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Christoph Wunder • Johannes Schwarze

What (if anything) do satisfaction scores tell us about the intertemporal change in living conditions?

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What (if anything) do satisfaction scores tell us about the intertemporal change in living conditions?

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Abstract

This paper looks at the information content of satisfaction scores. It is argued that the information content depends on the extent to which people adapt to living conditions in general. Using data from the German Socio-Economic Panel Study (SOEP), the estimation of a dynamic panel data model provides evidence that adaptation takes place within a relatively short window of time: changes in living conditions are, for the most part, absorbed by an adjustment of the adaptation level within one year. This leads to the conclusion that the information content of satisfaction scores accentuates recent changes in living conditions. Remote changes are not captured by the according survey questions, even if these changes have long-term impact on living conditions. The usefulness of satisfaction scores as an indicator of people's living conditions is discussed.

Keywords: adaptation, dynamic panel data model, subjective well-being, satisfaction

JEL Classification: C23, I31

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1 Introduction

In recent years, data on people's subjective well-being has received increasing interest from both social scientists and policy makers. Scientific studies worked out that measures of subjective well-being may deliver insights into people's lives and living conditions that are complementary to information provided by objective indicators, such as income or GDP (e.g., Dolan and Peasgood 2008). Policy makers have also drawn their attention to subjective indicators. In this context, French President Nicholas Sarkozy established a commission chaired by Joseph Stiglitz on the measurement of economic performance and social progress. One of the key recommendations of the final report of the commission is that "[s]tatistical offices should incorporate questions to capture people's life evaluations, hedonic experiences and priorities in their own survey" (Stiglitz et al. 2009, p. 16).

A typical way to measure people's subjective well-being is to use self-reported satisfaction scores obtained from survey questions about life satisfaction and satisfaction with specific areas of life (for an overview cf. Frey and Stutzer 2002). An example survey question can be found in the questionnaire of the German Socio-Economic Panel Study (SOEP). The survey asks: "How satisfied are you with your life, all things considered?" The response is measured on a discrete scale that ranges from 0 (completely dissatisfied) to 10 (completely satisfied).

In order to assess the usefulness of satisfaction scores as an indicator of people's living conditions, it is necessary to clarify to what extent people adapt to their living conditions. The reason for this is that adaptation determines the substantive information content of satisfaction scores: in the presence of strong adaptation, satisfaction scores provide primarily information about recent changes in living conditions. In this case, remote changes do not influence the current evaluation, even if they have long-term impact on living conditions. Instead, they are (fully) offset by an adjustment of the adaptation level. In the contrary case of weak adaptation, satisfaction scores represent an evaluation of both the recent changes in and the long-term development of living conditions. As a result, the potential information content provided by satisfaction scores could be between a short-term snapshot based on recent changes in living conditions and a long-term picture of the development of living conditions (that considers recent changes as one part of the picture).

Adaptation is one of the core research fields in the literature on subjective well-being. However, previous studies usually analyzed adaptation to certain circumstances and life events. For example, the seminal study by Brickman et al. (1978) looked at adaptation among lottery winners and accident victims; economists developed a sustained interest in adaptation to income (e.g., Di Tella et al. 2007, Clark et al. 2008, Wunder 2009). Also, researchers investigated adaptation to major life events, such as divorce (cf. Lucas 2005), marriage (cf. Lucas et al. 2003), and widowhood (cf. Wunder and Schwarze 2009).

Despite of intense research activities in specific fields, it lacks a systematic approach to the empirical analysis of to what extent people adapt to their living conditions *in general*. As a result, there is a knowledge deficit regarding the substantive information content of satisfaction scores: do satisfaction scores reflect recent changes in living conditions (in the case of strong adaptation) or do they provide information about long-term development of living conditions (in the case of weak or no adaptation)? The present paper attempts to fill in this research gap. In the next section, an approach to empirically analyze general adaptation to living conditions is introduced. The data is described in Section 3. The results are presented in Section 4. Finally, the conclusions are drawn in Section 5.

2 A model of general adaptation to living conditions

In this section, an econometric model that provides an estimate of the extent of general adaptation to living conditions is introduced in two steps. First, it is argued, in a short review of adaptation level theory, that utility depends on the difference between the consumption level and the adaptation level. In the second step, a dynamic panel data model that yields a direct estimate of the extent of general adaptation is derived.

The assessment of living conditions on the basis of satisfaction scores depends on the expectations a person has about life. For example, the multiple discrepancies theory sees satisfaction as a function of the perceived gap between factual living conditions and expectations (cf. Michalos 1985). However, expectations depend in turn on the context in which the person lives in, so that current expectations of life depend on living conditions (and expectations) in the past. For example, individuals may have higher income expectations at present due to increased incomes

in the past. Thus, increasing incomes are likely to lead to an upward adjustment in expectations (cf. Diener and Biswas-Diener 2002, Solberg et al. 2002).

The context-dependence of expectations can be studied within the theoretical framework of adaptation level theory (cf. Helson 1964). Adaptation level theory hypothesizes that the hedonic experience (i.e., utility) depends on the difference between the stimulus level and the level of the stimulus that provokes no reaction in the individual. This neutral level, denoted the adaptation level, represents an individuals's expectations: increasing (decreasing) expectations are mirrored in an increasing (decreasing) adaptation level.

Assuming for simplicity that the utility function is linear, the utility u derived from the consumption of a commodity x can be written as follows:

$$u_t = (x_t - w_t)\beta\,, \tag{1}$$

where $\beta > 0$ denotes the effect of the consumption of the commodity on utility, w is the adaptation level. Assuming that an utility index of zero denotes a threshold between dissatisfaction ($u < 0$) and satisfaction ($u > 0$), the following conclusion can be drawn: an individual is satisfied, if the quantity of x consumed is larger than the adaptation level. The individual is dissatisfied, if the quantity of x consumed is lower than the adaptation level. Hence, an individual derives (positive) utility from consumption, when the quantity consumed is larger than the neutral level.

A widely used formulation of the adaptation level that takes into account the role of time is (cf. Frederick and Loewenstein 1999):

$$w_t = \alpha x_{t-1} + (1-\alpha)w_{t-1}. \tag{2}$$

According to Equation 2, the adaptation level in period t is calculated as a function of the stimulus level in $t-1$ and the adaptation level in $t-1$. Equation 2 can also be read as: the

adaptation level of the commodity x in period t depends on the levels of x in all previous periods and the adaptation level in the initial situation.[1]

The parameter α indicates the extent to which an individual changes his or her adaptation level and adapts to living conditions represented by the stimulus level in the preceding period. It is assumed that $0 \leqslant \alpha \leqslant 1$. If $\alpha = 1$, the adaptation level is completely determined by the level of x in the previous period. If $\alpha = 0$, the level of x does not influence the current adaptation level. i.e., adaptation does not take place. In this case, a person evaluates living conditions with respect to his or her long-term beliefs and expectations. Thus, both the recent changes and the long-term development of living conditions would determine a person's utility. Therefore, large values of α indicate strong adaptive processes, whereas small values of α indicate weak (or no) adaptive processes. Rewriting Equation 2 shows that the change in adaptation levels between period $t-1$ and t is proportional to the difference between the quantity of x and the adaptation level in period $t-1$ (cf. Frederick and Loewenstein 1999):

$$w_t - w_{t-1} = \alpha(x_{t-1} - w_{t-1}). \tag{3}$$

If a constant quantity of the commodity is consumed over time, i.e., if $x_{it} = x_{t-1} = ... = x_0 = \mu_x$, then the adaptation level converges to a constant value $w = \mu_x$. As a result, the difference between x and w converges to zero, and the utility derived from consumption of constant quantities of the commodity x decreases over time. This process represents the main idea of adaptation: "[T]he essence of adaptation [is] that persistent bad things gradually become less aversive, and persistent good things gradually become progressively less pleasurable" (Frederick and Loewenstein 1999, p. 306).

[1] The dependence of w_t on the level of x in all previous periods can be seen from rewriting Equation 2 as $w_t = \alpha x_{t-1} + \sum_{\tau=0}^{t-2} \alpha(1-\alpha)^{(t-1)-\tau} x_\tau + (1-\alpha)^t w_0$, where w_0 denotes the adaptation level in the initial situation. It also follows that the calculation takes into account that the stimulus has less weight, the further it is in the past. The initial value w_0 may be seen to represent a person's long-term beliefs and expectations.

An econometric model that allows to estimate the extent of adaptation (i.e., the parameter α) can be derived by taking first differences of the utility function in Equation 1:

$$u_t - u_{t-1} = (x_t - x_{t-1})\beta - (w_t - w_{t-1})\beta. \tag{4}$$

From Equation 3 follows that one can substitute $\alpha(x_{t-1} - w_{t-1})$ for $(w_t - w_{t-1})$ in Equation 4:

$$u_t - u_{t-1} = (x_t - x_{t-1})\beta - \alpha(x_{t-1} - w_{t-1})\beta. \tag{5}$$

Considering that $(x_{t-1} - w_{t-1})\beta$ is the utility in $t-1$, it follows:

$$u_t - u_{t-1} = (x_t - x_{t-1})\beta - \alpha u_{t-1}. \tag{6}$$

Solving Equation 6 for the utility in t, u_t, leads to a dynamic model that describes the utility in t as a function of the utility in the preceding period and the change in the consumption of the commodity x.

$$u_t = (1-\alpha)u_{t-1} + \Delta x_t \beta. \tag{7}$$

The econometric model that takes into account that living conditions can be characterized by a vector $\mathbf{x}$ of K commodities is:

$$u_{it} = \beta_0 + (1-\alpha)u_{i,t-1} + \Delta \mathbf{x}'_{it}\boldsymbol{\beta} + \mathbf{d}'_t\boldsymbol{\delta} + \nu_i + \varepsilon_{it}, \tag{8}$$

where ν is an individual-specific error term and ε is the idiosyncratic error. The parameter β_0 denotes a constant term. Wave dummies are included in the vector $\mathbf{d}$, $\boldsymbol{\delta}$ is the corresponding coefficient vector. The remaining parameters are defined as above. The resulting model can be estimated as a dynamic panel data model. At first glance, it may seem surprising that the model does not include the levels of the covariates. However, it follows from the derivation of the

model that the parameters in Equation 8 have a clear counterpart in the statements of adaption level theory.[2]

3 Data

The data used in this paper is based on the German Socio-Economic Panel Study (SOEP). The SOEP is a longitudinal study of households that surveys the same respondents annually. A detailed description of the survey can be found in Wagner et al. (2007).[3]

In the SOEP life satisfaction is ascertained by the following question: "How satisfied are you with your life, all things considered?" The response is measured on an 11-point scale ranging from 0 (completely dissatisfied) to 10 (completely satisfied). The respondents report an average level of 6.9. The median is seven and the most frequent score (mode) in the sample is eight. Although satisfaction scores are collected on an ordinal scale, assuming cardinality of satisfaction scores makes little difference to the results of regression analyses (cf. Ferrer-i-Carbonell and Frijters 2004). Hence, we are able to apply econometric models designed for continuous response variables.

We make use of a set of (time invariant) standard control variables that enter the model in first-differences. The respondents' disability status and the number of nights stayed in hospital depict the health status of the respondents. Unfortunately, the information about the number of nights stayed in hospital is not available for 1990 or 1993, so that we are not able to use the respective waves. Furthermore, we exclude the data collected at the first and second interviews of each person from the SOEP sample because of panel and learning effects (cf. Landua 1993, Ehrhardt et al. 2000). After all, the sample consists of 20 waves from 1986 to 2007 excluding 1990 and 1993, so that the data set has a large number of individuals who are observed for a relatively small number of time periods.

[2] An example for a dynamic panel data model that includes levels of the covariates as well as first differences can be found in Pudney (2008). However, his approach has a different theoretical starting point.

[3] The data used in this paper is 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 PanelWhiz-generated DO file to retrieve the SOEP data used here and any PanelWhiz plug-ins are available upon request. Any data or computational errors in this paper are my own. Haisken-DeNew and Hahn (2006) describe PanelWhiz in detail.

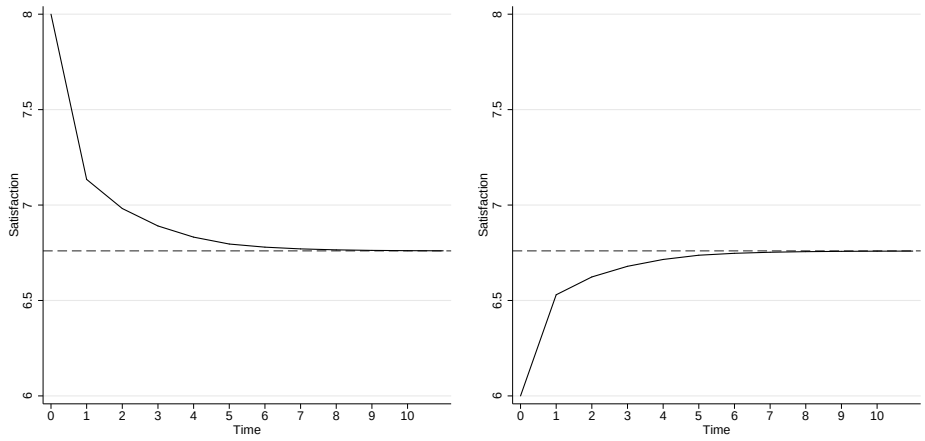
4 Results

This section looks at the estimation results for the model introduced in Equation 8. Table 1 reports results obtained from four different estimation strategies. Columns (1) and (2) show OLS and fixed effects estimates, respectively. Although these results are inconsistent for fixed T (e.g., Hsiao 2003), they give a first idea of the parameters involved. The inconsistency problem can be solved applying Generalized Method of Moments (GMM) estimators. Columns (3) and (4) report results from the two-step Arellano-Bond estimator with Windmeijer bias-corrected standard errors (cf. Arellano and Bond 1991, Windmeijer 2005). Since the Arellano-Bond test provides evidence for second order serial correlation in the first differenced residuals of the model specification in Column (3), further lags of the dependent variables were included in the specification in Column (4). For the model with four lags, no evidence for autocorrelation of second or higher order is found. The Sargan-test of overidentifying restrictions indicates that the moment conditions are valid (i.e., the null hypothesis of the Sargan-test cannot be refuted, p-value: 0.53). Thus, the interpretation focuses mainly on the results reported in Column (4).

The parameter estimates of the first-differenced control variables included in the model show the expected signs: individuals with poor health report, ceteris paribus, lower satisfaction scores than those with good health; income is positively correlated with life satisfaction; full- and part-time employed persons are more satisfied than non-working individuals, and unemployment has a clear negative correlation; married people report higher satisfaction scores than persons living alone (i.e., single, divorced, or widowed).

The primary interest lies in the coefficient of the first lag of the life satisfaction variable. The parameter provides an estimate of the extent to which people generally adapt to living conditions. From the estimate of 0.18 follows that the adaptation parameter α takes the value 0.82. In the context of Equation 2, this value indicates that the adaptation level at present is a weighted average where living conditions in the previous period are weighted at approximately 80 percent, and the previous adaptation level is weighted at only 20 percent. Thus, a person's expectations and aspirations about life at present are shaped, for the most part, by the living conditions in the previous period. Long-term beliefs (that would be reflected in a long-term constant adaptation level) seem to play only a minor role in the assessment of living conditions.

Figure 1
Adaptive process in life satisfaction scores over time



Note: The dashed line indicates the long-term average life satisfaction. The solid lines represent the satisfaction scores reported by an average individual that experiences a positive and negative shock in living conditions, respectively. The graph in the left shows general adaptation to a positive shock. The graph in the right illustrates a negative shock.

To look at the adaptation parameter estimated in an alternative way, Figure 1 illustrates the process of general adaptation to living conditions for an average individual over time. The graphs are based on the estimation results in Column (4) in Table 1 and take into account the additional lags of the dependent variable (i.e., life satisfaction in $t-2$, $t-3$, and $t-4$). The graph in the left part of the figure shows a positive shock in living conditions (e.g., a windfall income) that occurs in $t = 0$. This causes the individual to report a satisfaction score of 8 which is larger by approximately one point as the long-term average of 6.8.[4] Already in the subsequent period ($t = 1$), a drastic decrease in satisfaction is observed: adaptation absorbed the shock in life satisfaction to the most part after one period has elapsed. Only three periods later, in $t = 4$, the satisfaction score has almost returned to its long-term average value. The right graphic shows an example of a negative shock. The course of satisfaction scores is analogous, except that the curve approaches the long-term average from below.

[4] The value of 6.8 is chosen because it is the average value in the subsample used in the regression model of Column (4) in Table 1.

5 Conclusion

In this paper, we investigated the question of to what extent people adapt to living conditions. The answer to this question is of great importance, because adaptation determines the information content of satisfaction scores. The empirical evidence pointed to relatively strong general adaptation to living conditions. Thus, we conclude that satisfaction scores first and foremost tell us something about recent changes in living conditions. They appear not to be informative about remote changes, even if those changes have long-term impact on living conditions. Hence, we learn nothing (or only very little) about the long-term development of living conditions.

Can satisfaction scores be used to inform policy and society about people's living conditions? The literature proposed to use data on subjective well-being, for example, (1) to identify specific population subgroups with problems, (2) to analyze the correlates (and causes) of well-being, or (3) detect trends (cf. Layard 2010). (The wider policy implications of data on subjective well-being are discussed, for example, in Oswald (1997), Frey and Stutzer (2000), Layard (2005), and Huschka and Wagner (2010).) In this paper, we come to the conclusion that satisfaction scores can, indeed, be used as an indicator of living conditions. However, one has to be cautious: what we can learn from satisfaction scores is of a short-term nature. Survey questions on life satisfaction tend to operate like a seismograph: they record *movements* in living conditions (just as a seismograph records movements in the ground); they do not capture persistent shifts in circumstances (as an altimeter would measure the level above the ground.)

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6 Tables

Table 1
Estimation results

	(1) OLS	(2) FE	(3) AB	(4) AB
Life satisfaction in $t-1$	0.585***	0.110***	0.105***	0.176***
	(0.002)	(0.004)	(0.006)	(0.011)
Life satisfaction in $t-2$				0.075***
				(0.008)
Life satisfaction in $t-3$				0.036***
				(0.006)
Life satisfaction in $t-4$				0.016***
				(0.005)
First-differenced variables:				
Disability status: disabled	-0.172***	-0.122***	-0.045**	-0.060**
	(0.022)	(0.020)	(0.022)	(0.027)
Nights stayed in hospital	-0.005***	-0.003***	-0.003***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.001)
Years of education	0.032***	-0.003	-0.001	0.004
	(0.008)	(0.007)	(0.008)	(0.011)
Log of net household income	0.232***	0.163***	0.163***	0.202***
	(0.013)	(0.012)	(0.014)	(0.018)
Log of household size	0.098***	0.149***	0.071***	0.126***
	(0.023)	(0.021)	(0.024)	(0.033)
Full time employed	0.180***	0.120***	0.119***	0.120***
	(0.016)	(0.015)	(0.017)	(0.023)
Part time employed	0.074***	0.043***	0.055***	0.061***
	(0.015)	(0.014)	(0.015)	(0.020)
Unemployed	-0.307***	-0.223***	-0.193***	-0.180***
	(0.018)	(0.016)	(0.018)	(0.023)
Single	-0.275***	-0.184***	-0.115***	-0.143***
	(0.033)	(0.031)	(0.037)	(0.051)
Divorced	-0.104***	-0.134***	-0.052	-0.044
	(0.037)	(0.035)	(0.039)	(0.049)
Widowed	-0.924***	-0.972***	-0.810***	-0.928***
	(0.074)	(0.073)	(0.084)	(0.110)
West-Germany	0.077	0.071	0.064	0.084
	(0.074)	(0.070)	(0.080)	(0.109)
Constant	2.836***	6.464***	6.406***	4.955***
	(0.026)	(0.034)	(0.045)	(0.182)
Number of observations	195208	195208	149785	91817
Number of individuals		29602	26285	17029

Note: Significance levels: *<0.1, *<0.05, ***<0.01. Robust standard errors in parentheses. Col. (1): ordinary least squares estimates. Col. (2): fixed effects estimates. Col. (3) and (4): Arellano-Bond two-step estimates with Windmeijer bias-corrected standard errors. All estimations include dummy variables for the year of the survey.
Source: SOEP 1986-2007 (without 1990, 1993).