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Abstract

This paper analyses people's life satisfaction measurement. In the literature on happiness, numerous studies have discussed the Easterlin Paradox, where Easterlin (1974) states that the increase in the reported happiness does not seem to be related with the economic growth. There are several possibilities that result in observing the paradox. The first possibility is the recent personal news shock effect that people's happiness is higher if they receive good news before the interview. Another possibility is of a social norm where people may report happiness by considering the expectation of others they interact with. The third possibility, which this paper focuses on, is the change in one's criteria of the happiness level. If the measurement of happiness changes over time, the level of happiness is not comparable across different time periods. This paper uses the British Household Panel Survey to estimate the criteria of people's happiness levels. It finds that the measurement is not constant across time.

JEL Classification Numbers: I31, J10, D10

Keywords: Subjective Well-being; Life Satisfaction; Easterlin Paradox

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1 Introduction

In the literature on happiness, a paradox that the increase in the level of reported happiness does not correlate with the economic growth in Easterlin (1974) motivated further studies to analyze happiness. The happiness and subjective well-being are related to the policy and social changes, and thus, analyzing the well-being would be valuable for policymakers.

In the analysis of happiness and income relationship, two opposite results have been observed. On the one hand, Easterlin (1974) and Easterlin (1995) stated that happiness level is higher in developed countries in cross-country analysis, but the positive correlation between income and happiness was not observed within country analysis. Blanchflower and Oswald (2004) support Easterlin's views but found the positive correlation for some demographic groups. On the other hand, Stevenson and Wolfers (2008) assessed the paradox by using more recent data of a broad array of countries and found positive relationship between income and happiness within and across countries. Stevenson and Wolfers (2008) also used several micro-data sets and confirmed the positive correlation between the level of average subjective well-being and GDP per capita across countries. Deaton (2008) stated there is a strong positive relationship between the log of GDP and life satisfaction. Di Tella, MacCulloch and Oswald (2003) used several macroeconomic variables in a happiness equation and found that GDP per capita has positive effects on life satisfaction. In addition, there are empirical studies that have found a positive correlation between these variables (for example Clark and Oswald, 1994; Frey and Stutzer, 2000; van Praag, Frijters and Ferrer-i-Corbonell, 2003; Ferrer-i-Corbonell and Frijters, 2004; Ferrer-i-Corbonell, 2005).

Several approaches have been taken to analyze the relationship between the well-being and income. First, we consider the literature that uses the linear and nonlinear relationship between them (for example Deaton, 2008). This type of approach assumes that people obtain their life satisfaction mainly from their income. Second, we consider the literature that considers the effect of others' preferences on an individual's preference[1] (Easterlin, 1995). This means that the individual's well-being depends on not only her income in absolute terms but also her status in a social group. The study including reference income considers that one's happiness depends on one's status and other's.

This paper, with the aim of finding the relationship between income and happiness, focuses on one's personal measurement of well-being. In a survey, individuals are asked to report their happiness or well-being on a zero-to-ten scale, based on their own criteria. In next year, they are asked to report their respective happiness levels again. In the one-year gap between both surveys, individuals might have had various life events such as income increase, marriage, and moving to a big city. Then, if one's income increased, her life satisfaction would increase. However, the positive relationship might not be observed due to some reasons. One possible reason is the recent personal news shock effect. If she had a temporal bad news, say, the previous night, she would report lower satisfaction even if she had an income increase. Sano and Ohtake (2007) analyzed temporal news shock on life satisfaction. They stated that if one had a good news, her life satisfaction tended to be higher. However, if she had a bad news, her life satisfaction tended to be lower.

Another possible reason is of a social norm (Easterlin, 1974). One may report the

[1] Ferrer-i-Corbonell (2005) briefly summarized the interdependence of preference.

satisfaction level considering another individual's expectation. This would result in a bias in the correlation between well-being and income. The third possibility is the change in one's criteria of the satisfaction level. If the measurement of life satisfaction was changing over time, the level of life satisfaction is not comparable across time. If one was promoted and got higher income, one might have a different criteria of satisfaction. This causes a bias in the correlation between income and well-being.

This paper analyzes the third possibility by using two life satisfaction variables. The two life satisfaction variables are life satisfaction overall (overall satisfaction) and current life satisfaction compared with that of the previous year (compared satisfaction). The purpose of using two life satisfaction variables is that the overall satisfaction might not be comparable over time because the life satisfaction measurement can change with time. When a respondent was asked to answer her overall satisfaction, she would evaluate it considering her past life. Because numerous events might have happened to her from the last time she was asked the same question, the measurement of the overall satisfaction might have changed over time. Thus, the criterion of the current overall satisfaction would be different from the criterion last time. However, the questionnaire on the compared satisfaction asked the individual to compare her current life satisfaction with that of the previous year directly, and thus, this approach allows us to evaluate the satisfactions of two periods with the same measurement. Therefore, the compared satisfaction implies direct increase from that of the previous year.

The next section explains the data used in this study. Section three discusses an estimation model and an estimating approach of the criteria analysis. Section four discusses the regression results and threshold analysis. Then this study concludes in Section five.

2 Data

This section explains the data set used in this study and the construction of the analysis sample. This study used the British Household Panel Survey (BHPS) which is a panel survey that began in 1991, conducted by the Institute for Social and Economic Research at the University of Essex. The survey interviewed the same representative individuals over a period of years and collected the information of social and economic changes at the individual level and at the household level in the UK. It was also motivated to understand the changes, causes, and consequences related to a range of socio-economic variables. It was an annual survey targeting each household member aged over 16 years. More than 5,000 households were interviewed, and approximately 10,000 individuals were interviewed and reported information on economic activities such as income and job status. In addition, the survey questionnaire asked about a variety of topics of policy interest, such as household composition, education and training, health, and labor market behavior.

This study used the data sets from Wave 6, year 1996-1997, to Wave 18, year 2008-2009. Wave 1 to Wave 5 and Wave 11 did not have a life satisfaction questionnaire, and thus, we dropped six waves from the analysis sample.

The key life satisfaction variables used in this study were the overall satisfaction and the compared satisfaction. For the overall satisfaction, people are asked to answer the question, "How dissatisfied or satisfied are you with your life overall?," where they have to report one for "not satisfied at all" to seven for "completely satisfied." Then, for the

compared satisfaction, they answer the following question, "Would you say that you are more satisfied with life, less satisfied or feel about the same as you did a year ago?," where they answer one of the three options accordingly.

The description of the independent variable was as follows. The independent variable included the real annual income, reference income, age variables, and dummy variables of gender, household size, number of kids, education, region, housing type, and wave. The real annual income was used as an income variable and was deflated by the consumer price index, which is the 2010-based price index. We included two age variables: one's age and its square. For one's education level, there are seven categories: higher degree; 1st degree; Higher National Diploma (HND), Higher National Certificate (HNC), and teaching; General Certificate of Education Advanced Level (A-level); General Certificate of Education Ordinary Level (O-level); Certificate of Secondary Education (CSE); and others. According to Brown and Roberts (2012), this study categorized the education level as following: university level for higher degree and 1st degree; some higher education level for HND, HNC, teaching and A-level; high school level for O-level and CSE; and others. The regional variable included nineteen values such as Inner London, Outer London, Wales, Scotland, and Northern Ireland. There are eight types of housing, for example, Owned Outright and Owned with Mortgage.

3 Model

3.1 Model of Estimation

This study follows the methodology of Ferrer-i-Corbonell (2005). It considers a satisfaction function as follows:

$$W = W(y, y^r, X), \tag{1}$$

where W is the concept of life satisfaction, y is the household income, y^r represents the reference income, and X is the socio-economic and demographic characteristics. Ferrer-i-Corbonell (2005) considered several specifications of the reference income. This study applies the specification of Ferrer-i-Corbonell (2005) to include the cell-average of the reference group by age cohort, gender, education, region, and wave.

In an empirical application, this paper used the following specification:

$$W_{it} = \beta_0 + \beta_1 \ln(y_{it}) + \beta_2 \ln(y_t^r) + X'\gamma + u_{it}, \tag{2}$$

where i indicates individuals and t indicates waves.

3.2 Model to Estimate Threshold Points

This section explains how we estimate and test the inconsistency of the life satisfaction measurement over time. Primary, we estimate the measurement by applying an ordered probit estimation of equation 2. Let W be the overall life satisfaction response taking the values between one and seven. The value of W is derived from a latent variable model in which the latent variable W^* is determined as follows:

$$W^* = \boldsymbol{x}\boldsymbol{\beta} + e, \quad e|\boldsymbol{x} \sim N(0, 1), \tag{3}$$

where $\boldsymbol{x}$ indicates explanatory variables and $\boldsymbol{\beta}$ is the parameter vector. We define the threshold point α_{kt}, where k is the threshold level and t is the wave, as follows:

$$\begin{aligned}
&W = 1 \quad if \quad W^* \leq \alpha_{1t} \\
&W = 2 \quad if \quad \alpha_{1t} < W^* \leq \alpha_{2t} \\
&W = 3 \quad if \quad \alpha_{2t} < W^* \leq \alpha_{3t} \\
&W = 4 \quad if \quad \alpha_{3t} < W^* \leq \alpha_{4t} \\
&W = 5 \quad if \quad \alpha_{4t} < W^* \leq \alpha_{5t} \\
&W = 6 \quad if \quad \alpha_{5t} < W^* \leq \alpha_{6t} \\
&W = 7 \quad if \quad \alpha_{6t} < W^*.
\end{aligned} \tag{4}$$

Estimating the ordered probit for each wave cannot give a time-consistent threshold. The survey information on people's satisfaction in comparison with the previous year allows us to compensate for the information on the comparable threshold over time. Therefore, we applied the ordered probit estimation to the life satisfaction equation with the compared satisfaction variable:

$$q = \boldsymbol{x}\boldsymbol{\gamma} + v, \tag{5}$$

where q represents the compared satisfaction variable.

Estimating these two models together, we estimate the corrected life satisfaction measurement criteria α_{kt}. However, the regression with only these equations, equations 3 to 5, does not allow us to identify the estimates of $\boldsymbol{\beta}$ and $\boldsymbol{\gamma}$. Thus, we estimate the following equation together:

$$\Delta y = \Delta \boldsymbol{x} \beta + \Delta e. \tag{6}$$

This equation is the first difference of equation 3. Equation 6 gives the estimate of $\boldsymbol{\beta}$. Therefore, we can estimate and identify all parameters.

We use the GMM estimation to estimate three equations at the same time. If the measurement of life satisfaction is the same over time, the threshold points, α_{kt}, would not vary over time. Thus, if these thresholds changed over time, people might measure their life satisfaction with different criteria in each wave. This would result in the underestimation of the effect of income on well-being. This implies that the Easterlin Paradox could be observed in the well-being analysis.

4 Empirical Analysis

Table 1 shows the summary statistics of the main variables. The overall satisfaction was about 5.2 on the one-to-seven scale. People in the UK were relatively happier. The compared satisfaction was 0.1. Since people who reported "less satisfied," "about the same," or "more satisfied" took -1, 0, or 1, respectively, the mean of the compared satisfaction showed that there were more people who reported "more satisfied" than people who reported "less satisfied." The number of people in a household was about 2.8, and the number of kids in a household was about 0.6. The average age was about 46 yeas. There were almost equal number of males and females in the sample. The real annual income was about £17,326.

Table 2 is the key table in this sudy, which shows the comparison between the first difference of the overall satisfaction and the compared satisfaction. Both measures indicate the life satisfaction changes between the current time and the previous year. Thus, if there was an increase or a decrease in the first difference of the overall satisfaction, people would report "more satisfied" or "less satisfied," respectively. However, the table shows inconsistency between these life satisfaction variables. There were people whose change in the overall satisfaction was positive, meaning their overall satisfaction improved, but they reported that they were "less satisfied" than they were a year ago. There were people who took negative values on the change in the overall satisfaction, meaning that they felt less satisfied that they did a year ago, but they reported "more satisfied" than a year ago. Further, even though there were people who reported their change in life satisfaction was positive or negative, they stated they had about the same satisfaction compared to the previous year. The table presumably indicates that people might not correctly measure their satisfaction with their lives.

From the distribution of these life satisfaction variables, we constructed two life satisfaction variables using the overall satisfaction and the compared satisfaction. One is the add-up satisfaction, which is the corrected life satisfaction upon adding -1, 0, or 1 to the initial overall satisfaction, depending on the answer to the compared life satisfaction, "less satisfied," "about the same," or "more satisfied." Thus, this is the consistent life satisfaction variable between the overall satisfaction change and the compared satisfaction. Another is the trimmed satisfaction. The scale of the add-up satisfaction is not one-to-seven scale. Thus the trimmed satisfaction is constructed by replacing zero and eight of the add-up satisfaction for one and seven in each wave to keep the trimmed satisfaction to have one-to-seven scale as with the overall satisfaction. The distribution tables of both the add-up satisfaction and the trimmed satisfaction are in Appendix.

Figure 1 shows the trend of three satisfaction variables, which are the overall satisfaction, the add-up satisfaction, and the trimmed satisfaction, and the log of real income. The dashed line, which is the log of real income over the sample period, shows continuous increase over time, from 6.6 to 7.0. The solid line is the actual overall satisfaction. This line has a small blip and dip but seems decreasing over time. These lines seem to imply the Easterlin paradox that the increase in life satisfaction does not seem to be correlated with the income increase. The dash-dot line is the add-up satisfaction. This line shows continuous increase in life satisfaction, implying that the add-up satisfaction increases depending on the increase of the log of real income. The dotted line is the trimmed satisfaction. Since this satisfaction is bounded between one to seven, it is placed between the overall satisfaction and the add-up satisfaction. This line seems to have moderate increase and to have positive increase compared to the overall satisfaction. This figure shows that we could not observe a clear positive correlation between the overall satisfaction and income, but constructing consistent life satisfaction variables between the overall satisfaction and the compared satisfaction, we might find a clearer correlation between constructed satisfaction variables and income.

Table 3 shows the regression result specified by equation 2. The OLS estimation results are reported in the first to third columns. The first column shows the OLS estimation of the overall satisfaction. The coefficient of income is negative and not statistically significant. This implies that the increase in one's income does not seem to increase one's life satisfaction. The second column displays the regression result for the add-up satisfaction. The income effect on life satisfaction was 0.22 and was positive and

statistically significant. The result of this estimate is noteworthy. The third column shows the estimation result for the trimmed satisfaction. The coefficient was positive; however, it was not statistically significant. The fourth to sixth columns report the fixed-effect estimation results. In the fixed effect estimation, the coefficient of income is positive but not significant in the overall satisfaction regression. However, with add-up satisfaction, the coefficient was 0.022. The magnitude of the income coefficient in the fifth column was larger than that in the fourth column. This indicates that if life satisfaction was corrected by arranging the original overall satisfaction for consistent change with the compared satisfaction, the income effect was larger. We might obtain this result because the scale is different from that of the overall satisfaction. The original life satisfaction had the one-to-seven scale; however, the add-up satisfaction had a different scale. This implies that as the overall satisfaction was bounded between one and seven, the coefficient in the fourth column was smaller. If the life satisfaction were not bounded, the effect of income would be larger. The sixth column discusses if the scale was fixed in the one-to-seven scale; consequently, the income coefficient was 0.016, which was smaller than the coefficient in the fifth column but larger than the coefficient in the fourth column. These results mean that consistently using the life satisfaction variable between the overall satisfaction and the compared satisfaction, the income effect on life satisfaction was larger than when using the original life satisfaction. Similar to prior studies, the reference income had a negative impact on life satisfaction; however, the fixed-effect estimation was not significant for the add-up and trimmed satisfaction variables.

Table 4 contains the regression result of the change in life satisfaction. In the first column, an increase in income has a positive effect on the increase in the overall satisfaction. The second column shows that if a person experiences increase in income, they report being happier than a year before. Also, in fixed-effect estimation, the coefficient of income was positive and significant. These results imply that increase in income tends to improve one's life satisfaction.

4.1 Threshold Point Analysis

Individuals' measurement of satisfaction could change over time because of various life events. These events would affect people's criteria of life satisfaction. This section analyzes if the threshold points of life satisfaction were stable across the sample period.

Table 5 shows application of the ordered probit estimation to the specification in equation 2. The income coefficient was not significant in the first column; however, it was positive and significant for the add-up and trimmed satisfaction variables. The coefficients of the reference income were negative, and they are significant for the overall and trimmed satisfaction variables.

Figure 2 shows the shifts of the threshold points of the overall satisfaction through the sample period. Applying GMM estimation for equations 3, 5, and 6 together gives the threshold estimates. The figure shows that the cut points were almost constant during the first five waves. For example, threshold 1 was varying around -3.2 in early sample period. However, after Wave 12, the thresholds varied with a large amount. Threshold 1 varied between -3 and -2 during the latter period. Then, we applied a test to check whether all the means were equal over time for each threshold point. The test result yielded that the hypotheses were rejected for all threshold points. This means, as the table shows, that the thresholds were not stable across time. Thus, the measurement of the reported life

satisfaction was changing over time. This might result in weak correlation between life satisfaction and income. This would be one reason why previous studies observed the Easterlin Paradox.

4.2 Robustness check

In previous sections, the estimation models include the linear terms of income and reference income. In this section, the estimation models include the linear and quadratic terms of income and reference income. Table 6 shows the regression result specified by equation 2 including the quadratic terms. The first column shows the OLS estimation result of the overall satisfaction. The coefficient of the squared income was positive. This means that if income increased, people reported a higher level of life satisfaction. The second column shows the OLS estimation result of the add-up satisfaction. The coefficient of the squared income was larger than the respective coefficient in the first column. The third column shows the OLS estimation of the trimmed satisfaction. The coefficient of the squared income was larger than the coefficient in the first column but smaller than the coefficient in the second column. In the fourth to sixth columns, the fixed-effect estimation results are reported. If we consider a fixed effect, the sizes of the coefficients of the squared income were smaller than the coefficients in the OLS estimation.

Table 7 gives the regression result of the change in life satisfaction. It shows that the linear and quadratic terms of income were not statistically significant with the change in the overall satisfaction. However, these terms were statistically significant when we used the life satisfaction compared with that of the previous year.

In Table 8, the ordered probit estimation was applied to the specification in Table 5 including the quadratic terms of income and reference income. The quadratic terms of income were positive and the linear terms of income were negative for the three life satisfaction variables. The reference income was not statistically significant for the overall satisfaction, but it was significant for the add-up and the trimmed satisfaction variables.

5 Conclusion

In the literature on happiness, the linear and nonlinear happiness–income analyses and the analysis including reference income were adapted to study the correlation between happiness and income. This study focused on estimating one's own measurement of life satisfaction to reveal that the life satisfaction criteria is changing over time.

Even though both the change in the overall life satisfaction and life satisfaction compared with that of the previous year might show the change in life satisfaction from the previous year, there was inconsistency between these variables. Constructing new life satisfaction variables that are consistent between those variables, we obtained larger relationship between income and happiness compared with previous studies. The regression results show that the estimate of the income effect on the overall life satisfaction was positive, but it was lower than the estimates of the constructed life satisfaction variables, which were the add-up and the trimmed life satisfaction variables. In addition, the threshold point analysis shows that one's measurement of life satisfaction was changing over time. This implies that since the criteria is changing with time, we might not compare the overall life satisfaction over time. Therefore, the previous literature obtained

low happiness–income correlation and the Easterlin paradox.

In this study, we constructed two life satisfaction variables to have consistency between the change in the overall satisfaction and life satisfaction compared with that of the previous year. However, there are more ways to construct life satisfaction variables. Thus, further studies are required to examine the income effect on well-being.

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Table 1: Summary statistics of demographic variables

Variable	Mean	Std. Dev.
Overall life satisfaction	5.24	1.28
Life satisfaction compared with that of the previous year	0.13	0.65
Number of people in household	2.83	1.37
Number of children in household	0.59	0.97
Age	46.11	18.25
Gender	1.55	0.50
Real annual income (in £)	17,326.332	17,466.132

Source: British Household Panel Survey.
Note: The real annual income is obtained by dividing annual income by the consumer price index based on 2010.

Table 2: Life satisfaction comparison matrix

ΔLife satisfaction (overall)	Life satisfaction compared with that of the previous year					
	Less satisfied		About the same		More satisfied	
	Obs.	%	Obs.	%	Obs.	%
-6	49	0.05	42	0.04	10	0.01
-5	81	0.08	53	0.05	24	0.02
-4	287	0.27	149	0.14	47	0.04
-3	879	0.82	642	0.60	142	0.13
-2	2,351	2.18	2,639	2.45	628	0.58
-1	4,798	4.45	12,583	11.67	4,113	3.81
0	5,377	4.99	31,287	29.02	13,805	12.80
1	2,027	1.88	11,620	10.78	6,707	6.22
2	540	0.50	2,739	2.54	1,944	1.80
3	152	0.14	783	0.73	612	0.57
4	53	0.05	235	0.22	196	0.18
5	9	0.01	69	0.06	58	0.05
6	10	0.01	65	0.06	21	0.02
Total	16,613	15.41	62,906	58.34	28,307	26.25

Source: British Household Panel Survey.

Table 3: Life satisfaction regression (level)

	LS overall OLS	Add-up LS OLS	Trimmed LS OLS	LS overall FE	Add-up LS FE	Trimmed LS FE
Ln inc	-0.001	0.022**	0.011	0.005	0.022***	0.016***
	(0.005)	(0.009)	(0.007)	(0.004)	(0.006)	(0.005)
Ln ref. inc	-0.095***	-0.017	-0.045**	-0.041***	0.020	-0.003
	(0.015)	(0.023)	(0.020)	(0.011)	(0.017)	(0.014)
Age	-0.043***	-0.078***	-0.067***	-0.012	0.125***	0.068***
	(0.003)	(0.004)	(0.003)	(0.012)	(0.017)	(0.014)
Age^2	0.001***	0.001***	0.001***	-0.000	-0.001***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	147,283	147,283	147,283	147,283	147,283	147,283
R-squared	0.057	0.051	0.048	0.008	0.041	0.021

Source: British Household Panel Survey.
Note: The add-up satisfaction is the life satisfaction constructed by adding compared satisfaction to initial overall life satisfaction. The trimmed satisfaction is the life satisfaction variable that is constructed by replacing zero and eight in the add-up satisfaction for one and seven, respectively. The reference income is the cell-average of the annual real income by age cohort, gender, education, region, and wave. The additional dependent variables are log of number of kids + 1, log of number of adult, education dummy variables, gender dummy variable, regional dummy variables, time dummy variables, house type dummy variables, and marital status dummy variables. Standard errors robust against individual-level clustering are reported in parentheses. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 4: Life satisfaction regression (FD)

	ΔLS (overall)	LS compared with the previous year	ΔLS (overall)	LS compared with the previous year
	OLS	OLS	FE	FE
Ln inc	0.008**	0.007***	0.012**	0.012***
	(0.003)	(0.002)	(0.006)	(0.003)
Ln ref. inc	-0.006	-0.017***	0.001	-0.008
	(0.009)	(0.006)	(0.015)	(0.007)
Age	0.004***	-0.025***	-0.007	-0.018***
	(0.001)	(0.001)	(0.017)	(0.006)
Age^2	-0.000***	0.000***	-0.000**	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Other controls	Yes	Yes	Yes	Yes
Observations	107,826	147,283	107,826	147,283
R-squared	0.003	0.066	0.004	0.013

Source: British Household Panel Survey.
Note: The reference income is the cell-average of the annual real income by age cohort, gender, education, region, and wave. The additional dependent variables are log of number of kids + 1, log of number of adult, education dummy variables, gender dummy variable, regional dummy variables, time dummy variables, house type dummy variables, and marital status dummy variables. Standard errors robust against individual-level clustering are reported in parentheses. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 5: Life satisfaction regression (Ordered probit estimation)

	LS (overall)	Add-up LS	Trimmed LS
Ln inc	-0.004	0.015***	0.009*
	(0.005)	(0.005)	(0.005)
Ln ref. inc	-0.081***	-0.011	-0.026*
	(0.013)	(0.013)	(0.014)
Age	-0.036***	-0.043***	-0.046***
	(0.002)	(0.002)	(0.002)
Age^2	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)
Other controls	Yes	Yes	Yes
Observations	147,283	147,283	147,283
Pseudo R-squared	0.018	0.013	0.013

Source: British Household Panel Survey.
Note: The add-up satisfaction is the life satisfaction constructed by adding compared satisfaction to initial overall life satisfaction. The trimmed satisfaction is the life satisfaction variable that is constructed by replacing zero and eight in the add-up satisfaction for one and seven, respectively. The reference income is the cell-average of the annual real income by age cohort, gender, education, region, and wave. The additional dependent variables are log of number of kids + 1, log of number of adult, education dummy variables, gender dummy variable, regional dummy variables, time dummy variables, house type dummy variables, and marital status dummy variables. Standard errors robust against individual-level clustering are reported in parentheses. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 6: Robustness check: life satisfaction regression (level)

	LS overall OLS	Add-up LS OLS	Trimmed LS OLS	LS overall FE	Add-up LS FE	Trimmed LS FE
Ln inc	-0.093***	-0.100***	-0.092***	-0.026**	-0.020	-0.018
	(0.013)	(0.021)	(0.018)	(0.015)	(0.011)	(0.012)
(*Ln* inc)^2	0.009***	0.012***	0.010***	0.003***	0.005***	0.004***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)
Ln ref. inc	-0.002	0.186**	0.103	-0.058	0.035	0.011
	(0.058)	(0.085)	(0.071)	(0.043)	(0.066)	(0.050)
(*Ln* ref. inc)^2	-0.008*	-0.017**	-0.013**	0.001	-0.002	-0.002
	(0.005)	(0.007)	(0.006)	(0.003)	(0.005)	(0.004)
Other controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	147,283	147,283	147,283	147,283	147,283	147,283
R-squared	0.057	0.051	0.049	0.008	0.041	0.022

Source: British Household Panel Survey.
Note: The add-up satisfaction is the life satisfaction constructed by adding compared satisfaction to initial overall life satisfaction. The trimmed satisfaction is the life satisfaction variable that is constructed by replacing zero and eight in the add-up satisfaction for one and seven, respectively. The reference income is the cell-average of the annual real income by age cohort, gender, education, region, and wave. The additional dependent variables are log of number of kids + 1, log of number of adult, education dummy variables, gender dummy variable, regional dummy variables, time dummy variables, house type dummy variables, and marital status dummy variables. Standard errors robust against individual-level clustering are reported in parentheses. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 7: Robustness check: life satisfaction regression (FD)

	ΔLS (overall)	LS compared with the previous year	ΔLS (overall)	LS compared with the previous year
	OLS	OLS	FE	FE
Ln inc	0.002	-0.020***	-0.000	-0.006
	(0.010)	(0.006)	(0.015)	(0.007)
(*Ln* inc)^2	0.001	0.003***	0.001	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Ln ref. inc	-0.082*	0.045*	-0.067	-0.010
	(0.046)	(0.027)	(0.058)	(0.026)
(*Ln* ref. inc)^2	0.006*	-0.005**	0.005	-0.000
	(0.003)	(0.002)	(0.004)	(0.002)
Other controls	Yes	Yes	Yes	Yes
Observations	107,826	147,283	107,826	147,283
R-squared	0.003	0.066	0.004	0.013

Source: British Household Panel Survey.
Note: The reference income is the cell-average of the annual real income by age cohort, gender, education, region, and wave. The additional dependent variables are log of number of kids + 1, log of number of adult, education dummy variables, gender dummy variable, regional dummy variables, time dummy variables, house type dummy variables, and marital status dummy variables. Standard errors robust against individual-level clustering are reported in parentheses. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

Table 8: Robustness check: life satisfaction regression (Ordered probit estimation)

	LS (overall)	Add-up LS	Trimmed LS
Ln inc	-0.063***	-0.047***	-0.046***
	(0.011)	(0.012)	(0.012)
(*Ln* inc)^2	0.006***	0.006***	0.005***
	(0.001)	(0.001)	(0.001)
Ln ref. inc	-0.013	0.106**	0.073
	(0.050)	(0.049)	(0.048)
(*Ln* ref. inc)^2	-0.006	-0.010**	-0.008**
	(0.004)	(0.004)	(0.004)
Other controls	Yes	Yes	Yes
Observations	147,283	147,283	147,283
Pseudo R-squared	0.018	0.013	0.013

Source: British Household Panel Survey.
Note: The add-up satisfaction is the life satisfaction constructed by adding compared satisfaction to initial overall life satisfaction. The trimmed satisfaction is the life satisfaction variable that is constructed by replacing zero and eight in the add-up satisfaction for one and seven, respectively. The reference income is the cell-average of the annual real income by age cohort, gender, education, region, and wave. The additional dependent variables are log of number of kids + 1, log of number of adult, education dummy variables, gender dummy variable, regional dummy variables, time dummy variables, house type dummy variables, and marital status dummy variables. Standard errors robust against individual-level clustering are reported in parentheses. * indicates significance at the 10% level. ** indicates significance at the 5% level. *** indicates significance at the 1% level.

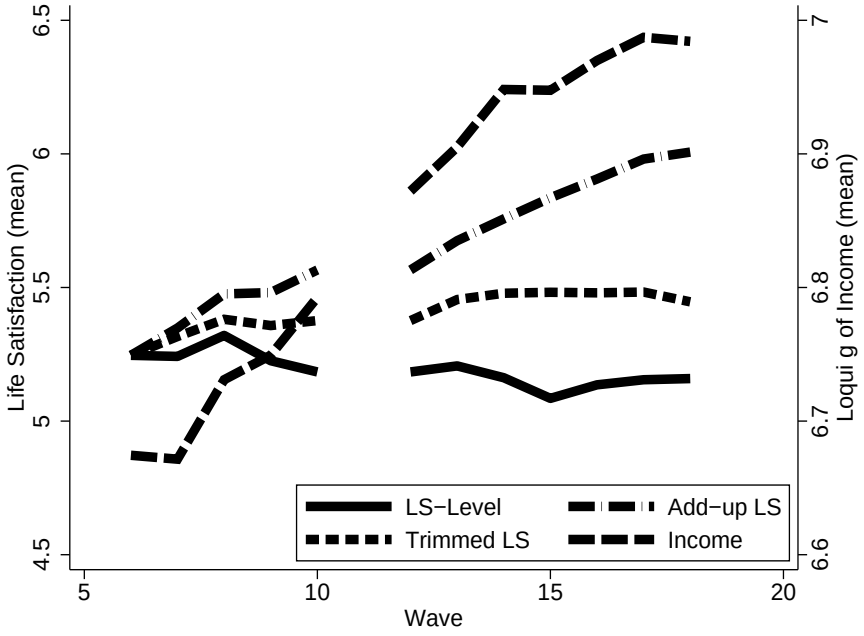

Figure 1: Life satisfaction comparisons

Source: British Household Panel Survey.
Note: The red solid line is the overall life satisfaction. The orange dashed line is the log of real total income in the previous month. The blue dash-dot line is the add-up satisfaction. The green dotted line is the trimmed satisfaction.

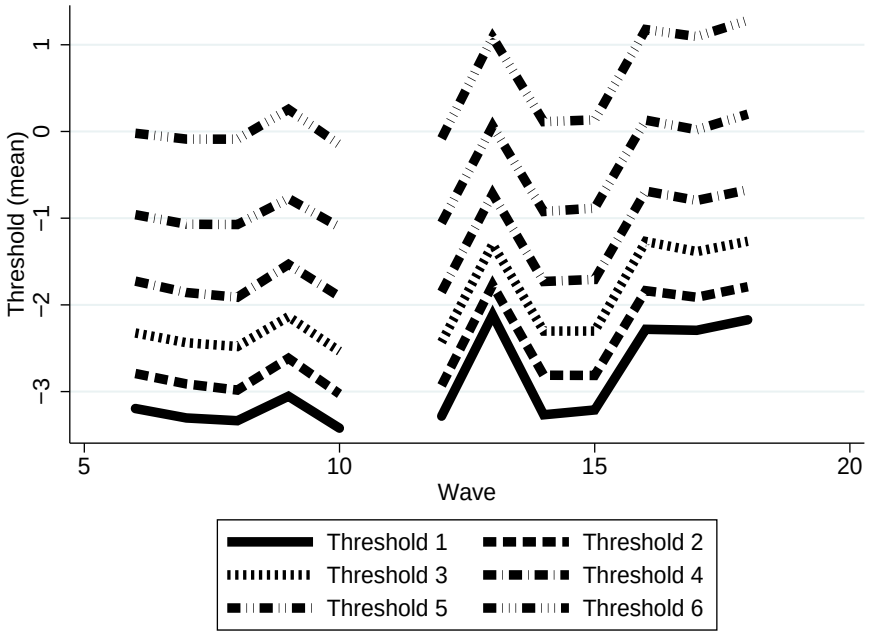

Figure 2: Threshold points transitions

Source: British Household Panel Survey.

Appendix

Table 9: Constructed life satisfaction distribution (in %, add-up life satisfaction)

Add-up satisfaction	wave							
	6	7	8	9	10			
-3	0.0	0.0	0.0	0.0	0.1			
-2	0.0	0.0	0.0	0.1	0.1			
-1	0.0	0.0	0.2	0.2	0.4			
0	0.0	0.4	0.7	0.6	1.1			
1	1.5	1.7	1.8	2.3	2.2			
2	2.4	3.1	3.5	3.2	3.2			
3	5.8	6.4	6.6	6.4	6.6			
4	14.4	13.4	12.1	12.2	11.8			
5	28.3	23.0	20.2	20.5	18.6			
6	31.5	28.5	25.2	25.1	23.7			
7	16.1	19.9	21.2	20.0	19.4			
8	0.0	3.6	6.9	6.2	7.7			
9	0.0	0.0	1.7	2.5	3.5			
10	0.0	0.0	0.0	0.6	1.4			
11	0.0	0.0	0.0	0.0	0.4			

	12	13	14	15	16	17	18	Total
-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
-4	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
-3	0.0	0.0	0.0	0.0	0.1	0.2	0.2	0.1
-2	0.0	0.0	0.0	0.2	0.3	0.3	0.6	0.1
-1	0.0	0.0	0.3	0.3	0.5	0.8	0.9	0.3
0	0.0	0.5	0.5	0.8	1.2	1.4	1.5	0.8
1	1.5	1.3	1.8	2.1	2.4	2.3	2.4	1.9
2	1.9	2.9	3.3	3.6	3.4	3.8	3.8	3.2
3	5.9	6.2	6.4	6.2	6.5	6.2	6.1	6.3
4	13.5	13.2	12.4	11.6	10.8	10.6	10.5	12.2
5	29.2	23.4	21.0	20.0	18.2	16.7	16.8	21.2
6	32.6	29.5	26.2	24.2	23.2	21.9	20.7	25.9
7	15.5	19.5	19.8	18.4	17.4	17.3	16.4	18.4
8	0.0	3.6	6.9	8.2	8.9	8.7	8.8	5.9
9	0.0	0.0	1.5	3.6	4.6	5.5	5.2	2.4
10	0.0	0.0	0.0	0.8	2.0	2.8	3.5	1.0
11	0.0	0.0	0.0	0.0	0.5	1.2	1.6	0.3
12	0.0	0.0	0.0	0.0	0.0	0.3	0.7	0.1
13	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0

Source: British Household Panel Survey.

Table 10: Constructed life satisfaction distribution (in %, trimmed life satisfaction)

Trimmed satisfaction	wave						
	6	7	8	9	10		
0	–	0.38	0.76	0.7	1.3		
1	1.48	1.67	1.91	2.43	2.43		
2	2.36	3.12	3.46	3.24	3.2		
3	5.82	6.41	6.62	6.44	6.65		
4	14.42	13.43	12.08	12.24	11.85		
5	28.34	23.02	20.2	20.61	18.76		
6	31.53	28.49	25.45	25.56	24.31		
7	16.07	19.92	22.32	22.03	22.71		
8	–	3.56	7.2	6.75	8.79		
	12	13	14	15	16	17	18
0	–	0.51	0.67	1.03	1.6	2	2.42
1	1.45	1.26	1.88	2.27	2.7	2.77	3.02
2	1.93	2.87	3.34	3.7	3.53	3.93	4.05
3	5.85	6.15	6.37	6.22	6.52	6.3	6.14
4	13.52	13.19	12.39	11.57	10.85	10.69	10.65
5	29.2	23.38	21.03	20	18.35	16.94	17.07
6	32.56	29.52	26.31	24.75	24.09	23.16	22.73
7	15.49	19.54	21.22	21.03	22.21	23.46	23.67
8	–	3.59	6.8	9.43	10.15	10.75	10.26

Source: British Household Panel Survey.