euro (in 2006) in West Germany. The average growth in income is 1.5%. However, this development is not mirrored in the flat profile of the curve indicating the values for the financial contentment. This evidence gives rise to the conclusion that the growth in incomes did not find an expression in an analogous rise in financial well-being.

[3] The data used in this paper were extracted using the Add-On package PanelWhiz v2.0 (Nov 2007) for Stata. PanelWhiz was written by Dr. John P. Haisken-DeNew (john@panelwhiz.eu). The following authors supplied PanelWhiz SOEP Plugins used to ensure longitudinal consistency, John P. Haisken-DeNew (6), Markus Hahn and John P. Haisken-DeNew (11). The PanelWhiz generated DO file to retrieve the SOEP data used here and any Panelwhiz Plugins are available upon request. Any data or computational errors in this paper are my own. Haisken-DeNew and Hahn (2006) describe PanelWhiz in detail.

Figure 2
Household income and financial contentment between 1985 and 2006



Source: SOEP 1985-2006. Cross-sectional weighted. The figure is restricted to West German respondents.

5 Results

5.1 The average rate of adaptation

Adaptation to income is analyzed by regressing the change in financial and life satisfaction, respectively, on the natural logarithm of the household incomes measured in two successive years. Table 1 shows the results for an estimation of the first differencing model in equation 7. As the household income is the aggregated income of all household members, its impact on subjective well-being depends on the number of persons living in the same household. Therefore, the change in the natural logarithm of the household size between two periods was included in the estimation equations to control for a variation in the number of persons sharing the household income. This specification avoids the application of a particular equivalence scale (cf. Schwarze 2003). The coefficient on the change in household size has, as expected, a negative sign. That is, an increase in the size of the household causes a reduction in the change in the financial contentment (given the household income). Further variables are included in the estimation in order to control for changes in the individuals' socio-economic status.

The average rate of adaptation for the entire population can be derived on the basis of the estimators for the coefficients γ_1 and γ_0. From the results in table 1, average rates of adaptation with respect to the household income are calculated as 4.2% (for satisfaction with household income) and 6.2% (for life satisfaction). As the rate of adaptation κ is a function of two random variables (i.e., the estimators for γ_1 and γ_0), the standard errors are estimated using the delta method (cf. Greene 2003). Details are provided in the appendix A on page 20. With standard errors of 0.0090 and 0.0282, respectively, the corresponding t-test statistics are 4.67 and 2.18 indicating that the rates of adaptation are statistically significant.

Table 1
Estimation results

variable	**financial satisfaction** **coefficient**	**robust s.e.**	**life satisfaction** **coefficient**	**robust s.e.**
log of household income in t: γ_1	1.070***	(0.021)	0.292***	(0.016)
log of household income in $t-1$: γ_0	-1.116***	(0.021)	-0.310***	(0.016)
log of household size	-0.370***	(0.033)	-0.064**	(0.027)
East Germany	0.062***	(0.011)	0.042***	(0.009)
yearly changes				
years of education	-0.018	(0.011)	0.009	(0.009)
home owner	-0.106***	(0.025)	0.018	(0.022)
single: reference				
married	0.121***	(0.047)	0.166***	(0.035)
separated	-0.319***	(0.070)	-0.118*	(0.061)
divorced	-0.065	(0.072)	0.161***	(0.059)
widowed	-0.076	(0.093)	-0.672***	(0.093)
non working	-0.391***	(0.026)	-0.195***	(0.022)
in training	-0.417***	(0.034)	0.018	(0.026)
job: low	-0.113***	(0.017)	-0.061***	(0.014)
job: middle: reference				
job: high	0.057***	(0.021)	0.028	(0.018)
self-employed	-0.147***	(0.040)	-0.007	(0.033)
jobless	-0.934***	(0.026)	-0.557***	(0.021)
pensioner	-0.284***	(0.030)	-0.104***	(0.026)
year fixed effects	included		included	
R-squared	0.05		0.02	
no. of individuals	23757		23973	
no. of observations	184398		187277	

Source: SOEP 1985-2006. Significance levels: *<0.1, *<0.05, ***<0.01. An intercept term is included in all regressions.

What is the interpretation of this result? The rate of adaptation κ refers to the depreciation of the natural logarithm of income in terms of financial satisfaction. The financial satisfaction derived from a given amount of income decreases between two successive years by approximately 4%

(the corresponding number for life satisfaction is approximately 6%). This result provides clear empirical evidence for the existence of adaptation to material well-being.

However, the depreciation of income due to adaptation has also an antagonist, namely, a rise in income: From $\gamma_1 > 0$ and $\gamma_0 < 0$ follows that an increase in income works in the opposite direction, i.e., it leads to increases in well-being. Therefore, financial satisfaction remains fairly unchanged over the years if the growth in income compensates for the adaptation to income. On the basis of the econometric model, the compensating income variation required to keep well-being constant over time can be calculated from

$$\Delta u = \gamma_1 \ln(y + \Delta y) + \gamma_0 \ln y + \Delta \mathbf{x}' \boldsymbol{\beta} \stackrel{!}{=} 0 \tag{8}$$

where fixed year effects and the intercept are omitted for better readability. Equation 8 demands that the increase in income, Δy, is such that well-being remains constant in the two periods. Solving for Δy and dividing by y gives the relative growth rate in income required.

$$\frac{\Delta y}{y} = \exp\left(-\frac{\Delta \mathbf{x}' \boldsymbol{\beta}}{\gamma_1}\right) y^{-\frac{\gamma_0}{\gamma_1}-1} - 1 \tag{9}$$

Using the estimation results from the financial satisfaction model in table 1 and assuming sample averages in the vector $\Delta \mathbf{x}$ and a monthly net income of $y = 2500$ euro, it follows that a growth in real income at a rate of lower equal 2% is fully offset by the adjustment of the representative individual's standard of judgement. In the period under consideration, the annual average growth in real household income per capita in the sample is about 1.4% and 2.0% for West and East Germany, respectively.[4] This improvement of the financial situation is, evidently, not translated in an equal sized increase in financial well-being because of the desensitization to the hedonic effects of income.

The analysis of the life satisfaction model exhibits qualitatively equivalent results as the financial satisfaction model. However, Douthitt et al. (1992) and Headey (1993), among other authors, worked out that the relationship between income and financial satisfaction is clearer

[4] This number is calculated from the unweighted data and differs from the weighted figures in section 4.

and exhibits typically a higher correlation than the relationship between income and life satisfaction. Hence, it is seems reasonable to concentrate on the analysis of the financial contentment to disentangle the process of adaptation to household income. Nevertheless, the adaptation to income over time has also an impact on life satisfaction that may be qualitatively equivalent to the effect on financial satisfaction.

5.2 Adaptation to gains and losses

In the preceding subsection 5.1, the average rate of adaptation was calculated for the entire sample. In particular, no distinction was made between persons who experienced an increase in income (winners) and those who suffered from a loss of income (losers). However, considering the prospect theory which states that gains are evaluated higher than losses, adaptation to income is expected to differ for winners and losers (cf. Kahneman and Tversky 1979). In this context, it can be expected that an income growth experienced by winners induces an upward shift in their expectations. The corresponding change in the standard of judgement is supposed to find its expression in the desensitization of the winners' satisfaction response function, i.e., the utility function, such that they are assumed to exhibit a positive rate of adaptation. On the contrary, a decline in the living standard may result in an adaptation of aspirations such that the then-losers lower their standard of judgement. Applying a lower standard to the evaluation of the financial situation suggests, in turn, a sensitization of the losers' satisfaction response function.

In order to test this hypothesis, the sample is divided up into two groups: The winners were defined as individuals whose per capita income rose in two successive years; the losers are, accordingly, those characterized by a decrease in income.[5] Furthermore, respondents 'at the corner', i.e., winners and losers who reported the maximum and minimum value on the satisfaction scale (10 or 0), respectively, are excluded from the sample in this part of the analysis. These individuals are not able to change their judgement in the presence of an increase (or decrease) in income. For example, when the income of a very contended person who reports

[5] The per capita income was used for the dividing up of the sample in order to control for a change in the household composition. That is, an individual may in fact be a winner in spite of a reduction in the household income due to a decrease in the household size.

already the maximum value on the satisfaction scale further rises, then he or she has not the possibility to adjust his or her assessment on the satisfaction scale, but the individual rather sticks 'at the corner'.[6] The model applied would interpret this response behavior as a desensitization to the higher income, although it is unknown how these respondents would have answered if the satisfaction scale was not truncated. Hence, the rate of adaptation could be overestimated if those observations were included in the estimation.

The econometric model in equation 7 is re-estimated for both winners and losers with respect to the financial and the life satisfaction evaluation. The resulting rates of adaptation are summarized in table 2. The second column repeats the numbers for the entire sample calculated in subsection 5.1. With respect to gains and losses, it is evident that the winners adapt more strongly to the increase in income than the losers to the decrease in income. Or to put it differently, this results suggests that, on the one hand, individuals push up their aspirations in the case of an improvement of their financial situation, and, on the other hand, they adapt to losses with a relatively lower rate of adjustment. This leads to a situation in which the benefits from an improved financial situation are fizzled out rather quickly, whereas people seem to persist longer in their aspirations in the case of a loss of income. In consequence, a recovery from losses is slower than habituation to gains. This finding holds for both the life and financial satisfaction and represents a clear confirmation of the hypothesis of an asymmetrical adaptation as formulated above.

The remainder of this subsection focuses on the financial satisfaction and analyzes adaptation with respect to education-specific subgroups of the sample. In a modern society, individuals set their standards of judgement according to the life plan they envisioned. (In principle, the maxims of life and judgement can be chosen freely as long as they can be justified to every other person.) However, life plans differ, and so do the standards of judgement. In this context, higher educated persons appear to have also a higher capacity for reflective self-evaluation. Hence, individuals with a higher educational attainment are expected to have carefully considered standards. They are expected to be less inclined to change their convictions due to changes

[6] I thank Andrew Clark for this point.

Table 2
Adaptation to gains and losses

	overall	**winner**	**loser**
financial satisfaction	4.19***	18.15***	-11.27***
no. of observations	184398	92857	88554
no. of individuals	23757	21717	21725
life satisfaction	6.15**	15.90***	-8.68
no. of observations	187277	94293	90021
no. of individuals	23973	21954	21960
adaptation with respect to education			
low	5.51***	23.35***	-14.37***
middle	4.43**	18.95***	-09.27***
high	3.25**	16.14***	-13.08***

Note: Significance levels: *<0.1, *<0.05, ***<0.01. The numbers of observations with respect to the winners and losers do not sum up to the number of overall observations because respondents 'at the corner' (cf. text) are excluded from the partitioned subsamples. The estimation results for the financial satisfaction regression are in the appendix B.

in the living conditions. That is, higher educated persons may exhibit a lower rate of adaptation to income.

The rate of adaptation estimated with respect to educational subgroups seems to confirm this hypothesis (cf. table 2): Those with a low educational attainment have the strongest average rate of adaptation to income, whereas high educated persons have the lowest, 5.5% compared to 3.3%. This means that the financial satisfaction of a given income diminishes more slowly for higher educated persons over time than for low educated ones.

The separate estimations for winners and losers point out the basis of this result. The relative retention of the standards of the higher educated persons seems to be a consequence from their pushing up aspirations to a smaller extent in the presence of an increase in income compared to the low educated ones. The rate of adaptation for individuals with a high and a low educational attainment is 23.35% and 16.14%, respectively. However, with respect to a decrease in income the results are ambiguous. The low and the high educated persons are characterized by a rate of adaptation of a similar magnitude whereas those with a middle educational attainment seem to downward adjust their standards more slowly. All in all, this finding gives rise to the supposition that the lower overall adaptation of higher educated persons is first and foremost a consequence of their lower upward adaptation that may lead to a more sustainable financial well-being.

5.3 Comparison of results

In the following subsection, we aim at comparing our measure of the rate of adaptation to findings established in the study by Di Tella et al. (2005). However, a comparison may provide only a rough yardstick as the phenomenon of adaptation was analyzed applying different models to diverse samples.

Using data from the German Socio-Economic Panel Study (SOEP), Di Tella et al. (2005) regressed an individual's current happiness (measured as global life satisfaction) on the logarithm of the current real net household income plus (the logarithm of) four lags (and one lead) of this income. They defined adaptation to income as a significant impact of the lagged income on current happiness, i.e., adaptation requires the sum of the regression coefficients of the income lags of order *i* to be non-zero: $\sum_{i}^{T} \alpha_{-i} \neq 0$. In their basic specification they found that two thirds of the initial income effect is lost after four years: "although the current effect of income [...] suggests that a rise in average real income of 12% [...] adds 0.03 units onto happiness scores [...] after four years have passed, adaptation effects reduce the size of the effect to only 0.01 units" (p. 12).

What is the rate of adaptation, κ, in this study? To translate the results, we have to calculate the rate at which the effect of income on well-being must be depreciated exponentially so that the income effect reduces from 0.03 to 0.01 units of happiness scores within four years. Solving $e^{-4\kappa} \cdot 0.03 = 0.01$ for κ yields a rate of adaptation of 27%. In contrast, our estimation result from the life satisfaction regression is 6%.

Although the analysis of Di Tella and his colleagues is comparable with respect to the estimation approach (fixed effects model) and the data source (SOEP), there are some considerable differences that may be responsible for the differing numbers. First, as the present analysis aims at identifying adaptation to income over time without referring to an explicit reference point, a function of the past income stream is not included in the well-being equation. Individuals whose income history is unknown are kept in the sample because neither the calculation of an intrapersonal comparison income nor the inclusion of income lags into the happiness equation is required. In contrast, Di Tella et al. make use only of individuals who participated at least five

years in the SOEP because four lags of past income are included in their happiness equation. As a consequence, their approach may be more prone to biases caused by panel attrition than the one presented in this paper. Second, Di Tella et al. include (only) four income lags. This procedure assumes that the income of periods further in the past has no impact on well-being. However, the consideration a long term impact of income seems more plausible than to assume that the adaptive process stops and leaves utility unaltered after a certain period of time. The present approach does not refer to this assumption since the individual's striving for novelty and variety may also alter the standard of judgement in the case of an unchanged income. Finally, it has to be noted that Di Tella et al. use the (generated) yearly real household post-government income from the Cross-National Equivalent File (CNEF) whereas the present study employs the monthly real household income from the household questionnaire.

However, although the numbers differ in magnitude, both provide clear evidence for adaptation to income.

6 Discussion

This paper builds on the idea that the assessment of the financial situation is based on a certain standard of judgement which is, again, influenced by the living conditions and the expectations. Although changes in the latent standard of judgement are in principal unobserved, they find an expression in people's evaluations of their lives and living conditions. One widespread measure of how people assess their living conditions is data on subjective well-being. Hence, it is a straightforward strategy to infer the extent of adaptation of the standards from the change in satisfaction evaluations. In this context, adaptation to income over time can be identified from a desensitization to income resulting from an improvement of the financial situation (or a sensitization to income resulting from the worsening of the financial situation). The empirical results provide clear evidence that people adjust their assessment of the household income over time such that increases (decreases) in income lead to a desensitization (sensitization) of the satisfaction response function.

The primary conclusion from the analysis is that the meaningfulness of an intertemporal comparison of subjective well-being measures, as it is carried out in longitudinal studies (cf. section 2), is clearly limited. Observing a change in the financial contentment, it is indistinct whether this change is a result from a variation in the living condition or an adjustment in the standard of judgement. This means that the inference to be made from an intertemporal analysis of satisfaction measures is only meaningful to the extent it is plausible to assume that the latent standards are approximately constant. The longer the period under consideration, the lesser this condition appears to be fulfilled.

A Estimation of the standard error for the rate of adaptation using the delta method

The rate of adaptation is calculated as a function of two random variables, the estimators $\hat{\gamma}_1$ and $\hat{\gamma}_0$. For that reason, we draw conclusion on the statistical significance of κ by deriving an estimator for its standard error using the delta method (cf. Greene 2003). With

$$\kappa = G(\boldsymbol{\gamma}) = \ln\left(-\frac{\gamma_0}{\gamma_1}\right) \tag{10}$$

the variance of $G(\boldsymbol{\gamma})$ is

$$\widehat{\mathrm{Var}(G(\boldsymbol{\gamma}))} = \frac{\partial G(\boldsymbol{\gamma})}{\partial \boldsymbol{\gamma}'} \hat{\boldsymbol{\Omega}}_{\gamma} \frac{\partial G(\boldsymbol{\gamma})}{\partial \boldsymbol{\gamma}} \tag{11}$$

where $\hat{\boldsymbol{\Omega}}_{\gamma}$ denotes a consistent estimator of the variance-covariance matrix of the (2×1)-vector $\boldsymbol{\gamma}$. In particular,

$$\widehat{\mathrm{Var}(G(\boldsymbol{\gamma}))} = \begin{bmatrix} 1/\gamma_0 & -1/\gamma_1 \end{bmatrix} \begin{bmatrix} \widehat{\mathrm{Var}(\gamma_0)} & \widehat{\mathrm{Cov}(\gamma_0, \gamma_1)} \\ \widehat{\mathrm{Cov}(\gamma_0, \gamma_1)} & \widehat{\mathrm{Var}(\gamma_1)} \end{bmatrix} \begin{bmatrix} 1/\gamma_0 \\ -1/\gamma_1 \end{bmatrix}. \tag{12}$$

References

Blanchflower, D. G. and Oswald, A. J. (2004). Well-being over time in Britain and the USA, *Journal of Public Economics* **88**(7-8): 1359–1386.

Brickman, P. and Campbell, D. T. (1971). Hedonic relativism and planning the good society, *in* M. H. Appley (ed.), *Adaptation Level Theory. A Symposium*, Academic Press, New York, pp. 287–302.

Clark, A. E., Frijters, P. and Shields, M. A. (2006). Income and happiness: Evidence, explanation and economic implications, *PSE Working Papers 2006-24*, PSE (Ecole normale supérieure).

Di Tella, R., Haisken-Denew, J. P. and Macculloch, R. (2005). Happiness Adaptation to Income and to Status in an Individual Panel, *SSRN eLibrary* .
URL: *http://ssrn.com/paper=760368*

Diener, E. and Oishi, S. (2000). Money and happiness: Income and subjective well-being across nations, *in* E. Diener and E. M. Suh (eds), *Culture and Subjective Well-being*, MIT Press, Cambridge, pp. 185–218.

Douthitt, R. A., Macdonald, M. and Mullis, R. (1992). The relationship between measures of subjective and economic well-being: A new look, *Social Indicators Research* **26**(4): 407–422.

Duesenberry, J. S. (1967). *Income, Saving and the Theory of Consumer Behavior*, Harvard University Press, Cambridge.

Easterlin, R. A. (1974). Does economic growth improve the human lot? Some empirical evidence, *in* P. A. David and M. W. Reder (eds), *Nations and Households in Economic Growth: Essays in Honor of Moses Abramovitz*, Academic Press, New York.

Ehrhardt, J. J., Saris, W. E. and Veenhoven, R. (2000). Stability of life-satisfaction over time, *Journal of Happiness Studies* **6**(2): 177–205.

Frederick, S. and Loewenstein, G. (1999). Hedonic adaptation, *in* D. Kahneman, E. Diener and N. Schwarz (eds), *Well-Being: The Foundations of Hedonic Psychology*, Russell Sage Foundation, New York.

Frey, B. S. and Stutzer, A. (2002). What can economists learn from happiness research?, *Journal of Economic Literature* **40**(2): 402–435.

Greene, W. H. (2003). *Econometric Analysis*, Prentice Hall International, Upper Saddle River, New Jersey.

Haisken-DeNew, J. P. and Frick, J. R. (2005). DTC. Companion to the German Socio-Economic Panel Study (GSOEP).
URL: *http://www.diw.de/english/sop/service/dtc/*

Haisken-DeNew, J. P. and Hahn, M. (2006). Panelwhiz: A flexible modularized stata interface for accessing large scale panel data sets. mimeo.
URL: *www.panelwhiz.eu*

Headey, B. (1993). An economic model of subjective well-being: Integrating economic and psychological theories, *Social Indicators Research* **V28**(2): 97–116.

Helson, H. (1964). *Adaptation-Level Theory. An Experimental and Systematic Approach to Behavior*, Harper & Row, New York.

Infratest Sozialforschung (2004). Living in Germany. Survey 2004 on the social situation of households. Individual question form.
URL: *http://www.diw.de/deutsch/sop/service/fragen/index.html*

Inglehart, R. and Rabier, J.-R. (1986). *Aspirations Adapt to Situations—But Why are the Belgians so Much Happier than the French? A Cross-Cultural Analysis of Subjective Quality of Life*, The University of Michigan, Ann Arbor.

Kahneman, D. and Tversky, A. (1979). Prospect theory: An analysis of decision under risk, *Econometrica* **47**(2): 263–91.

Koukounas, E. and Over, R. (1993). Habituation and dishabituation of male sexual arousal, *Behaviour Research and Therapy* **31**(6): 575–585.

Landua, D. (1993). Veränderung von Zufriedenheitsangaben in Panelbefragungen. Eine Analyse über nicht beabsichtigte Effekte des Längsschnittdesigns, *Kölner Zeitschrift für Soziologie und Sozialpsychologie* **45**(3): 553–571.

Meuwissen, I. and Over, R. (1990). Habituation and dishabituation of female sexual arousal, *Behaviour Research and Therapy* **28**(3): 217–226.

Samuelson, P. A. (1937). A note on measurement of utility, *The Review of Economic Studies* **4**(2): 155–161.

Schwarze, J. (2003). Using panel data on income satisfaction to estimate equivalence scale elasticity, *Review of Income and Wealth* **49**(3): 359–372.

Stutzer, A. (2004). The role of income aspirations in individual happiness, *Journal of Economic Behavior & Organization* **54**(1): 89–109.

van Praag, B. (1971). The welfare function of income in Belgium: An empirical investigation, *European Economic Review* **2**(3): 337–369.

van Praag, B. M. S. and Baarsma, B. E. (2005). Using happiness surveys to value intangibles: The case of airport noise, *Economic Journal* **115**(500): 224–246.

Wooldridge, J. M. (2002). *Econometric Analysis of Cross Section and Panel Data*, MIT Press, Cambridge.

Wunder, C., Schwarze, J., Krug, G. and Herzog, B. (2008). Welfare effects of the euro cash changeover, *European Journal of Political Economy* . Article in Press.
URL: *http://dx.doi.org/10.1016/j.ejpoleco.2008.04.002*

A Descriptive Statistics

Table 3
Summary statistics for model in columns 2 and 3 of table 1 (financial satisfaction)

variable	mean	std. dev.	min.	max.
satisfaction with HH Income	6.302	2.23	0	10
real HH income	2359	1355	10	65152
number of persons in HH	2.774	1.229	1	12
East Germany	0.272	0.445	0	1
age	46.443	15.755	18	80
years of education	11.761	2.435	7	18
home owner	0.511	0.5	0	1
single	0.197	0.398	0	1
married	0.657	0.475	0	1
married, but separated	0.015	0.121	0	1
divorced	0.071	0.257	0	1
widowed	0.06	0.238	0	1
non working	0.096	0.294	0	1
in training	0.047	0.211	0	1
job: low	0.147	0.354	0	1
job: mid	0.277	0.448	0	1
job: high	0.101	0.301	0	1
self-employed	0.055	0.228	0	1
jobless	0.061	0.24	0	1
pensioner	0.216	0.411	0	1

Source: SOEP 1985-2006. No. of individuals: 23757. No. of observations: 184398.

B Estimation results: Adaptation to gains and losses

Table 4
Adaptation of financial satisfaction to gains and losses

	winners		losers	
variable	**coefficient**	**robust s.e.**	**coefficient**	**robust s.e.**
log of household income in t: γ_1	0.905***	(0.038)	0.961***	(0.037)
log of household income in $t-1$: γ_0	-1.085***	(0.037)	-0.859***	(0.037)
log of household size	-0.235***	(0.050)	-0.238***	(0.054)
East Germany	0.136***	(0.015)	-0.022	(0.015)
yearly changes				
years of education	-0.022	(0.015)	-0.017	(0.018)
home owner	-0.095***	(0.035)	-0.118***	(0.037)
single: reference				
married	0.142**	(0.064)	0.093	(0.070)
separated	-0.191*	(0.098)	-0.483***	(0.105)
divorced	0.039	(0.102)	-0.200*	(0.105)
widowed	-0.023	(0.113)	-0.348*	(0.205)
non working	-0.393***	(0.039)	-0.378***	(0.036)
in training	-0.452***	(0.045)	-0.359***	(0.052)
job: low	-0.109***	(0.024)	-0.120***	(0.026)
job: middle: reference				
job: high	0.056*	(0.030)	0.062**	(0.031)
self-employed	-0.089	(0.056)	-0.195***	(0.057)
jobless	-0.938***	(0.038)	-0.894***	(0.036)
pensioner	-0.242***	(0.045)	-0.319***	(0.042)
year fixed effects	included		included	
R-squared	0.04		0.03	
no. of individuals	21717		21725	
no. of observations	92857		88554	

Source: SOEP 1985-2006. Significance levels: *<0.1, *<0.05, ***<0.01. An intercept term is included in all regressions. Individuals reporting maximum and minimum well-being are excluded from the winners and losers regression, respectively (cf. p. 15 for details).