# For "better" or "worse": a new life-satisfaction measure able to elicit preference rankings

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## Abstract

We provide conceptual reasons and empirical evidence that preference rankings elicited from changes in levels of life satisfaction are systematically biased. As a remedy, we propose the *ranking measure* where subjects state whether their life has become "better" or "worse". Using three representative datasets we show that the two measures produce conflicting preference rankings more often than not. The ranking measure is better explained by socio-economic variables than changes in levels. Adaptation (e.g. to income) is only observed for levels but not for rankings, indicating that adaptation is driven by the elicitation method rather than changes in preferences.

## 1. Introduction

The definition of social welfare has occupied philosophers and social scientists for centuries if not millennia. On the measurement side, differences in schools of thought are compounded with limited availability of data and challenges in eliciting the specific object of interest. Purely monetary measures such as the highly influential but strongly disputed Gross Domestic Product compete with other "objectively" measurable indicators (Human Development Index, Jones and Klenow 2016, Sen 1985) and subjective measures of wellbeing such as happiness or life satisfaction (Frey and Stutzer 2002, Benjamin et al. 2014b).

A prominent example that objective and subjective welfare measures might produce vastly different assessments over time is the Easterlin Paradox. While income and subjective well-being tend to be positively correlated in the short run, average life satisfaction (LS) has been almost constant in industrialised countries over the past decades despite a substantial increase in per capita GDP (Easterlin 1974, Easterlin et al. 2010).[1] Several explanations for this discrepancy between measures have been proposed. A leading one is that individuals get used to, i.e. adapt, to new (especially higher) levels of income and are caught in a "hedonic treadmill" (Diener et al. 2006).[2] The literature so far has not addressed the question of whether

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[1] The Easterlin Paradox has been challenged by Stevenson and Wolfers (2008, 2013).

[2] See e.g. Frederick and Loewenstein 1999, Diener et al. 2006, Loewenstein and Ubel 2008, diTella et al. 2010 and Vendrik 2013. Clark et al. (2016) recently presented evidence from a large-scale sample that there is no adaptation to poverty while De Neve et al. (2017) show

adaptation of reported levels of LS reflect changes in preferences or are (merely) a re-scaling of the physiological and psychological sensitivity to external stimuli. While preference rankings over states of the world plausibly include a very large number of strictly separate ranks, our bodies and minds face limitations in both range and step size when attributing satisfaction levels to states of the world (Rayo and Becker 2007a,b). These limitations extend – in an even stronger form – to the answer scales used in surveys eliciting levels of LS using a discrete scale from "completely dissatisfied" to "completely satisfied", spanning three to eleven categories.[3] We label this measure of LS the level measure (LM). There is evidence that responses correspond well both to neurological measures and other indicators of well-being such as frequency of genuine smiles, spousal fights, self-assessments of mental health and suicide (Berridge and Kringelbach 2011, Camerer et al. 2005, Daly and Wilson 2009, Daly et al. 2013, Fehr and Rangel 2011, Kristoffersen 2017). It hence plausibly captures how intensely satisfaction is perceived as a sensation. But does it also capture preference rankings over states of the world? We will argue, that it doesn't.

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that the subjective well-being measures are more sensitive to reductions in average income than to increases.

[3] Surveys including such a question are e.g. World Value Survey, German SOEP, UK Understanding Society, Eurobarometer, Latinobarometer, US General Social Survey, Happy Planet Index, World Happiness Index and the OECD Better Life Index.

Differences in reported levels of LS across individuals or time have been used to identify the socio-economic drivers of LS[4] and strong prescriptions have been proposed on the normative premise that LS should be maximised. Take the response to the Easterlin Paradox. It has led some to conclude that fostering economic growth should no longer be among governments' objectives but that, on the contrary, income should be more heavily taxed due to the externality a higher income imposes on other citizen (Layard 2006).

If one regards the objective of policymaking to be the maximization of perceived satisfaction levels in the population, then the above might be effective. This position is held by representatives of what Fleurbaey (2009) calls "hedonic welfarism". However, these policies might fail at maximizing utility based on preference rankings in the tradition of liberal welfare economics, which is concerned with "obtaining what one wants" instead of "being satisfied" (Fleurbaey 2009). As Frederick and Loewenstein (1999) point out, the two concepts are likely to differ in many situations. When using satisfaction data to inform policy making it is thus important to know how these two concepts differ and how they can best be measured.

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[4] Di Tella et al. 2003, Di Tella and MacCulloch 2006, Dolan et al. 2008, Ferrer-i-Carbonell 2005, Frey and Stutzer 2002, Frey et al. 2004, Luttmer 2005, Oswald 1997, Stevenson and Wolfrers 2013.

We show that changes in LS are unreliable indicators of individuals' ex-post preference rankings over changes in states of the world[5]. We identify conceptual reasons for them to differ and provide evidence from representative surveys indicating that basic requirements for identifying preference rankings from panel data are not met by reported levels of LS. This challenges interpretations of LS data as valid indicators of preference rankings.[6] However, a reliable subjective measure of preference rankings is desirable (Fleurbaey 2009).[7] In contrast to decision utility obtained from revealed preferences, LS is able to also evaluate changes that lie outside the control of the people affected and therefore captures a much broader set of policy relevant aspects such as the distribution of income and environmental quality.[8]

We therefore introduce the ranking measure (RM), asking subjects to directly compare the present to a specific past, i.e. two situations they have

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[5] Welfare economics traditionally is concerned with decision utility, i.e. ex-ante preferences, this difference in interpretation is necessary due to the elicitation method of stated as compared to revealed preferences and that LS is not elicited on hypothetical but rather on actually experienced situations.

[6] As formulated e.g. by Clark et al. 2008, Daly and Wilson 2009, Decancq et al. 2015, Frey et al. 2004, Krueger and Schkade 2008, Layard et al. 2008, Liberini et al. 2017, MacKerron 2012, Oswald and Wu 2010 and Kristoffersen 2017. We focus on *life satisfaction* as a *cognitive* measure of subjective well-being instead of *happiness* or others that are more *affective* since preferences also are a cognitive concept.

[7] „[N]ew questionnaires that would enable the respondents to express their ordinal preferences more directly than through the prism of a satisfaction level, may provide valuable information about people's preferences and values relative to the various dimensions of life…" (p. 1064)

[8] Köszegi and Rabin (2008) argue that both the revealed preference approach and subjective measures of well-being should be combined when attempting to "identify preferences, mistakes, and well-being" (p. 1821).

actually experienced.[9] The RM avoids the conceptual shortcomings of the LM in measuring preference rankings: it imposes no limits on the number of (successive) improvements or deteriorations reported, it compares two situations while keeping both preferences and reporting functions fixed, it has a natural common scale (better, indifferent, worse) and it does not need to cardinalise an ordinal concept when collecting the data and to then make it ordinal again when analysing it.

Bond and Lang (2014) and Schroeder and Yitzhaki (2017) provide strong evidence that measuring a continuous variable such as LS using only a few categories makes it impossible to unambiguously rank mean satisfaction of groups of respondents without imposing strong assumptions on the underlying distribution of LS and on a commonly shared reporting function. Indeed, Bond and Lang (2014) show that standard results of the LS literature can be reversed by using plausible alternative assumption about the distribution of LS. Our critique differs from theirs in that we focus on intra-personal rather than inter-personal (or inter-group) comparisons of survey responses and we propose a solution to the problem of the ranking challenge. As is the case for Bond and Lang (2014), the basic argument of our critique (and solution) can be extended to other continuous variables that are measured with a small number of categories (such as Likert scales) and where identification relies on the ability to rank responses. Such

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[9] Focusing on experienced situations distinguishes the subjective well-being approaches from stated preference approaches, which ask questions about hypothetical situations.

variables are abound in economics, psychology and the social sciences in general.

Comparing the preference rankings implied by LM and RM for three representative surveys with a total of well over a hundred thousand observations confirms that changes in LM and RM produce conflicting preference rankings in more than half of all cases. Moreover, these deviations are systematically correlated with socio-demographic variables indicating that at least one of them is a biased representations of the true preference ranking. The RM correlates more strongly and intuitively with changes in socio-economic aspects, while the LM has an inherent tendency towards adaptation both conceptually and empirically, especially if there is a trend in the evolution of income.

We extend previous work on the relationship between subjective well-being measures and preference rankings in several dimensions:

First, we focus on the comparability of satisfaction measures within subjects across time, evaluating the validity of changes over time. Other studies have analysed the validity of LS at one point in time, comparing it with measures of revealed or hypothetical choices and anticipated subjective well-being (e.g. Benjamin et al. 2012, 2014a, 2014b, Perez-Truglia 2015). The inter-temporal comparability is most important when using LS data from representative panel surveys and hence for much of the empirical work on LS (Fleurbaey and Schwandt 2016). It also seems the more natural direction

of comparison, when trying to identify preference rankings, which by definition are intra-personal comparisons. We combine conceptual reasoning with empirical evidence drawing on three representative surveys, one of which involves a randomised controlled trial.

Second, we propose a new elicitation method, the ranking measure, fixing several of the conceptual issues arising when comparing the LM across time to elicit preference rankings over states of the world.

Last, we provide evidence that the adaptation results characteristic of the LM might not primarily be driven by changes in preferences but rather represent adaptation in the reporting function.[10]

The remainder of this paper is organised as follows: The next section relates the LM of LS to requirements for eliciting preference rankings over states of the world when using panel surveys. Section 3 presents evidence from a randomised controlled trial with a representative sample testing for some of the key assumptions necessary for the LM to represent preference rankings. The RM is introduced in Section 4 and Section 5 compares the two measures based on three representative datasets. The last section concludes.

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[10] Note that we do not claim that perceived satisfaction does not adapt but merely that it does not represent a change in the underlying preference ranking.

## 2. Preference rankings and the level measure of life satisfaction

In what follows we derive necessary conditions for the LM to be able to capture individual preference rankings[11]. Assume that individual $i$ has rational and continuous, potentially time-dependent, preferences $\succcurlyeq_{i,t}$ over all relevant pairs of situations or states of the world $X$. A situation $x_{i,t} \in X$ is a vector including individual $i$'s characteristics like number of children, size of the house, education but also aggregates such as GDP, its distribution, inflation, pollution or combinations of both such as own position in the income distribution of a peer group etc. at a particular point in time $t$.

### 2.1 Reporting functions and measurement of life satisfaction

For a LS measure to capture preferences, a higher reported value has to imply that the respondent strictly prefers the situation to which she assigns a higher reported level of LS. In contrast to utility functions, the reverse might not hold, as the LM features only a small number of categories. Formally, $LM_{i,t}(x_{i,t}) = f_{i,t}(x_{i,t}, \succcurlyeq_{i,t})$ is the reported satisfaction level of individual $i$ for situation $x$ at time $t$ and $f_{i,t}$ a monotonically increasing reporting function mapping preferences $\succcurlyeq_{i,t}$ onto answer categories in the survey. With this notation, we can therefore distinguish between changes in the preference order and changes in how a given preference order is reported in a survey that might occur across individuals or time. Layard et al. (2008) and

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[11] Note that we don't normatively argue that preferences *should* be the objective of policies nor that they are the only possible interpretation of LS.

Fleurbaey and Schwandt (2016) e.g. use a reporting function but allow variation only across individuals but not across time.

LM questions slightly differ across surveys, but they all ask for the current level of LS and the answer scale provides a fixed number of categories represented by labels and numbers, e.g. the British Household Panel Survey (BHPS) asks "[...] how dissatisfied or satisfied are you with your life overall?" and the answer categories range from 1 "Not satisfied at all" to 7 "Completely satisfied".

### 2.2 Within-subject variation of reporting functions

Many authors use cross-sectional data for LS analysis and thus use between-subject variation. However, interpersonal comparison of what essentially is an ordinal concept is highly controversial (see also Bond and Lang 2014). Researchers therefore often use panel data, if available, focusing on within-subject comparisons over time. This is mostly done using fixed effects estimators, analysing the variation around within person means. For detecting preference rankings of two situations, first differences, i.e.

$dLM(x_{i,t}, x_{i,t-1}) = LM_{i,t}(x_{i,t}) - LM_{i,t-1}(x_{i,t-1}) = f_{i,t}(x_{i,t}, \succcurlyeq_{i,t}) - f_{i,t-1}(x_{i,t-1}, \succcurlyeq_{i,t-1})$, or rather $sign(dLM)$, is more suitable. The latter, however, involves not only two states of the world, but potentially two different preference relations and two reporting functions.[12] To infer the underlying preferences over situations $x_{i,t}$ and $x_{i,t-1}$ from changes in the observed LM, both the preference

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[12] Fixed effects models, by relying on the within person mean, implicitly assume that the reporting function and preferences are constant over the entire period covered by the data.

relation and the reporting function need to remain unchanged over the two periods.

In principle, both might change from one period to the next. For the moment, let's assume that preferences remain unchanged for at least two consecutive measurements and focus on adjustments of the reporting function. Let's also assume that respondents try to report their preferences, i.e. that monotonicity of $f_{i,t}$ at any point in time is given.

Two main reasons for adjusting the reporting function are: first, the answer scale has no intuitive meaning. The condition for reporting to be in the fifth out of seven satisfaction categories is ambiguous.[13] Respondents need to come up with an ad hoc reporting function making it hard to remember the function until the next wave of the survey. They might hence use a different one each time. As long as there is no systematic change distorting the representation of the underlying preferences this simply introduces noise to the data and in principle can be fixed by using large data sets (Bertrand and Mullianathan 2001, Frey and Stutzer 2002).

The second and more problematic reason for changes in the reporting function is that the scales of the preference concept and of the survey question don't match. While the answer scale has only a few categories, e.g. 7 in the BHPS, a complete mapping of preference relations over all possible

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[13] Conti and Pudney (2011) report evidence that minor changes such as displaying labels for only three instead of all seven categories in the BHPS substantially affects reported satisfaction levels, especially for women.

states of the world requires as many categories as there are states that can be ranked in a strict sense. For most respondents the latter will be a much higher number.

Respondents therefore face a trade-off when choosing a reporting function. They might either choose a steep one to report small to medium changes relevant in the present or they opt for a flat one to capture the "big picture". However, both can be achieved when using a steep reporting function but adjusting it to recent experiences. Such an adjustment is common for sensory perceptions[14] and in line with neurological limits to perceive sensations. A moving reference base for neurologically perceived LS allows an individual to capture the direction of changes in the short run even with a limited set of discrete levels of perception available (Rayo and Becker 2007a,b). With such an adjustment, the adaptation of the reporting function is not random but systematically depends on past and expected changes, which introduces biases that cannot be rectified by large numbers of observations (Bertrand and Mullianathan 2001).

In the literature, adaptation of LS to new situations is often interpreted as a "getting used to", i.e. a change in $\succcurlyeq_{i,t}$ (e.g. DiTella et al. 2010). However, in general one cannot tell whether the observed pattern is due to a preference

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[14] When judging sensory magnitudes with an objective cardinal scale, humans build an ad-hoc reference frame that depends on the range of stimuli they are exposed to when reporting them on a categorical scale. *"Sensory magnitudes are selected for this review of biases in judgement because the stimuli can be measured on a physical scale. Judgements of the quality of life [...] lack a precise measure of the stimuli. Thus the biases are more difficult to specify exactly."* (Poulton 1979, p. 777). See also Oswald (2008).

change or a shift in the reporting function.[15] Thus, unless respondents remember previous answers and use the same reporting function that is independent of any variables of interest across all waves of the survey, LM does not allow to reliably infer preference rankings from changes in its level even if participants attempt to report their preferences.

There is compelling evidence that self-assessments in surveys, including quality-of-life measures, are subject to reference biases, social norms and therefore vary over time even for a given individual (Groot 2000, Gil and Mora 2011, Bond and Lang 2014). Bond and Lang (2014) show that becoming disabled induces an adjustment of the reporting function relative to the control group. Reporting functions hence not only differ between individuals but also change over time and in response to changes in key socio-economic variables. This casts serious doubts on attempts to identify the impact of changes in such variables on preference rankings based on the LM.

## 2.3 Reporting life satisfaction when its drivers follow a trend

The identification problem is stronger when many improvements (or deteriorations) are experienced or expected in a row, because then the

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[15] The possibility that reporting functions change over time has been ignored not only in much of the economics literature on LS but also in psychology. See e.g. Karney and Coombs (2000) where current subjective assessments of marital satisfaction are taken to be the accurate measure when compared with recollections ten years later although the recollection question asked neither implies that participants should use the past utility nor the past reporting function. Hence, in line with the *Reassess* treatment reported in Section 3, there is no reason to expect that recollection answers match former current assessments. One might therefore question, whether the study really identifies a memory bias or merely an adjustment in either utility or reporting function.

limited answer scale is particularly restricting. While in dimensions such as income improvements might be expected to happen repeatedly, in others such as marital status this seems less plausible. A respondent might therefore choose a flatter reporting function or a different adaptation rule for the income dimension than for the marriage dimension such that the relative impact of both dimensions on LS cannot be compared to infer preferences. Hence, estimates of marginal rates of substitution are distorted (Benjamin et al. 2014a). This is in line with observations that income coefficients in LS regressions are often found to be relatively small (see e.g. Kopmann and Rehdanz 2013). As (differential) adjustments in reporting functions cannot be distinguished from changes in preferences in LM data, one might draw misleading conclusions on people's preferences.

The Easterlin Paradox for example might not imply that people are indifferent to higher levels of (average) income in the long run. LS data might simply not reveal the preference for increasing income due to an adapting reporting function. While the problem of preference misrepresentation has been mentioned in the literature before, solutions are still rare.[16]

We want to stress that our analysis only applies to the preference relation interpretation of LS. The LM might be a good representation of the mental state, i.e. the intensity of sensation in a given situation. Intensity of

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[16] See e.g. Benjamin et al. (2014a), Bertrand and Mullianathan (2001), Fleurbaey (2009), Frederick and Loewenstein (1999), Frey and Stutzer (2002), Loewenstein and Ubel (2008).

sensation might thus well have adapted to higher levels of income. But this does not mean that respondents are indifferent to increasing income. Our aim is to show why these two interpretations of LS will systematically differ. We abstain from making a normative judgment as to which of the concepts should be policy relevant.

### 3. Experimental evidence on the level measure

In this section we test how well participants remember past answers or the reporting function which are preconditions for eliciting preference rankings from within-subject comparisons of LM data. Since estimation methods rely on participants reporting higher levels of LS in situations they prefer, it is crucial that participants remember not only how satisfied they were in previous rounds of the survey but also the answer categories chosen. Some white noise can be taken care of by using large numbers of observations but if memories are biased – or non-existent – elicitation of preference rankings is greatly hampered.

### 3.1 The experiment

We commissioned a survey of a representative sample of the German population. The survey was conducted in two waves about three months apart by the market research company Lightspeed between June and October 2015. In wave 1 we asked a total of 2,300 participants for their age and gender, the LM (LM1) and whether they would be willing to participate

in a later wave on a similar topic. This creates a situation similar to those faced by participants in large annual panels like the BHPS or GESIS. All participants agreed to be re-contacted. A total of 1,600 participants also participated in the second wave equally and randomly distributed over four treatments.

The treatments differed in the type and order of LS questions in wave 2 (Table 1). In treatments *RecallExAnte* and *RecallExPost* participants were asked to recall the answer to LM1 given three months ago (LM1recall) and state whether they felt sure or unsure about the accuracy of their answer. The option "I cannot remember at all" was also available. The two treatments differed only with respect to the ordering of questions. In *RecallExAnte* LM1recall was asked first and hence participants could use it to anchor their response to the level measure (LM2) and the ranking measure (RM, see next section). This was not possible in *RecallExPost* where LM1recall was elicited last. Participants were prevented from changing their responses to previous questions.

**Table 1. Order of questions asked in Lightspeed survey.**

400 participants per treatment.

| Treatment | Wave 1 | Wave 2 | | |
|---|---|---|---|---|
| *Control* | LM1 | | LM2    RM | |
| *RecallExAnte* | LM1 | LM1recall | LM2    RM | |
| *RecallExPost* | LM1 | | LM2    RM | LM1recall |
| *Reassess* | LM1 | LM1reassess | LM2    RM | |

In treatment *Reassess* participants had to give a retrospective assessment of LS for the point in time they had completed wave 1 of the survey (LM1reassess). In contrast to LM1recall there is no objectively correct answer to LM1reassess. LM1reassess might differ from LM1 because of imperfect recollection of the situation three months ago or because either the reporting function or preferences might have changed. Answering LM1reassess requires participants to be able and willing to apply the current reporting function to the situation three month ago. A precondition is that they perceive their recollection of that situation to be sufficient to do that. All questions as well as the summary statistics can be found in Appendix A1.

### 3.2 Recollection ability and precision

Treatments RecallExAnte and RecallExPost check how well participants remember answers to the LM over three months. Interpreting changes in the LM over time as preference rankings requires that participants use their previous answer as a reference point and correctly report improvements or deteriorations accordingly. This requires that they either remember the answer given in the previous wave of the survey or that they correctly remember both the situation they were in, their preferences at the time and the reporting function used in order to reconstruct their previous response.

Over both treatments 43.3 percent of participants stated that they could not at all recollect their answer to LM1 or gave no number (see Table 2). Out of

the participants that answered LM1 and took part in the wave 2 only 20 percent correctly recalled their answer three months later.[17] In *RecallExAnte* the conditional rate of accurate answers was higher for those participants that stated a lower confidence (32.8 vs. 37.8 percent).[18] Thus, confidence here is a poor predictor of ability. The frequency of accurate answers is better than a random guess but the amount of noise introduced by imperfect recollection is substantial.

Next, we test whether the noise dominates the signal, i.e. the information on the underlying preferences the respondent tries to transmit.

**Table 2. Self-assessed and real accuracy of recollection of LM1.**

LM1recall and accuracy conditional on answering LM1.

| | | | LM1recall | |
| --- | --- | --- | --- | --- |
| Treatment | LM1 (#) | Confidence level | Total (#) | Accurate (#) |
| *RecallExAnte* | 397 | Precise | 67 | 22 |
| | | Guess | 188 | 71 |
| | | Cannot recall/no answer | 119/23 | - |
| *RecallExPost* | 399 | Precise | 27 | 13 |
| | | Guess | 169 | 53 |
| | | Cannot recall/no answer | 192/11 | - |

The direction of the observed change in LS (sign(LM2 − LM1)) only measures the preference ranking accurately if the recollection error

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[17] Based on a uniform distribution, the success rate of a random draw would have been 14.3 percent.

[18] Over both treatments combined the accuracy rate of the confident is 37.2 percent vs. 34.7 percent of the less confident.

(LM1recall – LM1) does not change the "signal" on their preferences (LM2 – LM1recall) that participants are assumed trying to send . In *RecallExPost[19]*, the recollection error results in a misrepresentation of the preference order for 102 out of 196 participants (52%) that answered all three questions. Thus, the preference rankings implied by (LM2 – LM1) and (LM2 - LM1recall) differ. Using the reference point that is commonly observable in surveys (LM1) results in a different preference ranking than using the one that participants have in their minds (LM1recall). A further 203 participants that answered LM1 and LM2 stated to be unable to recall LM1. For the latter the consistency rate cannot be determined but is likely to be lower than for those that did recall LM1.

*Result 1: Within subject variation of LM is an unreliable measure of preferences. About half (50.9 percent) of respondents stated to be unable to remember the answer given to a LM question three months ago, although a 'low confidence' option was available. For those that stated to remember, the preference ranking implied by the standard measure (LM2 - LM1) differed from that based on the recollection (LM2 - LM1recall) in about half of all cases (52 percent).*

Consistency rates in standard surveys will be lower due to the four times longer gap between consecutive waves. Hence, even when abstracting from

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[19] We analyze *RecallExPost* since in *RecallExAnte* the answer to LMrecall might influence the later answer to LM2 and thus distort the observed change in LS. On the other hand, we thereby have to accept that LMrecall might be influenced by the earlier answer to LM2.

the possibility that reporting functions and preferences can change over time, within-subject comparisons of the LM seem ill fitted to produce reliable information on preference rankings.

### 3.3 Reassessment ability

Allowing participants to reassess the situation three months ago rather than asking them to recall their prior assessment, increases response rates significantly. Instead of 64 and 49 percent (of those answering LM1) in treatments *RecallExAnte* and *RecallExPost*, respectively, 98.25 percent (393 out of 400) answered the LM1reassess question in treatment *Reassess* including four participants that did not answer LM1. The difference to LM1 is comparable to the answers given to LM1recall in terms of mean deviation and number of exact matches. The variance of (LM1 - LM1reassess) is significantly larger than that of (LM1 - LM1recall) ($p < 0.001$, variance ratio test). However, there is no reason to expect participants (even those with perfect memories) giving the same answers to LM1reassess and LM1 since both the reporting function and preferences might have changed. The precision of reassessments is unobservable.

*Result 2: Almost all participants (98.25 percent) provide reassessments of the satisfaction three months ago based on current preferences and reporting function.*

Respondents struggle to remember the category selected in a LM question three month ago but have no trouble in reporting a reassessment of the past

situation using a new ad hoc reporting function. This implies that many cannot remember the previously used reporting function as otherwise they could reconstruct (with error) their past answer. The experimental test indicates that within subject changes in the LM are a poor indicator of preference rankings even with only three months in between.

## 4. The ranking measure

Asking individuals directly to rank the current situation against the situation from the previous period prevents an uncontrollable change in reporting function from one wave to the next and the memory issues detected in the previous section. An example of such a question from the BHPS:

*"Would you say that you are more satisfied with life, less satisfied or feel about the same as you did a year ago?"* where the answer options were *"More satisfied"*, *"Less satisfied"*, *"About the same"* and *"Don't know"*.

Responses to an RM question can be described by $RM_{i,t}(x_{i,t}, x_{i,t-1}) = r_{i,t}(x_{i,t}, x_{i,t-1}, \succcurlyeq_{i,t})$. The individual compares today's situation $x_{i,t}$ with last period's situation $x_{i,t-1}$ using the current preference relation $\succcurlyeq_{i,t}$. The preference ranking is transformed into an answer on the answer scale according to the reporting function $r_{i,t}(.)$, i.e. it gives a retrospective evaluation of the experienced change in life.

## 4.1 When does the ranking measure capture preferences?

Under which conditions is the RM reliably able to capture preference rankings? First, if there is no bias in memory about last period's situation, the preference ranking of the two situations is weakly correct. The reporting function might be coarser than actual preferences, such that a very small improvement might still be reported as indifference. The RM requires individuals to remember the past situation (without bias). However, people might be reluctant reporting that things have become worse or glorify the past, therefore biasing the RM up or down. While the RM is not immune against memory biases[20], it requires memories of one's life only while the LM on top of that critically relies on remembering an ad hoc reporting function or the answer to a specific survey questions for an entire year.

Secondly, participants need to intend to report their preference rankings and not another concept. Thus, $r_{i,t}(.)$ needs to (weakly) preserve the preference ranking. This condition is equivalent to the monotonicity requirement of $f_{i,t}(.)$ for the LM. The BHPS question did not clearly ask to report a preference ranking instead of a change in sensation intensity and can be improved in that respect. Therefore we commissioned the following question in the GESIS panel and used the same phrasing in the Lightspeed survey:

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[20] On memory biases see Hoffrage et al. (2000), Karney and Coombs (2000), Levine and Safer (2002) and Morewedge et al. (2005). Note that studies of memory bias are not immune against misspecification either (see footnote 15).

*"In what follows we would like to know how you evaluate the development of your life over the past 12 months. In your opinion, has your life overall improved or deteriorated over the past 12 months? Please evaluate the changes from today's perspective."*

### 4.2 Advantages of the ranking measure

In contrast to the LM (see section 2.2), two situations are assessed and reported using the same preference relation and reporting function. Moreover, it is possible to observe arbitrarily long sequences of improvements or deteriorations. The RM also uses more intuitive categories. It seems easier to agree on what *"improvement"* means than on what is a "*4 out of 7*". This increases comparability across individuals. While there might still be heterogeneity in cut-offs between categories across individuals and time, this does not impede to rank two states of the world based on a "better" or "worse" response. With the LM heterogeneity in cut-offs between categories can reverse rankings (Bond and Lang 2014).

Direct measurements of changes have been found to outperform computed changes based on repeatedly reported levels in subjective assessments of health (Gunasekara et al. 2012) and preference reversals (Bateman et al., 2007).

The RM thus eliminates the uncontrollable change in utility and reporting functions, reduces the memory issues, is more intuitive, avoids the bounded

scale, is ordinal and promises therefore to be better suited to measure preference rankings as compared to the LM.

### 5. Comparison of measures: empirical evidence

Above we argued that the LM is a highly imperfect way to elicit preference rankings and suggested the RM as an, at least conceptually, more reliable alternative. Next we compare the two measures empirically.

To allow a direct comparison we reduce the LM to the information relevant for a preference ranking, i.e. whether an individual evaluates the present situation as "better" or "worse" than or is "indifferent" to the situation a year ago. This is achieved by using the sign of the change in the level measure $signdLM_{i,t} = \text{sign}(dLM_{i,t})$ with $dLM_{i,t} = LM_{i,t} - LM_{i,t-1}$.

We label the difference between RM and signdLM *deviation = RM - signdLM*. It captures when the preferences elicited by the two measures differ. If *deviation = 0*, both measures report the same preference ranking. If, however, *|deviation| = 2* they give opposite rankings. If *|deviation| = 1*, they weakly disagree.

### 5.1 Data

We draw on data from BHPS (University of Essex 2010), GESIS (GESIS 2017) and Lightspeed surveys which contain the LM and the RM. The RM question in the GESIS panel and the complete Lightspeed survey were

commissioned by us. Data descriptions and summary statistics can be found

in Appendix A.1.

**Table 3. Comparison of RM and signdLM**. Standard error in brackets. Lightspeed based on treatments *Control* and *RecallExPost*. Difference from zero is reported at * p<0.05, **p<0.01, ***p<0.001 significance levels.

| | BHPS | GESIS | Lightspeed |
|---|---|---|---|
| **Country** | UK | Germany | Germany |
| **Years covered** | 1996 - 2000 | 2014 - 2017 | 2015 |
| | 2002 - 2008 | | |
| **Observations** | 117,244 | 9,553 | 794 |
| **Mean signdLM** | -.15*** (.002) | .006 (.008) | .006 (.028) |
| **Mean RM** | .11*** (.002) | .279*** (.010) | .144*** (.022) |
| **Mean deviation** | .046*** (.002) | .273*** (.010) | .137*** (.033) |
| **signdLM = 0 (%)** | 46.4 | 32.1 | 37.2 |
| **RM = 0 (%)** | 57.9 | 39.2 | 59.4 |
| **signdLM < 0 (%)** | 27.6 | 33.6 | 31.1 |
| **RM < 0 (%)** | 15.6 | 16.4 | 13.1 |
| **Mean deviation** | .046*** (.002) | .273*** (.010) | .137*** (.033) |
| **Weak disagreement (%)** | 47.1 | 42.73 | 48.7 |
| **Agreement (%)** | 45.5 | 41.1 | 41.8 |
| **Corr(signdLM,RM)** | .21 | .18 | .17 |
| **t-test signdLM = RM (p-value)** | .000 | .000 | .000 |
| **Marginal homogeneity (Stuart Maxwell, p-value)** | .000 | .000 | .000 |

The BHPS panel is representative for Great Britain and starting from 2001

also for the whole of the UK. The two LS measures are available for the

years 1996 to 2008 (with 2001 missing) adding up to 117,244 observations.

As far as we are aware, the data of the RM in the BHPS has never been used

so far in any publication.

The GESIS panel is representative for Germany and features a more precise

RM question for eliciting preferences (as discussed in the previous section)

than the BHPS. While the LM was included in the GESIS panel starting 2014, the RM was added on our behalf in 2015. There are 9,553 valid observations for the years 2015 to 2017 in total for which both LM and RM are available.

The Lightspeed dataset (see section 3) is representative of Germany and contains 794 observations from the *Control* and *RecallExPost* treatments where LM2 and RM are not affected by the experimental setup.

### 5.2 Consistency between the two life satisfaction measures

Table 3 reports the descriptive data and test results for signdLM, RM and *deviation*. Across all data sets, comparing the means, we find that signdLM tends more towards the negative than RM, confirmed by a significant positive mean *deviation*. Still, the share of participants reporting no noteworthy change in LS is higher for the RM than the LM which is consistent with substantially more noise in LM answers. Across all datasets, the preference rankings elicited from the two measures at least weakly disagree in more than half of all cases confirming results from section 3. Correlation of both measures is around .2 and tests of asymptotic symmetry and marginal homogeneity are rejected. The two measures are thus significantly different in terms of means and distributions.

*Result 3: RM and signdLM are significantly different in mean and distribution, only weakly correlated and the elicited rankings of states of the world disagree in more than half of all cases.*

Some of the inconsistency between signdLM and RM is due to noise in signdLM that is caused by inaccurate but unbiased recollection of the LM reported in the previous wave. Treatment *RecallExAnte* in the Lighspeed dataset allows to quantify this by comparing consistency rates between signdLM and RM (44.4%) and between LM2 − LM1recall and RM (68.2%), thus 43% (= 1 − (100 − 68.2) / (100 - 44.4)) of inconsistency between signdLM and RM is due to inaccurate recollection. In the first case participants had to remember their answer for three months, in the second only for a few seconds. Systematic adjustments in the reporting function cannot be eliminated by this procedure.

## 5.3 Drivers of life satisfaction measures

Next we test whether the difference between the measures is systematic. Tables 4a and 4b contain results for the BHPS and Table 5 for the GESIS data set. The tables report regressions of deviation, signdLM and RM on changes in explanatory variables ($dX_{i,t}$) such as income, employment status and marital status, on time-invariant personal variables ($X_i$) such as gender, on year dummies ($X_t$) and allowing for the possibility of unobserved personal fixed effects ($u_i$):

$$signdLM_{i,t} = sign(LM_{i,t} - LM_{i,t-1})$$

$$= \beta_1 \, dX_{i,t} + \beta_2 \, X_i + \beta_3 \, X_t + u_i + e_{i,t}$$

$$RM_{i,t} = \hat{\beta}_1 \, dX_{i,t} + \hat{\beta}_2 \, X_i + \hat{\beta}_3 \, X_t + \hat{u}_i + \hat{e}_{i,t}$$

$$deviation = RM_{i,t} - signdLM_{i,t} = \tilde{\beta}_1 \, dX_{i,t} + \tilde{\beta}_2 \, X_i + \tilde{\beta}_3 \, X_t + \tilde{u}_i + \tilde{e}_{i,t}$$

For BHPS, two specifications are presented differing in the way changes in income are measured: self-assessed changes in financial situation (improved, stayed the same, deteriorated) are used in Table 4a and changes in reported household income in Table 4b. For GESIS, results based on the change in financial situation are reported in Table 5.[21] We have checked for multicollinearity by means of the variance inflation factor, which for all variables in all specifications is between 1 and 2 except for age and age$^2$, which by definition are correlated with each other.

We report the results of pooled OLS regressions. According to the Breusch-Pagan test, unobserved personal fixed effects are present for the RM and a Hausman test suggests using a fixed effects regression which we report in addition to pooled OLS. The results are quite similar. The fixed effects specification takes into account personal fixed effects in *changes* over time. Person fixed effects in *levels* are already accounted for in the pooled OLS regressions since we use first differences (changes over time) as dependent variable and for most independent variables. Since the dependent variables have either three or five categories, an ordered logistic regression is reported

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[21] The version with income is presented in the appendix (Table A.6).

in the appendix as robustness check (Table A.7). Specifications using the natural logarithm of income are also reported in the appendix (Table A.9). This does not improve the significance of the income variable but also doesn't change the other coefficients.

Regressions (1) in Tables 4a and 4b confirm that the *deviation* between the preference relations elicited by LM and RM is systematically correlated with key socio-demographic variables. Age, gender, changes in the financial situation, changes in employment status and changes in marital status are significant drivers of *deviation* in the BHPS. Hence, at least one of the LS measures provides biased estimates of preference rankings over these attributes.[22] In regressions (2) and (3), the $R^2$ is consistently about ten times higher in the RM specification than for signdLM, consistent with the RM being less noisy. Note that the only difference between regressions (2) and (3) is the dependent variable which both take one of three values (-1, 0, 1).

The direction of direct impacts of changes in socio-economic variables on the two measures of LS is the same and intuitive – with the exception of age were both the linear and the quadratic terms have opposing signs.[23] However, the size of coefficients for RM is roughly twice that for LM which explains the systematic differences in deviation.

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[22] This also holds for the Lightspeed dataset (see Table A.3).
[23] Results excluding the lags are reported in Tables A.4a and A.4b.

*Result 4: Changes in socio-economic variables have intuitive effects on both LS measures but their impact is consistently and significantly stronger for RM.*

## 5.4 Adaptation

When comparing the coefficients of changes and lagged changes in socio-economic variables in Tables 4a and 4b, a clear pattern emerges. An improvement in financial situation, finding a job, leaving the labour market (not due to unemployment but e.g. into retirement) and getting married all have positive immediate impacts on both measures, a positive impact on next year's RM but a negative impact on next year's LM. The same pattern but with reversed signs holds for becoming unemployed.

The LM therefore has a clear tendency towards findings that people get used to whatever happens to them. The key question is whether this adaptation reflects changes in preferences ('once you got to know it, more money isn't that great and unemployment not that bad after all *compared* to other things'), which has been a dominant interpretation in the adaptation literature, or merely an adjustment of the reporting function (that might reflect changes in satisfaction sensation but not preference rankings).

The RM exhibits the opposite pattern. Some of the benefits of an improvement in the financial situation and some of the downsides of unemployment only seem to occur to (or hit) people with some delay. By construction of the RM, this cannot be attributed to changes in the reporting

function. At least for some of the variables plausible explanations for the reinforcing impact of lags exist. After losing a job, people might first be hopeful that they find a new one soon. One year later, this hope might have died. Note that both changes in the financial situation and whether a new job has been found in the meantime are controlled for.

*Result 5: Lagged changes in socio-economic variables exhibit the standard adaptation pattern for the LM but the opposite pattern for RM.*

For the GESIS data in Table 5, this adaptation pattern is only observed for the change in financial situation, because socio-economic drivers are generally far from being significant.[24] The results for GESIS using income instead of financial situation can be found in Table A.6.

### 5.5 Trends in socio-economic variables and changes in reported LS

Is it possible to identify what is driving this difference in the impact of lagged changes in life circumstances? One of the motivations for adjusting the reporting function of the LM is to preserve the ability to report future changes on a bound answer scale. This is especially relevant if there is a clear trend in the variable to be assessed. Changes in the financial situation are the only candidate among the variables available here that can exhibit a trend over several periods.

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[24] This seems to be due to the fact that there are only three years of observations. When the BHPS is only analyzed for three periods (instead of ten), the picture gets very similar (see appendix Tables A.5a and A.5b).

**Table 4a. BHPS: Regressions on key socio-economic variables (financial situation).**
Variable description in Appendix A.1. Results from pooled OLS and fixed effects regressions including year fixed effects. Standard errors in parentheses. $^{*}$ p<0.05, $^{**}$p<0.01, $^{***}$p<0.001.

| | (1) deviation OLS | (2) signdLM OLS | (3) signRM OLS | (4) signRM FE |
|---|---|---|---|---|
| female | 0.0171$^{**}$ | 0.00332 | 0.0205$^{***}$ | 0 |
| | (0.00615) | (0.00336) | (0.00567) | |
| age | -0.0209$^{***}$ | 0.00466$^{***}$ | -0.0162$^{***}$ | -0.0292 |
| | (0.00109) | (0.000649) | (0.000971) | (0.0326) |
| age$^2$ | 0.000157$^{***}$ | -0.0000456$^{***}$ | 0.000111$^{***}$ | -0.00000131 |
| | (0.0000106) | (0.00000642) | (0.00000942) | (0.0000231) |
| **change_fin_situation** | **0.105$^{***}$** | **0.0844$^{***}$** | **0.189$^{***}$** | **0.163$^{***}$** |
| | (0.00474) | (0.00399) | (0.00386) | (0.00349) |
| **L.change_fin_situation** | **0.105$^{***}$** | **-0.0593$^{***}$** | **0.0458$^{***}$** | **0.0179$^{***}$** |
| | (0.00469) | (0.00400) | (0.00357) | (0.00350) |
| | | | | |
| stayed unemployed | -0.120$^{***}$ | -0.00902 | -0.129$^{***}$ | -0.0907$^{**}$ |
| | (0.0332) | (0.0245) | (0.0277) | (0.0326) |
| stayed out of labour market | -0.0428$^{***}$ | 0.00382 | -0.0390$^{***}$ | 0.0359$^{**}$ |
| | (0.00883) | (0.00522) | (0.00792) | (0.0121) |
| | | | | |
| **got employed** | **0.0548$^{**}$** | **0.0439$^{**}$** | **0.0987$^{***}$** | **0.125$^{***}$** |
| | (0.0175) | (0.0148) | (0.0136) | (0.0139) |
| **lag got employed** | **0.0198** | **0.00470** | **0.0245$^{*}$** | **0.0415$^{***}$** |
| | (0.0151) | (0.0129) | (0.0115) | (0.0115) |
| | | | | |
| **got unemployed** | **-0.0922$^{***}$** | **-0.0896$^{***}$** | **-0.182$^{***}$** | **-0.114$^{***}$** |
| | (0.0250) | (0.0212) | (0.0199) | (0.0186) |
| **lag got unemployed** | **-0.154$^{***}$** | **0.0501$^{*}$** | **-0.104$^{***}$** | **-0.0635$^{**}$** |
| | (0.0272) | (0.0233) | (0.0207) | (0.0199) |
| | | | | |
| **exited labour market** | **0.0726$^{***}$** | **0.0432$^{**}$** | **0.116$^{***}$** | **0.138$^{***}$** |
| | (0.0166) | (0.0141) | (0.0132) | (0.0127) |
| **lag exited labour market** | **0.109$^{***}$** | **-0.0403$^{**}$** | **0.0688$^{***}$** | **0.0398$^{**}$** |
| | (0.0169) | (0.0142) | (0.0126) | (0.0126) |
| **got married** | **0.190$^{***}$** | **0.0535$^{**}$** | **0.244$^{***}$** | **0.113$^{***}$** |
| | (0.0230) | (0.0194) | (0.0173) | (0.0180) |
| **lag got married** | **0.192$^{***}$** | **-0.0328** | **0.159$^{***}$** | **0.150$^{***}$** |
| | (0.0234) | (0.0197) | (0.0180) | (0.0177) |
| **marriage ended** | **-0.141$^{***}$** | **-0.0213** | **-0.163$^{***}$** | **-0.252$^{***}$** |
| | (0.0310) | (0.0284) | (0.0277) | (0.0233) |
| **lag marriage ended** | **-0.0469** | **0.0895$^{***}$** | **0.0426** | **-0.0251** |
| | (0.0307) | (0.0264) | (0.0228) | (0.0219) |
| | | | | |
| stayed married | -0.00202 | -0.00939$^{*}$ | -0.0114 | -0.174$^{***}$ |
| | (0.00705) | (0.00400) | (0.00645) | (0.0136) |
| | | | | |
| Year dummies | yes | yes | yes | yes |
| Constant | 0.233$^{***}$ | -0.117$^{***}$ | 0.116$^{***}$ | 1.099 |
| | (0.0306) | (0.0197) | (0.0271) | (1.368) |
| Observations | 83533 | 83533 | 83533 | 83533 |
| $R^2$ | 0.052 | 0.012 | 0.109 | 0.052 |
| Adjusted $R^2$ | 0.051 | 0.011 | 0.109 | -0.220 |
| AIC | 207001.0 | 183091.7 | 151818.8 | 114298.3 |
| BIC | 207243.7 | 183334.4 | 152061.5 | 114531.6 |

**Table 4b. BHPS: Regressions on key socio-economic variables (income).** Variable description in Appendix A.1. Results from pooled OLS and fixed effects regressions including year fixed effects (not reported). Standard errors in parentheses. $^*$ p<0.05, $^{**}$p<0.01, $^{***}$p<0.001.

| | (1)<br>deviation<br>OLS | (2)<br>signdLM<br>OLS | (3)<br>signRM<br>OLS | (4)<br>signRM<br>FE |
|---|---|---|---|---|
| female | 0.0146$^*$ | 0.00300 | 0.0176$^{**}$ | 0 |
| | (0.00633) | (0.00336) | (0.00591) | (.) |
| age | -0.0252$^{***}$ | 0.00407$^{***}$ | -0.0211$^{***}$ | -0.0126 |
| | (0.00110) | (0.000642) | (0.000989) | (0.0332) |
| age$^2$ | 0.000191$^{***}$ | -0.0000402$^{***}$ | 0.000151$^{***}$ | 0.0000175 |
| | (0.0000108) | (0.00000637) | (0.00000961) | (0.0000233) |
| **d_hh_inc_month** | **0.00177** | **0.00159** | **0.00336$^*$** | **0.00151** |
| | (0.00192) | (0.00181) | (0.00142) | (0.00137) |
| **L.d_hh_inc_month** | **0.00262** | **-0.00237** | **0.000245** | **-0.00131** |
| | (0.00194) | (0.00163) | (0.00144) | (0.00137) |
| | | | | |
| stayed unemployed | -0.183$^{***}$ | -0.0230 | -0.206$^{***}$ | -0.166$^{***}$ |
| | (0.0333) | (0.0247) | (0.0285) | (0.0328) |
| stayed out of labour market | -0.0822$^{***}$ | -0.00102 | -0.0833$^{***}$ | -0.00271 |
| | (0.00895) | (0.00515) | (0.00811) | (0.0122) |
| | | | | |
| **got employed** | **0.0440$^*$** | **0.0695$^{***}$** | **0.114$^{***}$** | **0.140$^{***}$** |
| | (0.0174) | (0.0148) | (0.0139) | (0.0141) |
| **lag got employed** | **0.0418$^{**}$** | **0.00164** | **0.0434$^{***}$** | **0.0538$^{***}$** |
| | (0.0153) | (0.0129) | (0.0120) | (0.0116) |
| | | | | |
| **got unemployed** | **-0.165$^{***}$** | **-0.125$^{***}$** | **-0.290$^{***}$** | **-0.210$^{***}$** |
| | (0.0250) | (0.0213) | (0.0206) | (0.0187) |
| **lag got unemployed** | **-0.186$^{***}$** | **0.0755$^{**}$** | **-0.111$^{***}$** | **-0.0610$^{**}$** |
| | (0.0273) | (0.0233) | (0.0212) | (0.0201) |
| | | | | |
| **exited labour market** | **0.0203** | **0.0158** | **0.0361$^{**}$** | **0.0700$^{***}$** |
| | (0.0166) | (0.0141) | (0.0133) | (0.0128) |
| **lag exited labour market** | **0.0799$^{***}$** | **-0.0327$^*$** | **0.0472$^{***}$** | **0.0291$^*$** |
| | (0.0169) | (0.0141) | (0.0127) | (0.0127) |
| **got married** | **0.200$^{***}$** | **0.0526$^{**}$** | **0.252$^{***}$** | **0.117$^{***}$** |
| | (0.0231) | (0.0195) | (0.0176) | (0.0182) |
| **lag got married** | **0.200$^{***}$** | **-0.0366** | **0.163$^{***}$** | **0.152$^{***}$** |
| | (0.0235) | (0.0197) | (0.0182) | (0.0179) |
| | | | | |
| **marriage ended** | **-0.185$^{***}$** | **-0.0398** | **-0.225$^{***}$** | **-0.306$^{***}$** |
| | (0.0311) | (0.0285) | (0.0282) | (0.0234) |
| **lag marriage ended** | **-0.0867$^{**}$** | **0.0967$^{***}$** | **0.0100** | **-0.0452$^*$** |
| | (0.0311) | (0.0263) | (0.0233) | (0.0220) |
| | | | | |
| stayed married | -0.00838 | -0.00995$^*$ | -0.0183$^{**}$ | -0.181$^{***}$ |
| | (0.00723) | (0.00399) | (0.00670) | (0.0138) |
| | | | | |
| Year dummies | yes | yes | yes | yes |
| Constant | 0.809$^{***}$ | -0.0493$^{**}$ | 0.760$^{***}$ | 0.766 |
| | (0.0265) | (0.0166) | (0.0234) | (1.390) |
| Observations | 84112 | 84112 | 84112 | 84112 |
| $R^2$ | 0.036 | 0.005 | 0.064 | 0.020 |
| Adjusted $R^2$ | 0.035 | 0.004 | 0.064 | -0.259 |
| AIC | 209865.3 | 184980.1 | 157105.5 | 118102.5 |
| BIC | 210108.1 | 185222.9 | 157348.3 | 118336.0 |

**Table 5. GESIS: Regressions on key socio-economic variables.** Variable description in Appendix A.1. Results from pooled OLS and fixed effects regressions including year fixed effects (not reported). Standard errors in parentheses. $^*$ p<0.05, $^{**}$p<0.01, $^{***}$p<0.001.

| | (1) deviation OLS | (2) signdLM OLS | (3) signRM OLS | (4) signRM FE |
|---|---|---|---|---|
| female | -0.00509 | -0.00523 | -0.0103 | - |
| | (0.0247) | (0.0191) | (0.0195) | (.) |
| age | -0.0252$^{**}$ | 0.00475 | -0.0205$^{**}$ | 0.0460 |
| | (0.00821) | (0.00648) | (0.00630) | (0.0704) |
| age$^2$ | 0.000167$^*$ | -0.0000501 | 0.000117 | -0.000501 |
| | (0.0000847) | (0.0000664) | (0.0000650) | (0.000664) |
| **change_fin_situation** | **0.232$^{***}$** | **0.119$^{***}$** | **0.351$^{***}$** | **0.304$^{***}$** |
| | (0.0163) | (0.0144) | (0.0123) | (0.0194) |
| **L.change_fin_situation** | **0.152$^{***}$** | **-0.0937$^{***}$** | **0.0584$^{***}$** | **0.0247** |
| | (0.0161) | (0.0140) | (0.0112) | (0.0180) |
| | | | | |
| stayed unemployed | 0.165 | -0.274 | -0.109 | -0.0599 |
| | (0.212) | (0.161) | (0.131) | (0.289) |
| stayed out of labour market | -0.0748 | 0.0112 | -0.0635 | 0.0263 |
| | (0.0425) | (0.0340) | (0.0336) | (0.129) |
| | | | | |
| **got employed** | **-0.0336** | **-0.0159** | **-0.0496** | **-0.0710** |
| | (0.0738) | (0.0603) | (0.0503) | (0.104) |
| **lag got employed** | **0.0536** | **0.0225** | **0.0761$^*$** | **0.0969** |
| | (0.0621) | (0.0526) | (0.0388) | (0.0685) |
| | | | | |
| **got unemployed** | **-0.0671** | **0.0510** | **-0.0161** | **-0.00631** |
| | (0.138) | (0.116) | (0.0861) | (0.161) |
| **lag got unemployed** | **0.0812** | **-0.0521** | **0.0292** | **-0.146** |
| | (0.177) | (0.137) | (0.105) | (0.164) |
| | | | | |
| **exited labour market** | **0.0498** | **0.0653** | **0.115$^*$** | **0.0966** |
| | (0.0673) | (0.0548) | (0.0470) | (0.0773) |
| **lag exited labour market** | **0.0815** | **0.0251** | **0.107$^*$** | **0.0878** |
| | (0.0665) | (0.0559) | (0.0470) | (0.0757) |
| | | | | |
| stayed married | 0.0364 | -0.0332 | 0.00315 | -0.345 |
| | (0.0294) | (0.0228) | (0.0238) | (0.181) |
| | | | | |
| **got married** | **-0.00950** | **0.0972** | **0.0877** | **-0.0392** |
| | (0.113) | (0.100) | (0.0748) | (0.135) |
| **lag got married** | **-0.0174** | **0.0785** | **0.0611** | **0.0527** |
| | (0.0952) | (0.0836) | (0.0694) | (0.101) |
| | | | | |
| **marriage ended** | **-0.0725** | **0.0743** | **0.00175** | **-0.128** |
| | (0.132) | (0.103) | (0.0881) | (0.159) |
| **lag marriage ended** | **-0.0332** | **0.0957** | **0.0625** | **0.0652** |
| | (0.104) | (0.0914) | (0.0745) | (0.115) |
| Year dummies | yes | yes | yea | yes |
| Constant | -0.108 | -0.195 | -0.303 | -1.509 |
| | (0.201) | (0.163) | (0.159) | (1.841) |
| Observations | 4864 | 4864 | 4864 | 4864 |
| $R^2$ | 0.107 | 0.022 | 0.257 | 0.127 |
| Adjusted $R^2$ | 0.103 | 0.018 | 0.254 | -0.998 |
| *AIC* | 13106.7 | 11680.3 | 9219.6 | 4058.3 |

| | | | | |
|---|---|---|---|---|
| *BIC* | 13236.5 | 11810.0 | 9349.4 | 4175.2 |

**Table 6. Deviation between measures on direction of change and trends in financial situation (BHPS).** Description of variables given in Appendix A.1. Results from pooled OLS regression including year fixed effects. Standard errors in parentheses. [*] $p<0.05$, [**]$p<0.01$, [***]$p<0.001$.

| | (1) deviation | |
|---|---|---|
| female | 0.0182[**] | (0.00594) |
| age | -0.0206[***] | (0.00105) |
| age$^2$ | 0.000155[***] | (0.0000104) |
| | | |
| financial deterioration | -0.0438[***] | (0.00907) |
| Lag financial deterioration | -0.102[***] | (0.00968) |
| financial improvement | 0.134[***] | (0.00957) |
| Lag financial improvement | 0.0783[***] | (0.00903) |
| | | |
| **negative trend** | **-0.0462[**]** | **(0.0157)** |
| **positive trend** | **0.0442[**]** | **(0.0146)** |
| | | |
| stayed unemployed | -0.116[***] | (0.0320) |
| stayed out of labour market | -0.0409[***] | (0.00851) |
| got employed | 0.0489[**] | (0.0169) |
| got unemployed | -0.0986[***] | (0.0227) |
| exited labour market | 0.0668[***] | (0.0159) |
| lag got employed | 0.0209 | (0.0147) |
| lag got unemployed | -0.150[***] | (0.0253) |
| lag exited labour market | 0.111[***] | (0.0162) |
| got married | 0.189[***] | (0.0227) |
| marriage ended | -0.150[***] | (0.0297) |
| stayed married | -0.00147 | (0.00678) |
| lag got married | 0.192[***] | (0.0229) |
| lag marriage ended | -0.0453 | (0.0284) |
| Year dummies | yes | |
| Constant | 0.624[***] | (0.0265) |
| Observations | 83533 | |
| $R^2$ | 0.053 | |
| Adjusted $R^2$ | 0.052 | |
| *AIC* | 206936.4 | |
| *BIC* | 207216.4 | |

Table 6 provides some additional insights into the adaptation pattern that is observed for the LM but not the RM. It reports how deviation is affected by trends in the financial situation. For this purpose, changes in financial situation have been categorised into improvements, no change and

deteriorations that enter both directly and lagged.[25] Moreover, the dummy variables 'positive trend' and 'negative trend' have been created. They equal one if the financial situation has improved (deteriorated) for two successive periods. Coefficients for both are highly significant and lend support to the hypothesis that reporting functions of the LM are adjusted more if there is an experienced trend in the assessed variable.[26]

*Result 7: The deviation between preference rankings elicited by signdLM and RM increases in absolute terms if there is a trend in a socio-economic driver of LS.*

Do adjustments of the reporting function only happen when participants have reached the bounds of the answer scale? The main regression results from Table 4a remain when excluding observations where LM is either 1 or 7 in the BHPS (Table A.10) or the lag of LM is either 1 or 7 (Table A.11), i.e. when participants have reached the end of the answer scale and thus have no further opportunity of indicating improvement or deterioration respectively without adjustments in the reporting function. This indicates

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[25] De Neve et al. (2017) study the differential impact of positive and negative growth on the level measure and find that levels of subjective well-being are about twice as sensitive to negative as compared to positive growth. While we find a substantially larger coefficient for improvements than for deteriorations, this does not contract their results. Most importantly, the deviation measure captures the difference between signdLM and RM and hence does not speak on the change in the LM directly. Moreover, we measure changes in financial satisfaction at the individual level while De Neve et al. (2017) consider macroeconomic events.

[26] Results are similar but not significant when using leads instead of lags for creating the trends, which can be interpreted as proxies for expected trends (see Table A.8).

that adaptation of reporting functions starts before the bounds of the answer scale are reached.

Combined our results provide supporting evidence for systematic adaptation of the reporting function and hence systematic distortion in the representation of preference rankings when using the LM.[27]


## 6. Conclusion and Discussion

Several conceptual concerns raise doubt that the established level measure of life satisfaction is suitable to elicit reliable preference rankings over states of the world. The adjustment of preferences and, more importantly, of the way they are mapped onto the discrete and bound answer scale via ad hoc reporting functions reduce the comparability of answers given by survey panel members in subsequent years. Empirical evidence from three representative surveys covering two countries, almost two decades and well over a hundred thousand observations give credence to these concerns. An alternative elicitation method, the ranking measure of life satisfaction is introduced and compared with the level measure.

The key empirical findings are that survey participants are largely unable to remember answers given to life satisfaction questions three months ago but are able to reassess the situation they experienced using a new reporting

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[27] For evidence that the LM is unreliable in eliciting estimates of the marginal rate of substitution between different attributes that are complementary to those presented here, see Benjamin et al. (2014a).

function. The noise introduced by imprecise recollection of previous answers reverts the preference ranking elicited by the level measure in more than half of all cases. The ranking measure raises consistency rates by more than 50 percent compared to the level measure in a controlled experiment. In three representative panel surveys the change in the level measure and the ranking measure are only weakly correlated and significantly differ in their means and distributions. These differences are systematically correlated with key socio-economic variables such as age, changes in the financial situation, employment and marital status. The level measure but not the ranking measure systematically features adaptation to changes in life's circumstances and especially so when there is a trend in the underlying socio-economic variable.

Combining the conceptual concerns and the empirical evidence and previous findings in the literature (e.g. Benjamin et al. 2014a, Bond and Lang 2014) suggests that the level measure of life satisfaction produces biased estimates of preference rankings. In particular the widely reported adaptation to income changes and other aspects of life seems to be mainly driven by adjustments in the reporting function rather than by changes in the underlying preferences. This challenges at least some interpretations of key results from the life satisfaction literature such as the Easterlin Paradox. Levels of life satisfaction have remained mostly flat in developed countries despite substantial increases in average income over the last decades. This

might be an adequate description of the satisfaction sensation in the population, but the results presented here call into question that this implies an indifference towards increases in per capita income in the long run. Depending on which concept policy makers decide to target, recommendations will be very different. According to ex-post preferences, increases in income do matter, also in the long run, whereas for long-run satisfaction intensities this seems not to be the case.

The reference to the Easterlin Paradox raises another issue. The level measure allows to compare satisfaction levels at very different points in time and to plot charts in terms of cardinal levels. However, given that the level measure is a poor proxy for preference rankings even for two subsequent years, it is important to exercise great care in interpreting these charts, i.e. not to take them as representations of preferences. The ranking measure does not allow drawing the same types of charts. This draws attention to the fact that the ordinal concept of preference rankings requires a direct comparison of two states of the world. Hence, if states five or ten years apart are to be compared, corresponding questions need to be included in the survey. However, the issue of imperfect and potentially biased recollection of past states of the world might then be a more serious issue. The level measure obscures problems with comparability (even for subsequent periods) by using an absolute (cardinal) scale for a relative (ordinal) concept. While such comparisons might be enlightening for some

research questions and policy issues, their use and interpretation requires careful judgment by the analyst as not to be taken as indicators of preference rankings. The latter seem to be more reliably captured by the ranking measure of life satisfaction.

Knowing how people evaluate changes they have experienced is important for policy evaluation since this is both an essential input for many conventional welfare measures and, more practically, it is valuable information for policymakers in order to evaluate the acceptance of policy changes. In our view, the ranking measure is well suited to provide such insights.

Future research could compare the level and the ranking measure of life satisfaction in more detail shedding light on the differences in drivers, developments over time, and especially marginal rates of substitution for public goods (e.g. as in Anderson et al. 2016, Frey et al. 2004, Kopmann and Rehdanz 2013, Levinson 2012). This will further identify where the two measures and interpretations of life satisfaction differ and where a clear political decision for one of the target concepts needs to be made.

While we have focused attention on elicitation of preferences using life satisfaction data, many of the points raised and the potential to address them by using a direct measure of changes rather than within or between subject comparisons of levels, can also be transferred to many other variables elicited using Likert scales in (panel) surveys.

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**Appendix (For Online Publication)**

**A.1 Description of variables**

Here we describe the explanatory variables used in the regressions. The following variables[28] are available and summarised in Table A.1 and Table A.2:

**Table A.1** Summary Statistics of BHPS variables

| | (1) count | mean | sd | min | max |
|---|---|---|---|---|---|
| signdLM | 117244 | -.0148408 | .732213 | -1 | 1 |
| signRM | 117244 | .1101122 | .6397049 | -1 | 1 |
| difference | 117244 | .1249531 | .8655879 | -2 | 2 |
| female | 115413 | .5476419 | .4977272 | 0 | 1 |
| age | 115404 | 46.91606 | 18.12847 | 17 | 100 |
| change_fin_situation | 116830 | 2.041051 | .6940744 | 1 | 3 |
| hh_inc_month | 117244 | 2.676986 | 2.134119 | -.009 | 86.70329 |
| d_hh_inc_month | 117244 | .0820844 | 1.704277 | -65.97318 | 86.54298 |
| fin_trend3 | 116449 | 2.041383 | .461874 | 1 | 3 |
| inc_trend3 | 104883 | 2.351201 | .639902 | 1 | 3 |
| fin_trend3_lead | 85219 | 2.031789 | .4571693 | 1 | 3 |
| inc_trend3_lead | 104654 | 2.344583 | .6417428 | 1 | 3 |
| d_employment_status | 117203 | 2.100305 | 1.3621 | 1 | 6 |
| d_marital_status_legal | 116846 | 3.386466 | .6048385 | 1 | 4 |

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[28] The codebooks are available under http://www.gesis.org/unser-angebot/daten-erheben/gesis-panel/gesis-panel-data-usage/ and https://www.iser.essex.ac.uk/bhps/documentation/volb where we use the "individual-level data for respondents" in waves F to R except K.

**Table A.2** Summary Statistics of GESIS variables

|  | (1) | | | | |
| --- | --- | --- | --- | --- | --- |
|  | count | mean | sd | min | max |
| signdLM | 9553 | .0059667 | .8239416 | -1 | 1 |
| signRM | 9553 | .2788653 | .7277624 | -1 | 1 |
| difference | 9553 | .2728986 | .9995578 | -2 | 2 |
| female | 9553 | .5174291 | .4997223 | 0 | 1 |
| age | 9523 | 49.893 | 14.11716 | 20 | 74 |
| change_fin_situation | 9465 | 3.191337 | .8915453 | 1 | 5 |
| hh_income | 7812 | 3.185625 | 1.656383 | .45 | 7 |
| d_hh_inc | 6656 | .0282527 | 1.011679 | -6.55 | 6.55 |
| d_employment_status | 8604 | 1.900628 | 1.454252 | 1 | 6 |
| d_marital_status_legal | 8849 | 3.337326 | .600452 | 1 | 4 |

d_hh_income_month is the change in monthly household income from past to current year in 1,000 EUR for Gesis and 1,000 GBP for BHPS. In GESIS net monthly household income is computed from changes in reported categories of income ranges of which we took the middle value to describe the category. The question was: "`If you take a look at the total income from all members of the household: how high is the monthly average household income today? I.e. the sum of all incomes including pensions and social benefits? Please use the list below"'[29] There are 14 answer categories ranging from "`700 Euro and less"' to "`6000 Euro and more"'. In BHPS, the household monthly income is computed from household income in different categories (labour income, capital income...) that are asked separately. The answer scales for the subcategories are open.

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[29] The German original version is: "Wenn man nun die Einkünfte aller Mitglieder Ihres Haushalts zusammen nimmt: Wie hoch ist das durchschnittliche monatliche Nettoeinkommen aller Haushaltsmitglieder also die Summe aller Einkünfte einschließlich aller Bezüge und Sozialleistungen insgesamt? Benutzen Sie bitte wieder die Liste".

Change_fin_situation is a subjective evaluation of the change in financial situation. In GESIS, the question is: "In your opinion, has your Life improved or deteriorated in the following domains? Financial situation:"'[30]. There are five answer options: "Considerably improved", "Slightly improved", "Stayed the same", "Slightly deteriorated", "Considerably deteriorated" and "Don't know".

In BHPS, the question was "`Would you say that you yourself are better off or worse off financially than you were a year ago?"' and the answer options were "`Better off"', "`Worse off"', "`About the same"' and "`Don't know"'. In both GESIS and BHPS, the question about current employment status contains categories like employed part time, employed full time, unemployed, student, old-age pensioner, unable to work etc. We computed 6 categories for the change in employment situation d_employment_status depending on current and previous answer:

- *got unemployed*: switched to "`unemployed"' from any other category,
- *got employed*: switched to "`employed"' or "`part time employed"' from any other category,

_____

[30] German original: "Hat sich Ihr Leben Ihrer Meinung nach in den folgenden Bereichen in den letzten 12 Monaten verschlechtert oder verbessert? Finanzielle Situation:"

- *exit labour market*: switched from "`employed`" or "`unemployed`" or "`part time employed`" to any but those categories,

- *stayed employed*: was in any of the categories "`employed`" or "`part time employed`",

- *stayed unemployed*: stayed in "`unemployed`",

- *stayed out of labour market*: was in anything but "`employed`" or "`unemployed`" or "`part time employed`".

In both, GESIS and BHPS, marital status contains different categories like married, divorced, never married, widowed, and separated. We computed the 4 following categories of the change in marital status d_marital_status_legal:

- *got married*: switch to married from any other category,

- *marriage ended*: switch to divorced from any other category,

- *stayed married*: stayed in category married,

- *stayed not married*: stayed in any group or switch between these groups: divorced, widowed, separated.

To compute the trend in financial situation or in income for BHPS (in Gesis there are not enough waves in the panel yet) we computed fin_trend3 and

inc_trend3. They both are categorical variables with three categories computed for both change_fin_situation and d_hh_income_month:

- *Negative trend* if there was improvement in t and t-1

- *No trend* if there was anything else than positive or negative trend

- *Positive trend* if there was deterioration in t and t-1

For the expected trend inc_trend3_lead and fin_trend3_lead we used t+1 instead of t-1.

We also include gender and age.

**Lightspeed data:**

**LM1 and LM2:**

*We would like to ask you how you evaluate your life.*

*Everything taken together, how satisfied are you with your CURRENT life situation?*

*10 categories from "completely dissatisfied" to "completely satisfied", with "don't know" option.*

> *Im Folgenden würden wir gerne von Ihnen wissen, wie Sie Ihr Leben bewerten.*

*Alles in allem betrachtet, wie zufrieden sind Sie mit Ihrer*

***GEGENWÄRTIGEN*** *Lebenssituation?*

*Ganz und gar unzufrieden – Ganz und gar zufrieden, weiß nicht*

**LM1recall:**

*How well can you remember the answer you gave during the first*

*questionnaire 3 months ago concerning the satisfaction with your situation*

*back then?*

*I can remember exactly, it was:*

*I am not sure but I think it was:*

*I cannot remember.*

*Wie gut können Sie sich daran erinnern, welche Antwort Sie in der*

*ersten Befragung vor 3 Monaten bezüglich Ihrer Zufriedenheit mit*

*Ihrer damaligen Lebenssituation gegeben haben?*

*Ich kann mich genau erinnern, es war:*

*Ich bin mir nicht sicher, aber ich denke es war:*

*Ich kann mich nicht erinnern.*

**LM1reassess:**

*We would like to ask you how you evaluate your life AT THE TIME OF THE*

*FIRST QUESTIONNAIRE (beginning of August 2015).*

*Everything taken together, how satisfied were you with your life situation 3*

*months ago?*

> *Im Folgenden würden wir gerne von Ihnen wissen, wie Sie Ihr Leben*
>
> ***ZUM ZEITPUNKT DER ERSTEN BEFRAGUNG** (Anfang Juli*
>
> *2015) bewerten.*
>
> *Alles in allem betrachtet, wie zufrieden waren Sie mit Ihrer*
>
> *Lebenssituation vor 3 Monaten?*

**RM:**

*We would like to ask you how you evaluate the CHANGES in your life since*

*the first questionnaire (beginning of August 2015).*

*In your opinion, has your life as a whole since then improved or become*

*worse?*

*Please evaluate any changes from today's perspective.*

| Considerably deteriorated | Slightly deteriorated | Stayed the same | Slightly imporved | Considerably imporved | Don't know |
|---|---|---|---|---|---|
| | | | | | |

*Im Folgenden würden wir gerne von Ihnen wissen, wie Sie die*

***VERÄNDERUNGEN*** *Ihres Lebens seit der ersten Befragung*

*(Anfang Juli 2015) bewerten.*

*Hat sich Ihr Leben Ihrer Meinung nach in dieser Zeit insgesamt*

*verbessert oder verschlechtert?*

*Bewerten Sie die Veränderungen aus heutiger Sicht.*

| Deutlich verschlechtert | Leicht verschlechtert | Gleich geblieben | Leicht verbessert | Deutlich verbessert | Weiß nicht |
|---|---|---|---|---|---|

## A.2 Additional regression results

**Table A.3 Lightspeed: Ordered logit regressions on changes in perceived changes in socio-economic circumstances (Treatments: *Control* and *RecallExPost*).** Standard errors in parentheses. $^{*}$ p<0.05, $^{**}$p<0.01, $^{***}$p<0.001.

|  | (1) difference | (2) signdLM | (3) RM |
|---|---|---|---|
| Age | -0.0161$^{**}$ | 0.0120$^{*}$ | -0.0111 |
|  | (0.00551) | (0.00528) | (0.00653) |
| Female | 0.106 | -0.228 | -0.204 |
|  | (0.135) | (0.134) | (0.156) |
| ch_job | 0.372$^{**}$ | 0.161 | 1.151$^{***}$ |
|  | (0.126) | (0.141) | (0.200) |
| ch_money | 0.309$^{*}$ | 0.210 | 1.059$^{***}$ |
|  | (0.129) | (0.127) | (0.177) |
| ch_leisure | 0.380$^{*}$ | -0.160 | 0.565$^{**}$ |
|  | (0.167) | (0.141) | (0.208) |
| ch_relationship | 0.108 | 0.253 | 0.803$^{***}$ |
|  | (0.150) | (0.145) | (0.236) |
| ch_health | 0.176 | 0.155 | 0.689$^{***}$ |
|  | (0.152) | (0.148) | (0.204) |
| ch_family | 0.130 | 0.220 | 0.735$^{**}$ |
|  | (0.150) | (0.147) | (0.227) |
| ch_friends | -0.326 | 0.0218 | -0.598$^{**}$ |
|  | (0.178) | (0.154) | (0.232) |
| ch_neighbour | 0.0202 | 0.0658 | 0.182 |
|  | (0.160) | (0.159) | (0.249) |
| cut1, Constant | -4.289$^{***}$ | -0.357 | -3.028$^{***}$ |
|  | (0.354) | (0.261) | (0.363) |
| cut2, Constant | -1.818$^{***}$ | 1.254$^{***}$ | 0.973$^{**}$ |
|  | (0.281) | (0.264) | (0.346) |
| cut3, Constant | 0.0761 |  |  |
|  | (0.274) |  |  |
| cut4, Constant | 2.139$^{***}$ |  |  |
|  | (0.303) |  |  |
| Observations | 794 | 795 | 796 |
| r2_p | 0.0313 | 0.0168 | 0.245 |
| p | 5.98e-09 | 0.00311 | 1.26e-30 |

**Table A.4a. BHPS: Regressions on key socio-economic variables (financial situation) without lags.** Variable description in Appendix A.1. Results from pooled OLS and fixed effects regressions including year fixed effects. Standard errors in parentheses. $^{*}$ p<0.05, $^{**}$p<0.01, $^{***}$p<0.001.

| | (1)<br>deviation OLS | (2)<br>signdLM OLS | (3)<br>signRM OLS | (4)<br>signRM FE |
|---|---|---|---|---|
| female | 0.0171$^{**}$ | 0.00406 | 0.0212$^{***}$ | 0 |
| | (0.00554) | (0.00284) | (0.00510) | (.) |
| age | -0.0232$^{***}$ | 0.00622$^{***}$ | -0.0170$^{***}$ | -0.0106 |
| | (0.000929) | (0.000530) | (0.000832) | (0.0233) |
| age$^2$ | 0.000171$^{***}$ | -0.0000555$^{***}$ | 0.000115$^{***}$ | 0.00000305 |
| | (0.00000925) | (0.00000532) | (0.00000823) | (0.0000181) |
| change_fin_situation | 0.132$^{***}$ | 0.0689$^{***}$ | 0.201$^{***}$ | 0.162$^{***}$ |
| | (0.00402) | (0.00309) | (0.00341) | (0.00292) |
| stayed unemployed | -0.204$^{***}$ | 0.0353 | -0.169$^{***}$ | -0.0996$^{***}$ |
| | (0.0263) | (0.0189) | (0.0209) | (0.0232) |
| stayed out of labour market | -0.0448$^{***}$ | 0.00543 | -0.0393$^{***}$ | 0.0227$^{**}$ |
| | (0.00752) | (0.00430) | (0.00673) | (0.00876) |
| got employed | -0.00485 | 0.0612$^{***}$ | 0.0563$^{***}$ | 0.0821$^{***}$ |
| | (0.0132) | (0.0113) | (0.0100) | (0.00964) |
| got unemployed | -0.0861$^{***}$ | -0.0960$^{***}$ | -0.182$^{***}$ | -0.114$^{***}$ |
| | (0.0206) | (0.0174) | (0.0164) | (0.0148) |
| exited labour market | 0.0469$^{***}$ | 0.0472$^{***}$ | 0.0941$^{***}$ | 0.110$^{***}$ |
| | (0.0139) | (0.0116) | (0.0111) | (0.0103) |
| got married | 0.205$^{***}$ | 0.0513$^{**}$ | 0.257$^{***}$ | 0.122$^{***}$ |
| | (0.0193) | (0.0162) | (0.0146) | (0.0147) |
| marriage ended | -0.110$^{***}$ | -0.0228 | -0.133$^{***}$ | -0.196$^{***}$ |
| | (0.0266) | (0.0242) | (0.0235) | (0.0187) |
| stayed married | 0.0163$^{**}$ | -0.0209$^{***}$ | -0.00459 | -0.116$^{***}$ |
| | (0.00621) | (0.00333) | (0.00571) | (0.0101) |
| Year dummies | yes | yes | yes | yes |
| Constant | 0.507$^{***}$ | -0.290$^{***}$ | 0.218$^{***}$ | 0.327 |
| | (0.0250) | (0.0166) | (0.0216) | (0.948) |
| Observations | 114568 | 114568 | 114568 | 114568 |
| $R^2$ | 0.046 | 0.008 | 0.107 | 0.049 |
| Adjusted $R^2$ | 0.045 | 0.008 | 0.107 | -0.175 |
| *AIC* | 286652.3 | 252794.3 | 209947.1 | 163799.3 |
| *BIC* | 286864.6 | 253006.5 | 210159.3 | 164001.9 |

**Table A.4b. BHPS: Regressions on key socio-economic variables (income) without lags.** Variable description in Appendix A.1. Results from pooled OLS and fixed effects regressions including year fixed effects. Standard errors in parentheses. $^*$ p<0.05, $^{**}$p<0.01, $^{***}$p<0.001.

| | (1) deviation OLS | (2) signdLM OLS | (3) signRM OLS | (4) signRM FE |
|---|---|---|---|---|
| female | 0.0154$^{**}$ | 0.00323 | 0.0186$^{***}$ | 0 |
| | (0.00568) | (0.00283) | (0.00533) | (.) |
| age | -0.0262$^{***}$ | 0.00454$^{***}$ | -0.0216$^{***}$ | -0.00448 |
| | (0.000940) | (0.000524) | (0.000855) | (0.0237) |
| age$^2$ | 0.000194$^{***}$ | -0.0000415$^{***}$ | 0.000153$^{***}$ | 0.0000305 |
| | (0.00000937) | (0.00000527) | (0.00000845) | (0.0000183) |
| d_hh_inc_month | -0.000520 | 0.00310$^*$ | 0.00258$^*$ | 0.00232$^*$ |
| | (0.00156) | (0.00153) | (0.00103) | (0.00103) |
| stayed unemployed | -0.250$^{***}$ | 0.0129 | -0.237$^{***}$ | -0.172$^{***}$ |
| | (0.0265) | (0.0190) | (0.0215) | (0.0235) |
| stayed out of labour market | -0.0705$^{***}$ | -0.00797 | -0.0784$^{***}$ | -0.0157 |
| | (0.00761) | (0.00424) | (0.00692) | (0.00886) |
| got employed | 0.0145 | 0.0695$^{***}$ | 0.0840$^{***}$ | 0.102$^{***}$ |
| | (0.0133) | (0.0113) | (0.0104) | (0.00978) |
| got unemployed | -0.163$^{***}$ | -0.132$^{***}$ | -0.295$^{***}$ | -0.209$^{***}$ |
| | (0.0205) | (0.0174) | (0.0170) | (0.0149) |
| exited labour market | -0.00545 | 0.0207 | 0.0152 | 0.0461$^{***}$ |
| | (0.0138) | (0.0116) | (0.0111) | (0.0104) |
| got married | 0.207$^{***}$ | 0.0524$^{**}$ | 0.260$^{***}$ | 0.123$^{***}$ |
| | (0.0193) | (0.0163) | (0.0148) | (0.0149) |
| marriage ended | -0.153$^{***}$ | -0.0401 | -0.193$^{***}$ | -0.243$^{***}$ |
| | (0.0265) | (0.0241) | (0.0240) | (0.0189) |
| stayed married | 0.0121 | -0.0223$^{***}$ | -0.0102 | -0.124$^{***}$ |
| | (0.00636) | (0.00332) | (0.00594) | (0.0103) |
| Year dummies | yes | yes | yes | yes |
| Constant | 0.877$^{***}$ | -0.0953$^{***}$ | 0.781$^{***}$ | 0.388 |
| | (0.0226) | (0.0142) | (0.0198) | (0.964) |
| Observations | 114980 | 114980 | 114980 | 114980 |
| $R^2$ | 0.035 | 0.004 | 0.064 | 0.018 |
| Adjusted $R^2$ | 0.035 | 0.004 | 0.064 | -0.214 |
| *AIC* | 288942.9 | 254197.4 | 216222.7 | 168243.2 |
| *BIC* | 289155.3 | 254409.7 | 216435.0 | 168445.9 |

**Table A.5a. BHPS: Regressions on key socio-economic variables (financial situation) including only the three first years of the panel, making it comparable to the current time horizon of GESIS.** Variable description in Appendix A.1. Results from pooled OLS and fixed effects regressions including year fixed effects. Standard errors in parentheses. $^{*}$ $p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$.

| | (1) deviation OLS | (2) signdLM OLS | (3) signRM OLS | (4) signRM FE |
|---|---|---|---|---|
| female | 0.00461 | 0.00857 | 0.0132 | 0 |
| | (0.0126) | (0.00940) | (0.0104) | (.) |
| age | -0.0219$^{***}$ | 0.00483$^{**}$ | -0.0171$^{***}$ | -0.0198 |
| | (0.00232) | (0.00174) | (0.00183) | (0.0264) |
| age$^2$ | 0.000175$^{***}$ | -0.0000539$^{**}$ | 0.000121$^{***}$ | -0.000124 |
| | (0.0000229) | (0.0000174) | (0.0000177) | (0.000264) |
| **change_fin_situation** | **0.101$^{***}$** | **0.0821$^{***}$** | **0.184$^{***}$** | **0.162$^{***}$** |
| | (0.00998) | (0.00862) | (0.00799) | (0.0118) |
| **L.change_fin_situation** | **0.100$^{***}$** | **-0.0591$^{***}$** | **0.0411$^{***}$** | **0.00365** |
| | (0.00963) | (0.00842) | (0.00750) | (0.0120) |
| stayed unemployed | -0.114 | -0.000554 | -0.115$^{*}$ | -0.177 |
| | (0.0663) | (0.0577) | (0.0550) | (0.116) |
| stayed out of labour market | -0.0216 | -0.00405 | -0.0257 | 0.0146 |
| | (0.0189) | (0.0143) | (0.0151) | (0.0684) |
| **got employed** | **0.0255** | **0.0917$^{**}$** | **0.117$^{***}$** | **0.160$^{**}$** |
| | (0.0363) | (0.0325) | (0.0275) | (0.0560) |
| **lag got employed** | **0.0311** | **0.0190** | **0.0501$^{*}$** | **0.0248** |
| | (0.0316) | (0.0280) | (0.0240) | (0.0397) |
| **got unemployed** | **-0.0618** | **-0.0774** | **-0.139$^{**}$** | **-0.0947** |
| | (0.0547) | (0.0483) | (0.0463) | (0.0699) |
| **lag got unemployed** | **-0.0645** | **0.0118** | **-0.0527** | **-0.0619** |
| | (0.0572) | (0.0517) | (0.0439) | (0.0666) |
| **exited labour market** | **0.103$^{**}$** | **0.0278** | **0.131$^{***}$** | **0.170$^{***}$** |
| | (0.0359) | (0.0318) | (0.0289) | (0.0456) |
| **lag exited labour market** | **0.142$^{***}$** | **-0.0633** | **0.0783$^{**}$** | **0.0225** |
| | (0.0378) | (0.0328) | (0.0271) | (0.0454) |
| **got married** | **0.237$^{***}$** | **0.0352** | **0.272$^{***}$** | **0.107** |
| | (0.0520) | (0.0449) | (0.0392) | (0.0694) |
| **lag got married** | **0.119$^{*}$** | **0.0570** | **0.176$^{***}$** | **0.210$^{***}$** |
| | (0.0511) | (0.0417) | (0.0380) | (0.0629) |
| **marriage ended** | **-0.156$^{**}$** | **-0.00368** | **-0.159$^{**}$** | **-0.300$^{**}$** |
| | (0.0593) | (0.0565) | (0.0544) | (0.0949) |
| **lag marriage ended** | **-0.0802** | **0.117$^{*}$** | **0.0370** | **-0.0799** |
| | (0.0621) | (0.0556) | (0.0477) | (0.0728) |
| stayed married | -0.0372$^{*}$ | 0.00653 | -0.0307$^{*}$ | -0.289$^{**}$ |
| | (0.0148) | (0.0112) | (0.0121) | (0.0992) |
| Year dummies | Yes (3 years) | Yes (3 years) | Yes (3 years) | Yes (3 years) |
| Constant | 0.273$^{***}$ | -0.112$^{*}$ | 0.161$^{**}$ | 1.156 |
| | (0.0620) | (0.0463) | (0.0510) | (0.653) |
| Observations | 16426 | 16426 | 16426 | 16426 |
| $R^2$ | 0.050 | 0.017 | 0.112 | 0.046 |
| Adjusted $R^2$ | 0.049 | 0.016 | 0.111 | -1.231 |
| AIC | 40450.0 | 36069.9 | 29755.0 | 12099.0 |
| BIC | 40604.2 | 36224.0 | 29909.1 | 12237.7 |

**Table A.5b. BHPS: Regressions on key socio-economic variables (income) including only the three first years of the panel, making it comparable to the current time horizon of GESIS.** Variable description in Appendix A.1. Results from pooled OLS and fixed effects regressions including year fixed effects. Standard errors in parentheses. $^*$ p<0.05, $^{**}$p<0.01, $^{***}$p<0.001.

| | (1) deviation OLS | (2) signdLM OLS | (3) signRM OLS | (4) signRM FE |
|---|---|---|---|---|
| female | 0.00271 | 0.00892 | 0.0116 | 0 |
| | (0.0128) | (0.00940) | (0.0107) | (.) |
| age | -0.0261$^{***}$ | 0.00423$^*$ | -0.0219$^{***}$ | -0.0197 |
| | (0.00232) | (0.00173) | (0.00186) | (0.0267) |
| age$^2$ | 0.000207$^{***}$ | -0.0000477$^{**}$ | 0.000160$^{***}$ | -0.000136 |
| | (0.0000230) | (0.0000173) | (0.0000180) | (0.000268) |
| d_hh_inc_month | 0.00252 | 0.00174 | 0.00426 | 0.00206 |
| | (0.00394) | (0.00377) | (0.00287) | (0.00380) |
| L.d_hh_inc_month | 0.000442 | 0.000271 | 0.000713 | -0.00325 |
| | (0.00401) | (0.00347) | (0.00290) | (0.00466) |
| stayed unemployed | -0.187$^{**}$ | -0.0107 | -0.198$^{***}$ | -0.216 |
| | (0.0659) | (0.0585) | (0.0563) | (0.116) |
| stayed out of labour market | -0.0645$^{***}$ | -0.0113 | -0.0758$^{***}$ | -0.0478 |
| | (0.0189) | (0.0141) | (0.0153) | (0.0690) |
| got employed | 0.00764 | 0.121$^{***}$ | 0.129$^{***}$ | 0.180$^{**}$ |
| | (0.0364) | (0.0327) | (0.0285) | (0.0566) |
| lag got employed | 0.0548 | 0.0121 | 0.0668$^{**}$ | 0.0393 |
| | (0.0321) | (0.0282) | (0.0249) | (0.0403) |
| got unemployed | -0.138$^*$ | -0.105$^*$ | -0.243$^{***}$ | -0.181$^*$ |
| | (0.0545) | (0.0489) | (0.0480) | (0.0705) |
| lag got unemployed | -0.0920 | 0.0306 | -0.0614 | -0.0518 |
| | (0.0583) | (0.0523) | (0.0458) | (0.0675) |
| exited labour market | 0.0468 | 0.00380 | 0.0506 | 0.103$^*$ |
| | (0.0358) | (0.0316) | (0.0293) | (0.0458) |
| lag exited labour market | 0.112$^{**}$ | -0.0514 | 0.0604$^*$ | 0.0223 |
| | (0.0379) | (0.0326) | (0.0273) | (0.0457) |
| got married | 0.253$^{***}$ | 0.0345 | 0.288$^{***}$ | 0.100 |
| | (0.0522) | (0.0452) | (0.0400) | (0.0699) |
| lag got married | 0.116$^*$ | 0.0510 | 0.167$^{***}$ | 0.180$^{**}$ |
| | (0.0513) | (0.0419) | (0.0389) | (0.0637) |
| marriage ended | -0.195$^{**}$ | -0.0297 | -0.225$^{***}$ | -0.373$^{***}$ |
| | (0.0601) | (0.0565) | (0.0570) | (0.0960) |
| lag marriage ended | -0.123 | 0.123$^*$ | 0.0000408 | -0.122 |
| | (0.0630) | (0.0553) | (0.0492) | (0.0736) |
| stayed married | -0.0351$^*$ | 0.00698 | -0.0281$^*$ | -0.280$^{**}$ |
| | (0.0150) | (0.0111) | (0.0124) | (0.100) |
| Year dummies | Yes (3 years) | Yes (3 years) | Yes (3 years) | Yes (3 years) |
| Constant | 0.824$^{***}$ | -0.0509 | 0.773$^{***}$ | 1.543$^*$ |
| | (0.0528) | (0.0391) | (0.0426) | (0.658) |
| Observations | 16506 | 16506 | 16506 | 16506 |
| $R^2$ | 0.034 | 0.010 | 0.067 | 0.015 |
| Adjusted $R^2$ | 0.033 | 0.009 | 0.066 | -1.299 |
| AIC | 40931.4 | 36359.6 | 30748.7 | 12757.2 |
| BIC | 41085.6 | 36513.8 | 30902.9 | 12896.0 |

**Table A.6. GESIS: Regressions on key socio-economic variables (income).** Variable description in Appendix A.1. Results from pooled OLS and fixed effects regressions including year fixed effects. Standard errors in parentheses. $^*$ $p<0.05$, $^{**}p<0.01$, $^{***}p<0.001$.

| | (1) deviation OLS | (2) signdLM OLS | (3) signRM OLS | (4) signRM FE |
|---|---|---|---|---|
| female | -0.0374 | 0.00256 | -0.0349 | 0 |
| | (0.0318) | (0.0236) | (0.0266) | (.) |
| age | -0.0280$^*$ | 0.00232 | -0.0257$^{**}$ | -0.0796 |
| | (0.0114) | (0.00879) | (0.00939) | (0.102) |
| age$^2$ | 0.000188 | -0.0000316 | 0.000156 | 0.000643 |
| | (0.000116) | (0.0000890) | (0.0000960) | (0.000951) |
| **d_hh_inc** | **0.0318** | **0.00866** | **0.0405$^{**}$** | **0.0403$^*$** |
| | (0.0199) | (0.0170) | (0.0140) | (0.0186) |
| **L.d_hh_inc** | **0.0215** | **0.00218** | **0.0236** | **0.0154** |
| | (0.0173) | (0.0147) | (0.0133) | (0.0170) |
| stayed unemployed | -0.106 | -0.516$^{**}$ | -0.623$^{**}$ | -0.440 |
| | (0.277) | (0.177) | (0.214) | (0.430) |
| stayed out of labour market | -0.179$^{**}$ | 0.0368 | -0.142$^{**}$ | -0.0884 |
| | (0.0567) | (0.0428) | (0.0461) | (0.179) |
| **got employed** | **0.0480** | **-0.0862** | **-0.0382** | **-0.212** |
| | (0.0960) | (0.0784) | (0.0726) | (0.144) |
| **lag got employed** | **0.0713** | **0.0276** | **0.0989** | **0.0864** |
| | (0.0777) | (0.0667) | (0.0548) | (0.0935) |
| **got unemployed** | **-0.343** | **0.0343** | **-0.309$^*$** | **-0.454$^*$** |
| | (0.185) | (0.149) | (0.150) | (0.217) |
| **lag got unemployed** | **-0.0303** | **0.0523** | **0.0221** | **-0.0401** |
| | (0.222) | (0.179) | (0.159) | (0.241) |
| **exited labour market** | **-0.0492** | **0.0432** | **-0.00595** | **-0.0195** |
| | (0.0859) | (0.0666) | (0.0644) | (0.106) |
| **lag exited labour market** | **0.116** | **-0.00752** | **0.108** | **0.0726** |
| | (0.0845) | (0.0699) | (0.0614) | (0.110) |
| **got married** | **0.00865** | **0.0611** | **0.0698** | **-0.185** |
| | (0.149) | (0.125) | (0.108) | (0.207) |
| **lag got married** | **0.0222** | **0.0794** | **0.102** | **0.0267** |
| | (0.114) | (0.0995) | (0.0846) | (0.134) |
| **marriage ended** | **0.0473** | **0.0365** | **0.0838** | **0.0593** |
| | (0.166) | (0.128) | (0.120) | (0.225) |
| **lag marriage ended** | **-0.00834** | **0.0705** | **0.0621** | **0.158** |
| | (0.137) | (0.108) | (0.104) | (0.165) |
| stayed married | -0.0319 | -0.0120 | -0.0440 | -0.301 |
| | (0.0410) | (0.0323) | (0.0335) | (0.254) |
| Year dummies | yes | yes | yes | yes |
| Constant | 1.308$^{***}$ | -0.0595 | 1.248$^{***}$ | 2.827 |
| | (0.268) | (0.210) | (0.220) | (2.703) |
| Observations | 3442 | 3442 | 3442 | 3442 |
| $R^2$ | 0.032 | 0.005 | 0.064 | 0.018 |
| Adjusted $R^2$ | 0.027 | -0.001 | 0.059 | -1.535 |
| *AIC* | 9486.4 | 8260.7 | 7301.9 | 2899.1 |
| *BIC* | 9609.3 | 8383.6 | 7424.8 | 3009.7 |

**Table A.7. BHPS: Regressions on key socio-economic variables (financial situation).**
Variable description in Appendix A.1. Results from **ordered logistic regressions** including year fixed effects. Standard errors in parentheses. $^*$ p<0.05, $^{**}$p<0.01, $^{***}$p<0.001.

| | (1) deviation | (2) signdLM | (3) signRM |
|---|---|---|---|
| female | 0.0366$^{**}$ | 0.00695 | 0.0758$^{***}$ |
| | (0.0132) | (0.0133) | (0.0142) |
| age | -0.0469$^{***}$ | 0.0123$^{***}$ | -0.0586$^{***}$ |
| | (0.00236) | (0.00237) | (0.00253) |
| age$^2$ | 0.000354$^{***}$ | -0.000119$^{***}$ | 0.000410$^{***}$ |
| | (0.0000233) | (0.0000235) | (0.0000248) |
| **change_fin_situation** | **0.226$^{***}$** | **0.222$^{***}$** | **0.655$^{***}$** |
| | (0.0100) | (0.0101) | (0.0113) |
| **L.change_fin_situation** | **0.230$^{***}$** | **-0.156$^{***}$** | **0.154$^{***}$** |
| | (0.0101) | (0.0101) | (0.0110) |
| stayed unemployed | -0.271$^{***}$ | -0.0340 | -0.435$^{***}$ |
| | (0.0728) | (0.0742) | (0.0782) |
| stayed out of labour market | -0.0821$^{***}$ | 0.00896 | -0.121$^{***}$ |
| | (0.0190) | (0.0191) | (0.0204) |
| **got employed** | **0.113$^{**}$** | **0.115$^{**}$** | **0.378$^{***}$** |
| | (0.0380) | (0.0384) | (0.0417) |
| **lag got employed** | **0.0417** | **0.0120** | **0.0910$^*$** |
| | (0.0329) | (0.0330) | (0.0358) |
| **got unemployed** | **-0.198$^{***}$** | **-0.264$^{***}$** | **-0.648$^{***}$** |
| | (0.0514) | (0.0527) | (0.0570) |
| **lag got unemployed** | **-0.356$^{***}$** | **0.147$^*$** | **-0.353$^{***}$** |
| | (0.0573) | (0.0584) | (0.0626) |
| exited labour market | 0.166$^{***}$ | 0.111$^{**}$ | 0.419$^{***}$ |
| | (0.0356) | (0.0360) | (0.0397) |
| lag exited labour market | 0.246$^{***}$ | -0.103$^{**}$ | 0.234$^{***}$ |
| | (0.0365) | (0.0365) | (0.0395) |
| **got married** | **0.427$^{***}$** | **0.139$^{**}$** | **0.861$^{***}$** |
| | (0.0509) | (0.0507) | (0.0566) |
| **lag got married** | **0.434$^{***}$** | **-0.0792** | **0.547$^{***}$** |
| | (0.0515) | (0.0512) | (0.0562) |
| **marriage ended** | **-0.308$^{***}$** | **-0.0668** | **-0.609$^{***}$** |
| | (0.0664) | (0.0694) | (0.0763) |
| **lag marriage ended** | **-0.112** | **0.249$^{***}$** | **0.155$^*$** |
| | (0.0643) | (0.0654) | (0.0699) |
| stayed married | -0.0000336 | -0.0234 | -0.0439$^{**}$ |
| | (0.0151) | (0.0152) | (0.0163) |
| Year dummies | yes | yes | yes |
| Cut1, Constant | -3.975$^{***}$ | -0.720$^{***}$ | -1.971$^{***}$ |
| | (0.0695) | (0.0668) | (0.0721) |
| Cut 2,Constant | -1.592$^{***}$ | 1.339$^{***}$ | 1.044$^{***}$ |
| | (0.0666) | (0.0669) | (0.0720) |
| Cut3, Constant | 0.505$^{***}$ | | |
| | (0.0664) | | |
| Cut4, Constant | 2.889$^{***}$ | | |
| | (0.0680) | | |
| Observations | 83533 | 83533 | 83533 |

| | | | |
|---|---|---|---|
| Percent correctly predicted | | 0.414 | 0.520 |
| Log likelihood | -103336.9 | -87923.9 | -74544.3 |
| chi2 | 4253.6 | 1004.5 | 10233.9 |
| chi2type | LR | LR | LR |
| df_m | 25 | 25 | 25 |
| p | 0 | 6.47e-196 | 0 |

**Table A.8. Deviation between measures on direction of change and trends in financial situation using leads instead of lags to capture expected trends (BHPS).** Description of variables given in Appendix A.1. Results from pooled OLS regression including year fixed effects. Standard errors in parentheses. * p<0.05, **p<0.01, ***p<0.001.

| | (1) deviation | |
|---|---|---|
| female | 0.0186** | (0.00700) |
| age | -0.0208*** | (0.00126) |
| age$^2$ | 0.000160*** | (0.0000125) |
| | | |
| financial deterioration | -0.0491*** | (0.0114) |
| Lag financial deterioration | -0.0985*** | (0.00930) |
| Lag financial improvement | 0.0977*** | (0.00879) |
| financial improvement | 0.132*** | (0.0105) |
| | | |
| **negative trend (lead)** | **-0.0219** | **(0.0152)** |
| **positive trend (lead)** | **0.0329*** | **(0.0136)** |
| | | |
| stayed unemployed | -0.0891* | (0.0388) |
| stayed out of labour market | -0.0412*** | (0.0100) |
| got employed | 0.0369 | (0.0199) |
| got unemployed | -0.0893** | (0.0275) |
| exited labour market | 0.0562** | (0.0187) |
| lag got employed | 0.0191 | (0.0174) |
| lag got unemployed | -0.138*** | (0.0297) |
| lag exited labour market | 0.114*** | (0.0191) |
| got married | 0.212*** | (0.0264) |
| marriage ended | -0.162*** | (0.0340) |
| stayed married | 0.00147 | (0.00797) |
| lag got married | 0.173*** | (0.0269) |
| lag marriage ended | -0.0389 | (0.0335) |
| Year dummies | yes | |
| Constant | 0.621*** | (0.0312) |
| Observations | 60133 | |
| $R^2$ | 0.049 | |
| Adjusted $R^2$ | 0.049 | |
| *AIC* | 148716.0 | |
| *BIC* | 148968.1 | |

**Table A.9. BHPS: Regressions on key socio-economic variables (log of income).**
Variable description in Appendix A.1. Results from pooled OLS and fixed effects regressions including year fixed effects. Standard errors in parentheses. $^*$ p<0.05, $^{**}$p<0.01, $^{***}$p<0.001.

| | (1) deviation OLS | (2) signdLM OLS | (3) signRM OLS | (4) signRM FE |
|---|---|---|---|---|
| female | 0.0156$^*$ | 0.00232 | 0.0179$^{**}$ | 0 |
| | (0.00637) | (0.00338) | (0.00594) | (.) |
| age | -0.0252$^{***}$ | 0.00403$^{***}$ | -0.0212$^{***}$ | -0.0133 |
| | (0.00111) | (0.000648) | (0.000997) | (0.0331) |
| age$^2$ | 0.000191$^{***}$ | -0.0000402$^{***}$ | 0.000151$^{***}$ | 0.0000181 |
| | (0.0000109) | (0.00000642) | (0.00000968) | (0.0000235) |
| **d_log_hh_inc_month** | **0.00728** | **0.00867** | **0.0159$^{***}$** | **0.0173$^{***}$** |
| | (0.00545) | (0.00493) | (0.00431) | (0.00398) |
| **L.d_log_hh_inc_month** | **0.0126$^*$** | **-0.00974$^*$** | **0.00283** | **0.00302** |
| | (0.00552) | (0.00490) | (0.00424) | (0.00400) |
| stayed unemployed | -0.173$^{***}$ | -0.0282 | -0.201$^{***}$ | -0.165$^{***}$ |
| | (0.0339) | (0.0251) | (0.0290) | (0.0336) |
| stayed out of labour market | -0.0827$^{***}$ | -0.0000113 | -0.0827$^{***}$ | -0.00344 |
| | (0.00902) | (0.00517) | (0.00817) | (0.0123) |
| **got employed** | **0.0389$^*$** | **0.0694$^{***}$** | **0.108$^{***}$** | **0.135$^{***}$** |
| | (0.0178) | (0.0151) | (0.0141) | (0.0143) |
| **lag got employed** | **0.0360$^*$** | **0.00525** | **0.0412$^{***}$** | **0.0483$^{***}$** |
| | (0.0155) | (0.0131) | (0.0121) | (0.0118) |
| **got unemployed** | **-0.164$^{***}$** | **-0.124$^{***}$** | **-0.289$^{***}$** | **-0.205$^{***}$** |
| | (0.0254) | (0.0217) | (0.0211) | (0.0191) |
| **lag got unemployed** | **-0.194$^{***}$** | **0.0785$^{***}$** | **-0.115$^{***}$** | **-0.0621$^{**}$** |
| | (0.0280) | (0.0238) | (0.0216) | (0.0205) |
| **exited labour market** | **0.0210** | **0.0173** | **0.0383$^{**}$** | **0.0757$^{***}$** |
| | (0.0168) | (0.0142) | (0.0135) | (0.0129) |
| **lag exited labour market** | **0.0835$^{***}$** | **-0.0373$^{**}$** | **0.0462$^{***}$** | **0.0295$^*$** |
| | (0.0171) | (0.0143) | (0.0129) | (0.0129) |
| **got married** | **0.200$^{***}$** | **0.0527$^{**}$** | **0.253$^{***}$** | **0.115$^{***}$** |
| | (0.0233) | (0.0195) | (0.0177) | (0.0183) |
| **lag got married** | **0.198$^{***}$** | **-0.0365** | **0.162$^{***}$** | **0.153$^{***}$** |
| | (0.0237) | (0.0199) | (0.0184) | (0.0181) |
| **marriage ended** | **-0.186$^{***}$** | **-0.0389** | **-0.225$^{***}$** | **-0.301$^{***}$** |
| | (0.0317) | (0.0289) | (0.0284) | (0.0238) |
| **lag marriage ended** | **-0.0823$^{**}$** | **0.0970$^{***}$** | **0.0147** | **-0.0397** |
| | (0.0316) | (0.0266) | (0.0236) | (0.0224) |
| stayed married | -0.00820 | -0.00946$^*$ | -0.0177$^{**}$ | -0.186$^{***}$ |
| | (0.00729) | (0.00404) | (0.00674) | (0.0140) |
| Year dummies | yes | yes | yes | yes |
| Constant | 0.808$^{***}$ | -0.0483$^{**}$ | 0.760$^{***}$ | 0.795 |
| | (0.0267) | (0.0168) | (0.0236) | (1.391) |
| Observations | 82908 | 82908 | 82908 | 82908 |
| $R^2$ | 0.036 | 0.005 | 0.064 | 0.020 |
| Adjusted $R^2$ | 0.035 | 0.005 | 0.064 | -0.262 |
| AIC | 206721.6 | 182117.6 | 154677.8 | 116036.7 |
| BIC | 206964.0 | 182360.0 | 154920.3 | 116269.8 |

**Table A.10. BHPS: Regressions on key socio-economic variables (financial situation) excluding observations where the current LM is either 1 or 7.** Variable description in Appendix A.1. Results from pooled OLS and fixed effects regressions including year fixed effects. Standard errors in parentheses. $^{*}$ p<0.05, $^{**}$p<0.01, $^{***}$p<0.001.

| | (1) deviation OLS | (2) signdLM OLS | (3) signRM OLS | (4) signRM FE |
|---|---|---|---|---|
| female | 0.0222$^{**}$ | -0.00645 | 0.0158$^{**}$ | 0 |
| | (0.00703) | (0.00421) | (0.00596) | (.) |
| age | -0.0243$^{***}$ | 0.0102$^{***}$ | -0.0141$^{***}$ | -0.0131 |
| | (0.00129) | (0.000833) | (0.00103) | (0.0374) |
| age$^2$ | 0.000200$^{***}$ | -0.000115$^{***}$ | 0.0000844$^{***}$ | -0.0000260 |
| | (0.0000129) | (0.00000849) | (0.0000100) | (0.0000271) |
| **change_fin_situation** | **0.115**$^{***}$ | **0.0746**$^{***}$ | **0.189**$^{***}$ | **0.170**$^{***}$ |
| | (0.00513) | (0.00425) | (0.00411) | (0.00385) |
| **L.change_fin_situation** | **0.111**$^{***}$ | **-0.0736**$^{***}$ | **0.0376**$^{***}$ | **0.0161**$^{***}$ |
| | (0.00507) | (0.00426) | (0.00379) | (0.00385) |
| stayed unemployed | -0.0968$^{*}$ | -0.0519 | -0.149$^{***}$ | -0.0863$^{*}$ |
| | (0.0377) | (0.0281) | (0.0289) | (0.0369) |
| stayed out of labour market | -0.0362$^{***}$ | -0.00166 | -0.0379$^{***}$ | 0.0428$^{**}$ |
| | (0.0103) | (0.00660) | (0.00830) | (0.0137) |
| **got employed** | **0.0605**$^{**}$ | **0.0303** | **0.0908**$^{***}$ | **0.124**$^{***}$ |
| | (0.0191) | (0.0160) | (0.0147) | (0.0156) |
| **lag got employed** | **0.0218** | **0.00142** | **0.0232** | **0.0405**$^{**}$ |
| | (0.0163) | (0.0137) | (0.0124) | (0.0127) |
| **got unemployed** | **-0.0978**$^{***}$ | **-0.0913**$^{***}$ | **-0.189**$^{***}$ | **-0.124**$^{***}$ |
| | (0.0274) | (0.0228) | (0.0212) | (0.0206) |
| **lag got unemployed** | **-0.169**$^{***}$ | **0.0756**$^{**}$ | **-0.0933**$^{***}$ | **-0.0542**$^{*}$ |
| | (0.0302) | (0.0253) | (0.0223) | (0.0224) |
| **exited labour market** | **0.0946**$^{***}$ | **0.0278** | **0.122**$^{***}$ | **0.153**$^{***}$ |
| | (0.0187) | (0.0155) | (0.0145) | (0.0144) |
| **lag exited labour market** | **0.117**$^{***}$ | **-0.0414**$^{**}$ | **0.0754**$^{***}$ | **0.0424**$^{**}$ |
| | (0.0191) | (0.0157) | (0.0137) | (0.0144) |
| **got married** | **0.205**$^{***}$ | **0.0206** | **0.226**$^{***}$ | **0.104**$^{***}$ |
| | (0.0255) | (0.0209) | (0.0190) | (0.0201) |
| **lag got married** | **0.192**$^{***}$ | **-0.0437**$^{*}$ | **0.149**$^{***}$ | **0.148**$^{***}$ |
| | (0.0257) | (0.0213) | (0.0194) | (0.0199) |
| **marriage ended** | **-0.139**$^{***}$ | **-0.0115** | **-0.151**$^{***}$ | **-0.235**$^{***}$ |
| | (0.0338) | (0.0304) | (0.0298) | (0.0260) |
| **lag marriage ended** | **-0.0494** | **0.0971**$^{***}$ | **0.0477** | **-0.00475** |
| | (0.0341) | (0.0290) | (0.0247) | (0.0246) |
| stayed married | 0.00380 | -0.0292$^{***}$ | -0.0254$^{***}$ | -0.185$^{***}$ |
| | (0.00808) | (0.00497) | (0.00681) | (0.0152) |
| Year dummies | yes | yes | yes | yes |
| Constant | 0.276$^{***}$ | -0.197$^{***}$ | 0.0785$^{**}$ | 0.422 |
| | (0.0350) | (0.0236) | (0.0287) | (1.517) |
| Observations | 71449 | 71449 | 71449 | 71449 |
| $R^2$ | 0.051 | 0.016 | 0.110 | 0.055 |
| Adjusted $R^2$ | 0.050 | 0.015 | 0.110 | -0.252 |
| *AIC* | 180607.9 | 157794.0 | 131606.7 | 99764.0 |
| *BIC* | 180846.5 | 158032.6 | 131845.3 | 99993.4 |

**Table A.11. BHPS: Regressions on key socio-economic variables (financial situation) excluding observations where the lag of LM is either 1 or 7.** Variable description in Appendix A.1. Results from pooled OLS and fixed effects regressions including year fixed effects. Standard errors in parentheses. $^*$ p<0.05, $^{**}$p<0.01, $^{***}$p<0.001.

| | (1) deviation OLS | (2) signdLM OLS | (3) signRM OLS | (4) signRM FE |
|---|---|---|---|---|
| female | 0.00286 | 0.0159$^{***}$ | 0.0187$^{**}$ | 0 |
| | (0.00652) | (0.00420) | (0.00604) | (.) |
| age | -0.0143$^{***}$ | -0.000441 | -0.0147$^{***}$ | -0.0248 |
| | (0.00117) | (0.000841) | (0.00105) | (0.0362) |
| age$^2$ | 0.0000730$^{***}$ | 0.0000183$^*$ | 0.0000914$^{***}$ | -0.0000126 |
| | (0.0000116) | (0.00000862) | (0.0000102) | (0.0000274) |
| **change_fin_situation** | **0.0956$^{***}$** | **0.0975$^{***}$** | **0.193$^{***}$** | **0.171$^{***}$** |
| | (0.00494) | (0.00428) | (0.00414) | (0.00386) |
| **L.change_fin_situation** | **0.0866$^{***}$** | **-0.0475$^{***}$** | **0.0391$^{***}$** | **0.0172$^{***}$** |
| | (0.00484) | (0.00426) | (0.00382) | (0.00387) |
| stayed unemployed | -0.161$^{***}$ | 0.0125 | -0.148$^{***}$ | -0.0817$^*$ |
| | (0.0359) | (0.0288) | (0.0289) | (0.0375) |
| stayed out of labour market | -0.0489$^{***}$ | 0.00945 | -0.0395$^{***}$ | 0.0454$^{***}$ |
| | (0.00925) | (0.00655) | (0.00845) | (0.0138) |
| **got employed** | **0.0396$^*$** | **0.0587$^{***}$** | **0.0983$^{***}$** | **0.128$^{***}$** |
| | (0.0185) | (0.0161) | (0.0148) | (0.0157) |
| **lag got employed** | **0.00345** | **0.0144** | **0.0179** | **0.0368$^{**}$** |
| | (0.0157) | (0.0138) | (0.0124) | (0.0128) |
| **got unemployed** | **-0.100$^{***}$** | **-0.100$^{***}$** | **-0.201$^{***}$** | **-0.126$^{***}$** |
| | (0.0257) | (0.0231) | (0.0215) | (0.0208) |
| **lag got unemployed** | **-0.139$^{***}$** | **0.0428** | **-0.0957$^{***}$** | **-0.0660$^{**}$** |
| | (0.0287) | (0.0253) | (0.0225) | (0.0225) |
| **exited labour market** | **0.0710$^{***}$** | **0.0543$^{***}$** | **0.125$^{***}$** | **0.164$^{***}$** |
| | (0.0178) | (0.0155) | (0.0146) | (0.0143) |
| **lag exited labour market** | **0.0922$^{***}$** | **-0.0278** | **0.0644$^{***}$** | **0.0386$^{**}$** |
| | (0.0182) | (0.0158) | (0.0141) | (0.0146) |
| **got married** | **0.150$^{***}$** | **0.0823$^{***}$** | **0.232$^{***}$** | **0.109$^{***}$** |
| | (0.0240) | (0.0207) | (0.0190) | (0.0201) |
| **lag got married** | **0.170$^{***}$** | **-0.0194** | **0.151$^{***}$** | **0.155$^{***}$** |
| | (0.0250) | (0.0217) | (0.0199) | (0.0201) |
| **marriage ended** | **-0.132$^{***}$** | **-0.00616** | **-0.138$^{***}$** | **-0.222$^{***}$** |
| | (0.0330) | (0.0310) | (0.0303) | (0.0264) |
| **lag marriage ended** | **-0.0529** | **0.0974$^{***}$** | **0.0445** | **-0.0167** |
| | (0.0322) | (0.0286) | (0.0249) | (0.0248) |
| stayed married | -0.0299$^{***}$ | 0.00964 | -0.0203$^{**}$ | -0.182$^{***}$ |
| | (0.00749) | (0.00495) | (0.00692) | (0.0153) |
| Year dummies | yes | yes | yes | yes |
| Constant | 0.122$^{***}$ | -0.0335 | 0.0888$^{**}$ | 0.870 |
| | (0.0328) | (0.0238) | (0.0292) | (1.464) |
| Observations | 70759 | 70759 | 70759 | 70759 |
| $R^2$ | 0.057 | 0.014 | 0.111 | 0.055 |
| Adjusted $R^2$ | 0.057 | 0.014 | 0.111 | -0.254 |
| *AIC* | 172994.9 | 156368.7 | 131099.4 | 98790.1 |
| *BIC* | 173233.3 | 156607.1 | 131337.8 | 99019.3 |