Article

Wealth in Great Britain Wave 3: Relationship between wealth, income and personal well-being, July 2011 to June 2012

This article uses data from the Wealth and Assets Survey (WAS) for July 2011 to June 2012 which, for the first time, included measures of personal well-being.

Table of contents

1 . Summary

This article uses data from the Wealth and Assets Survey (WAS) for July 2011 to June 2012 which, for the first time, included measures of personal well-being. It describes the results of regression analysis considering the relationships between the total wealth or total income of the households in which individuals live and their personal well-being. Regression analysis is a statistical technique which was used to analyse variation in well-being outcomes by specific characteristics and circumstances of individuals while holding all other characteristics equal. This allows for a better understanding of what matters most to an individual's personal well-being compared to analysis when different factors are considered separately.

2 . Main points

- An individual's level of personal well-being is strongly related to the level of wealth of the household in which they live. Life satisfaction, sense of worth and happiness are higher, and anxiety less, as the level of household wealth increases

- The levels of household income are less strongly related, with relationships found only with life satisfaction and sense of worth

- The net financial wealth of the household appears to be the type of wealth most strongly associated with personal well-being. In particular, life satisfaction will be higher in households with greater net financial wealth

- Levels of property wealth and private pension wealth were not found to be related levels of personal well-being

3 . Introduction

This article is published as part of the Wealth in Great Britain series [1] and uses data from the Wealth and Assets Survey (WAS). The analysis in this article has used data covering the period July 2011 to June 2012, during which questions on an individual's personal well-being were included for the first time.

These questions form part of the wider National Well-being Programme which aims to produce accepted and trusted measures of the well-being of the nation. Four measures of the personal well-being of individuals were developed as part of this programme and are now being used across a number of surveys.

The aim of this analysis was to consider how wealth and income are related to the different measures of personal well-being. However, a range of other factors could also be influencing any such association. So when looking at how wealth or income is associated with well-being, factors such as people's age, sex and ethnicity, to name a few, were controlled in the analysis. This allows for a better understanding of which factors matter most to the individual's personal well-being, as the relationship between wealth or income and personal well-being is considered knowing that other factors included in the analysis were held equal.

Although the regression analysis can show the nature, size and strength of the relationship between a specific personal characteristic or circumstance and personal well-being, we cannot say with certainty that the characteristic or circumstance has caused higher or lower well-being. Since these data are simply a snapshot of one point in time, we cannot establish whether a person's circumstances have contributed to their level of well-being or indeed whether their level of well-being has contributed to their current circumstances.

Notes for Introduction

1. [Wealth in Great Brtain, Wave 3 - 2010 to 2012](#) .

4 . What are wealth, income and personal well-being?

Total household wealth is a stock concept, and refers to the total value of a household's wealth at a point in time. In the Wealth and Assets Survey (WAS), wealth is defined as the sum of 4 components [1]:

- net property wealth

- net financial wealth

- physical wealth

- private pension wealth

Wealth is typically something which is accumulated and decumulated over time, with income providing one way of accumulating wealth.

Total household income is a flow concept, and refers to the incoming flow of resources into a household over time. In the WAS, income comprises 4 constituent parts:

- earned income from employment (including both employees and the self-employed)

- income from state support (including benefits, tax credits and state pensions)

- income from private pensions (including occupational and personal pensions)

- other income (such as income from investments and rent from property)

Total household income is the sum of these four constituent parts for all members of the household. This is a gross measure (that is, before tax and any other deductions).

Personal well-being[2] assesses the way in which people evaluate their own lives. The Office for National Statistics (ONS) measures of personal well-being ask people aged 16 and over to assess their life satisfaction; whether they feel their lives have meaning and purpose; and their recent experiences of positive and negative emotions. This is done using the 4 questions outlined below:

- overall, how satisfied are you with your life nowadays?

- overall, to what extent do you feel the things you do in your life are worthwhile?

- overall, how happy did you feel yesterday?

- overall, how anxious did you feel yesterday?

The questions are asked on a scale of 0 to 10, where 10 is "completely" and 0 is "not at all". These questions allow people to make an assessment of their life overall, as well as providing an indication of their day-to-day emotions. For the first 3 questions, a higher score indicates higher personal well-being. The fourth question, which asks about anxiety, is negatively framed so that a higher score indicates lower personal well-being. In this report the abbreviations "life satisfaction", "sense of worth", "happiness" and "anxiety" are used to refer to the 4 overall monitoring questions.

The figures for wealth and income in this report have not been equivalised [3] to reflect differences in household size or composition. This is discussed further in the Technical Appendix section.

Additionally, all figures in this report are presented as current values (that is, the value at time of interview) and have not been adjusted for inflation.

Why ask people about their well-being?

The reason for asking people to assess these aspects of their lives is ultimately to help understand more about an individual's perception of their own lives and how well they are doing and what is most important in shaping their views. This is one part of the much larger ONS Measuring National Well-being Programme.

Overall, the programme uses both objective information as well as information based on people's own views to monitor the overall well-being of the UK. This includes a wide range of measures developed after extensive public consultation undertaken in 2010 to 2011 during the National Debate (Office for National Statistics 2011) to ask people what matters most to them. The programme aims to provide information about how the UK is doing which moves beyond Gross Domestic Product (GDP) as the main measure of societal progress. The goal is to provide policy makers with information which will enable them to take into account the likely impacts of their ideas on the well-being of the people and environment of the UK and therefore to make more informed decisions.

## Personal well-being – the basic statistics from the Wealth and Assets Survey

Figure 1 shows the distribution of scores for each of the measures of personal well-being derived from the WAS. These results are similar to the results from the Annual Population Survey (APS) [4].

Figure 1a: Responses to the well-being questions, July 2011 to June 2012

How satisfied with life?

Figure 1a: Responses to the well-being questions, July 2011 to June 2012

How satisfied with life?
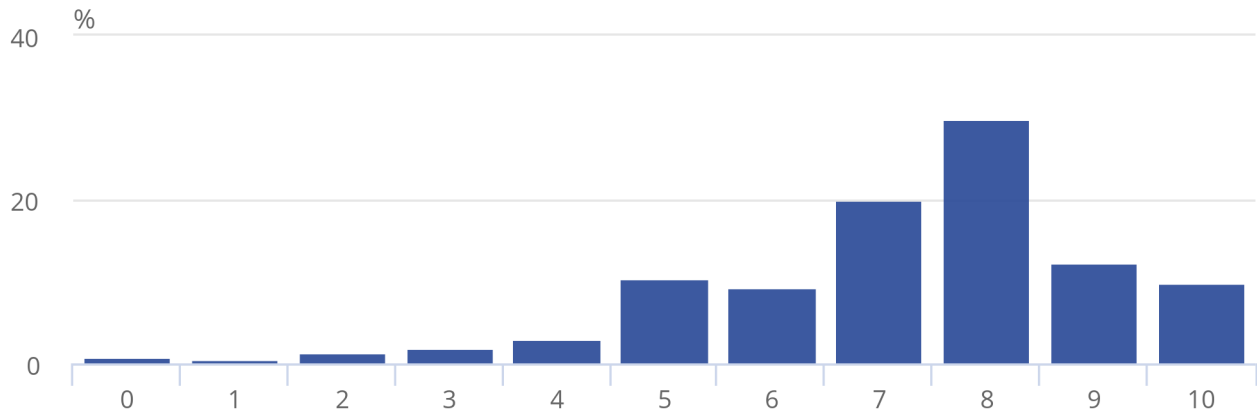
Source: Wealth and Assets Survey - Office for National Statistics

Figure 1b: Responses to the well-being questions, July 2011 to June 2012

Things you do are worthwhile?

Figure 1b: Responses to the well-being questions, July 2011 to June 2012

Things you do are worthwhile?

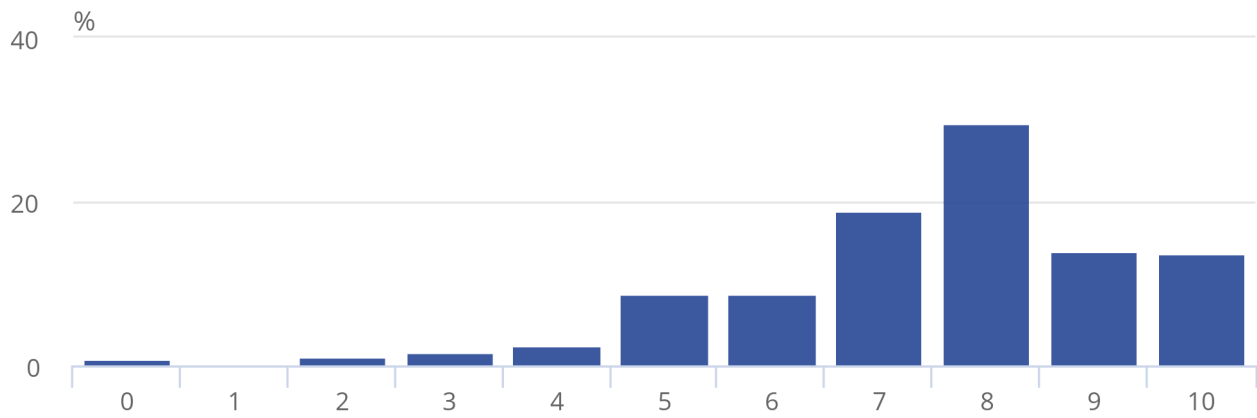**Source: Wealth and Assets Survey - Office for National Statistics**

Figure 1c: Responses to the well-being questions, July 2011 to June 2012

How happy did you feel yesterday?

Figure 1c: Responses to the well-being questions, July 2011 to June 2012

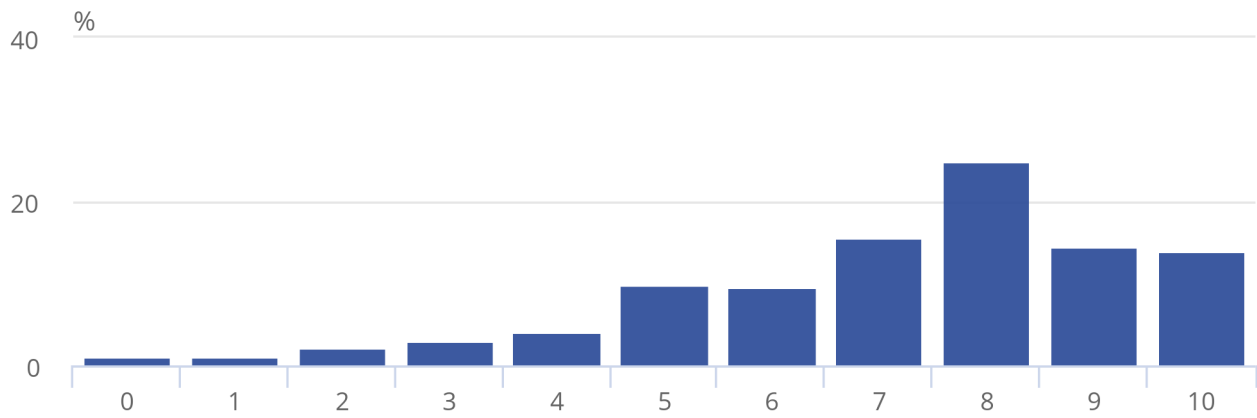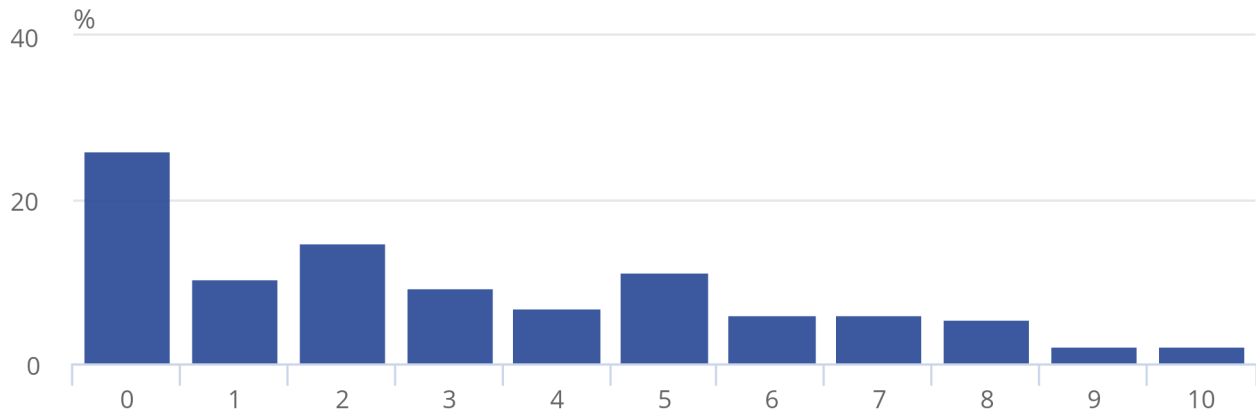How happy did you feel yesterday?

Source: Wealth and Assets Survey - Office for National Statistics

Figure 1d: Responses to the well-being questions, July 2011 to June 2012

How anxious did you feel yesterday?

Figure 1d: Responses to the well-being questions, July 2011 to June 2012

How anxious did you feel yesterday?

Source: Wealth and Assets Survey - Office for National Statistics

Notes for What are wealth, income and personal well-being?

1. How do we measure wealth?

2. Personal Well-being in the UK - 2013 to 2014

3. Equivalisation is a process that makes adjustments, so that the standard of living of households with different compositions can be compared

4. Personal Well-being datasets - Personal Well-being in the UK, 2012 to 2013 (151.5 Kb Excel sheet)

5 . Methodology section

In order to isolate the relationship between wealth or income and personal well-being, other factors which could potentially influence well-being and be associated with wealth and income are held constant in the analysis. It is crucial to include in the model all the characteristics that are expected to be associated with both personal well-being and the level of wealth and income.

The following characteristics are included in the regression models:

- sex

- age

- ethnicity (white/non-white)

- marital status

- highest qualification

- health status

- employment status

- presence of children in the household

- region of residence

Income and wealth are included simultaneously in the model, so that the effects of wealth can be estimated at constant levels of income, and likewise, the effects of income can be estimated at constant levels of wealth.

A crucial step in analysing the relationship between wealth or income and personal well-being relates to the way wealth or income is included in the regression model. Including absolute values of wealth or income in the model may lead to misleading conclusions since doing so relies on the assumption that, for example, an absolute difference in wealth (for example, £10,000) is associated with the same difference in personal well-being for all individuals, regardless of their initial level of wealth. Instead the relationship between wealth or income and personal well-being is likely to differ across the wealth or income distribution because an absolute difference in wealth or income is likely to have a larger impact on people living in lower wealth or income households than on people living in higher level wealth or income households. Therefore, using absolute values of wealth and income as independent variables may lead to failure in detecting a relationship between wealth or income and personal well-being, even if it exists.

In order to simply capture the fact that the effects of wealth or income on personal well-being are likely to vary with the level of wealth or income, a natural logarithmic transformation was applied to total household wealth and to total household income[1]. The model then relies on the assumption that a relative difference in wealth (for example, 10%) is associated with a constant change in personal well-being across all level of wealth. The other advantage of applying a logarithmic transformation is that it reduces the weight given to the few individuals living in households reporting very high or very low levels of wealth or income.

In addition, models using wealth and income deciles or quintiles are also used in this article in order to compare the well-being of individuals who belong to different wealth or income groups, but are otherwise identical. These models relax the assumption that relative differences in wealth are associated with constant differences in personal well-being.

This article also examines the relationships between personal well-being and different types of wealth, including:

- net property wealth

- private pension wealth

- physical wealth

- net financial wealth

The idea is to examine whether some types of wealth are more strongly associated with personal well-being than others. A natural logarithmic transformation is applied to each of these wealth components [2].

Two different regression analysis techniques were used in this analysis: linear regression models estimated by ordinary least squares (OLS) method and ordered probit models. Further information about these techniques can be found in the Technical Appendix section.

The ordered probit technique is best suited to the ordered nature of the responses to the personal well-being questions (that is, with responses on a scale from 0 to 10), while OLS is generally used for continuous data. However, the results of ordered probit analysis are not straightforward to interpret and explain to a wide audience in an accessible way. Since it is well documented that the 2 methods yield similar results when there are more than 4 categories for ordered responses, it is considered acceptable to undertake the analysis using either ordered probit or OLS (Ferrer-i-Carbonell and Frijters 2004; Stevenson and Wolfers 2008; Fleche et al., 2011).

The results of the OLS and ordered probit analysis in this article are very similar. As a result, this article focuses primarily on the results from the linear regression models estimated by the OLS method.

Results from both ordered probit and OLS models are available in the reference tables where available.

Interpreting what the numbers mean

The numbers included throughout the text and in the tables at the beginning of each section are the unstandardised coefficients for each variable included in the OLS model. This shows the size of the effect that the variable has on the specific aspect of personal well-being considered. Results are presented only if they are from the main regression models and whether they are statistically significant is clearly indicated.

In interpreting the findings, it is important to remember that these numbers represent the difference between 2 groups when all other variables in the model have been held equal. The comparisons are therefore between 2 individuals who are otherwise the same in every respect apart from the particular characteristic or circumstance being considered. This helps to isolate the effect of any specific characteristic or circumstance on personal well-being.

In order to give a sense of the size of the relationship found between each individual characteristic and personal well-being, we have used the following schema in the reference tables attached to this article:

- values with *** have a significant relationship at the 1% level

- values with ** have a significant relationship at the 5% level

This summarises the size of the difference between how an individual from the reference group would rate their well-being for each question compared to how an individual from another group would rate the same question, holding other variables equal.

However, tables in the main article and commentary have been restricted to those results which are "significant at the 5% level", this means there is a probability of less than .05 (or less than 1 in 20) that the result could have occurred by chance.

Notes for Methodology section

1. Since wealth can take negative values, the variable was translated by the minimum value of wealth prior to applying the natural logarithmic transformation

2. Since the different components of wealth can take negative values, the variables were translated by the minimum value of wealth prior to applying the natural logarithmic transformation

6 . Results

As previously mentioned it has been cited on several occasions that there is a relationship between income and levels of personal well-being[1]. For the first time however this article will also consider the relationships between the wealth of the households in which individuals live and their personal well-being.

How much does wealth and income matter to personal well-being?

When considering data from July 2011 to June 2012 of the Wealth and Assets Survey (WAS), Table 1 shows that all aspects of an individual's well-being have a significant relationship to the wealth of the household in which they live. Life satisfaction, sense of worth and happiness are all positively correlated meaning that individuals living in households with higher wealth, on average report higher life satisfaction, sense of worth and happiness, holding other factors equal. Anxiety has a significant negative relationship with wealth, meaning that on the whole individuals living in households with higher wealth report lower anxiety levels, holding other factors equal.

The picture is not quite the same with regard to total household income, where the only aspects of well-being having a significant relationship to the income of the household in which they live are life satisfaction and happiness. Individuals living in households with higher income, on average report higher life satisfaction and happiness. In this analysis, there is no significant relationship seen between an individual's sense of worth or anxiety and the total income of the household in which they live.

Table 1: Relationships between total household wealth and total household income, and personal well-being, after controlling for individual characteristics, July 2011 to June 2012

Great Britain

	Life satisfaction	Sense of worth	Happiness	Anxiety
Log of total Household wealth	0.0868***†	0.0692***†	0.0474**†	-0.0806***‡
Log of total Household income	0.128***†	0.0114	0.127***†	-0.0481

Source: Office for National Statistics

Notes:

1. † denotes a positive significant relationship at the 5% level. ‡ denotes a negative significant relationship at the 5% level.

2. *** denotes statistical significance at the 1% level.

Distribution of wealth and income

To extend the analysis, the **distribution** of wealth and income can also be considered. This will highlight if individuals living in households with the lowest wealth or income have similar well-being experiences to those living in households with the highest wealth or income. This grouped analysis was carried out with the data grouped into 5 (quintiles) or 10 (deciles). To group the data it is ranked from highest to lowest and split into equally-sized groups. For example:

- the bottom decile contains the lowest 10% of households

- the second decile contains households between the 10th and 20th percentile of the distribution

- continuing to the top decile that contains the highest 10% of households

By splitting wealth and income in this way it allows for comparisons where groups only differ by their wealth or income. This will give an understanding of how well-being is different between these groups.

Interpreting the results

Figure 2 shows the relationship between the 10 decile groups of total household wealth compared to the mid-point, the fifth decile. While calculating estimates of this nature the regression analysis also provides a measure of error around the estimates. This error allows a certain level of context to be considered. Once included these allow the identification of groups that are different and ones that are not. Figure 3 shows the equivalent for total household income. For both Figures 2 and 3 the blue columns show the estimate while the black lines show the confidence band of where the true value could lie.

Wealth

Figure 2: Relationships between total household wealth decile groups and personal well-being, after controlling for individual characteristics, July 2011 to June 2012
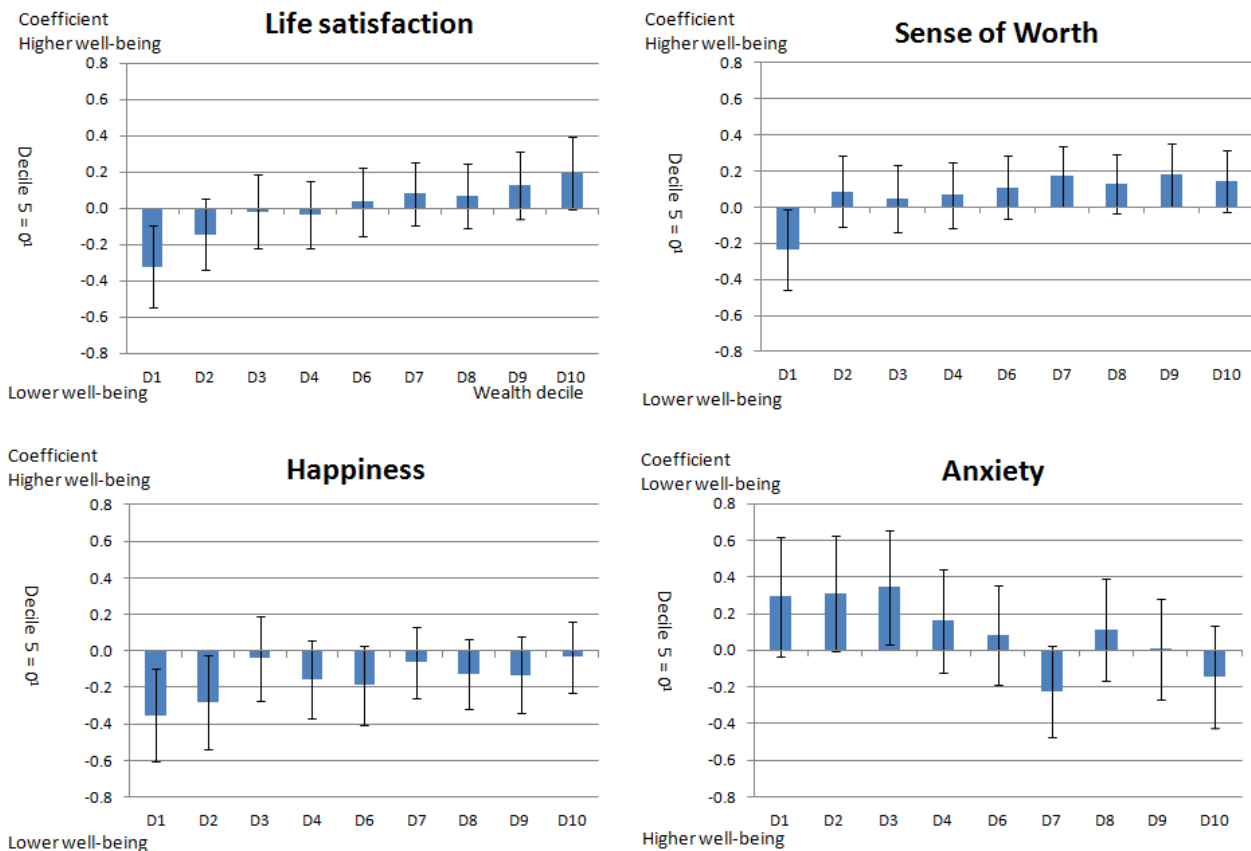
Source: Wealth and Assets Survey - Office for National Statistics

Notes:

1. People in households in the fifth decile of the total household wealth distribution are represented at the baseline (zero)

Figure 2 shows the difference in personal well-being associated with living in a household in the middle (fifth) decile group of the total household wealth distribution, compared to living in a household in one of the other groups.
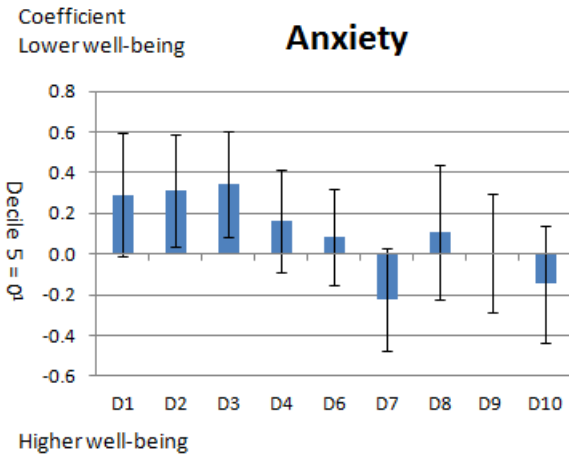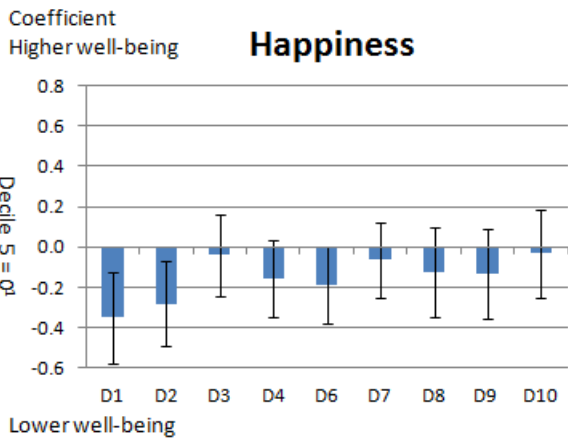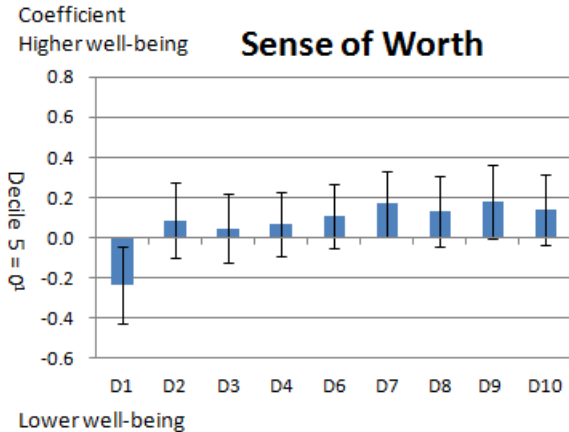
Individuals living in households in the lowest wealth decile are clearly more likely to report lower levels of life satisfaction, happiness and sense of worth than those living in households in the fifth wealth decile.

The general "shape" of each figure supports the results seen in Table 1 – with life satisfaction, happiness and sense of worth all appearing to increase as the wealth of the household is greater and anxiety appearing to be lower for individuals living in the higher wealth households. However, when other variables are held constant, the only significant differences are between decile 1 and decile 5 and between decile 1 and decile 10 for life satisfaction; between decile 1 and decile 5 and between decile 1 and deciles 7 and 9 for a sense of worth; between deciles 1 and 2 and decile 5 for happiness and between decile 3 and decile 5 for anxiety.

Income

Figure 3: Relationships between total household income decile groups and personal well-being, after controlling for individual characteristics, July 2011 to June 2012

Great Britain

Coefficient Higher well-being — **Life satisfaction**

Coefficient Higher well-being — **Sense of Worth**

Coefficient Higher well-being — **Happiness**

Coefficient Lower well-being — **Anxiety**

Source: Wealth and Assets Survey - Office for National Statistics

Notes:

1. People in households in the fifth decile of the total household income distribution are represented at the baseline (zero).

When personal well-being is assessed across income groups, similar stories can be seen. Those individuals living households in the top 3 income deciles are more likely to report higher life satisfaction than those living in households in the fifth income decile and individuals living in households in the bottom 2 income deciles are more likely to report lower levels of happiness than those living in the fifth wealth decile. When other variables are kept constant there are far fewer significant differences in the levels of well-being reported across the varying household income deciles.

Wealth components

Wealth in the WAS is made up of 4 elements; pension, physical, property and financial wealth:

- **net property wealth**: is made up by the value of any property privately owned in the UK or abroad (the value of any property owned net of any liabilities on the properties)

- **physical wealth**: this value of contents of the main residence and any other property of a household including collectables and valuables (such as antiques, artworks or stamps), vehicles and personalised number plates

- **net financial wealth**: is the value of formal and informal financial assets held by adults, and of children's assets (the value of any financial assets net of any financial liabilities held)

- **private pension wealth**: is the value of all pensions that are not state basic retirement or state earnings-related

Splitting total household wealth into these groups can indicate which of these had a stronger impact on personal well-being. Table 2 shows that only net financial household wealth and total household income have any significant relationships with well-being in this model. It shows that, on average, individuals living in households with higher net financial wealth will report higher levels of life satisfaction. This finding sits well with other articles that found relationships between expenditure and life satisfaction.

No significant relationship was found between other overall components of household wealth and the personal well-being of individuals living in these households in the analyses carried out for this report.

Table 2: Relationships between the components of wealth and total household income, and personal well-being, after controlling for individual characteristics, July 2011 to June 2012

Great Britain

	Life satisfaction	Sense of worth	Happiness	Anxiety
Log of pension wealth	-0.0183	0.0214	-0.0116	0.039
Log of physical wealth	0.0676	0.0776	0.0539	-0.112
Log of property wealth	0.0412	0.0317	0.0394	-0.0546
Log of financial wealth	0.0474***†	0.0077	0.00561	-0.026
Log of income	0.106**†	0.0188	0.125	-0.0552

Source: Wealth and Assets Survey, Office for National Statistics

Notes:

1. † denotes a positive significant relationship at the 5% level.

2. *** denotes statistical significance at the 1% level, ** at the 5% level.

Distribution of wealth by wealth components

To consider this further, the relationship between each of the wealth components and personal well-being was examined across the distribution of each component of wealth.

Table 3 shows the difference in personal well-being associated with living in a household in the middle (third) quintile of each wealth component distribution. Once again it is the financial wealth component that is having the most impact on the personal well-being measures of individuals living in the households with varying degrees of net financial wealth. Individuals living in households with the lowest 2 levels of net financial wealth are more likely to report lower personal well-being for life satisfaction with those living in households with the lowest level of household net financial wealth more likely to report lower personal well-being in the all well-being measures, that is, lower life satisfaction, lower sense of worth, lower happiness and higher anxiety, than those living in the middle or higher net financial wealth quintile groups.

There is also a significant increase in life satisfaction reported by individuals living in households in the top quintile of physical wealth compared to those living in households in the middle quintile.

Table 3: Relationships between the quintile groups of components of wealth and personal well-being, after controlling for individual characteristics, July 2011 to June 2012

Great Britain

		Life satisfaction	Sense of worth	Happiness	Anxiety
Pension wealth quintile (reference Q3)	Q1	0.00932	-0.0251	-0.0580	-0.142
	Q2	0.0802	0.0383	0.0602	-0.185
	Q4	0.0624	0.0327	-0.0175	-0.0109
	Q5	0.0243	0.0385	-0.0979	0.0312
Physical wealth quintile (reference Q3)	Q1	-0.0471	-0.0703	-0.0756	-0.0581
	Q2	0.0359	-0.00522	-0.0815	0.0995
	Q4	0.0715	0.0168	-0.00520	-0.114
	Q5	0.159**†	0.123	0.107	-0.0765
Property wealth quintile (reference Q3)	Q1	0.00668	0.0217	0.0538	0.203
	Q2	-0.0362	-0.0128	-0.0387	0.168
	Q4	-0.0247	0.00460	-0.105	0.0614
	Q5	0.0495	0.0459	-0.0124	0.0874
Financial wealth quintile (reference Q3)	Q1	-0.415***‡	-0.231***‡	-0.354***‡	0.482***†
	Q2	-0.153**‡	-0.0705	-0.0995	0.116
	Q4	0.0108	-0.00997	-0.0829	0.117
	Q5	0.0155	-0.0879	-0.0300	-0.0808

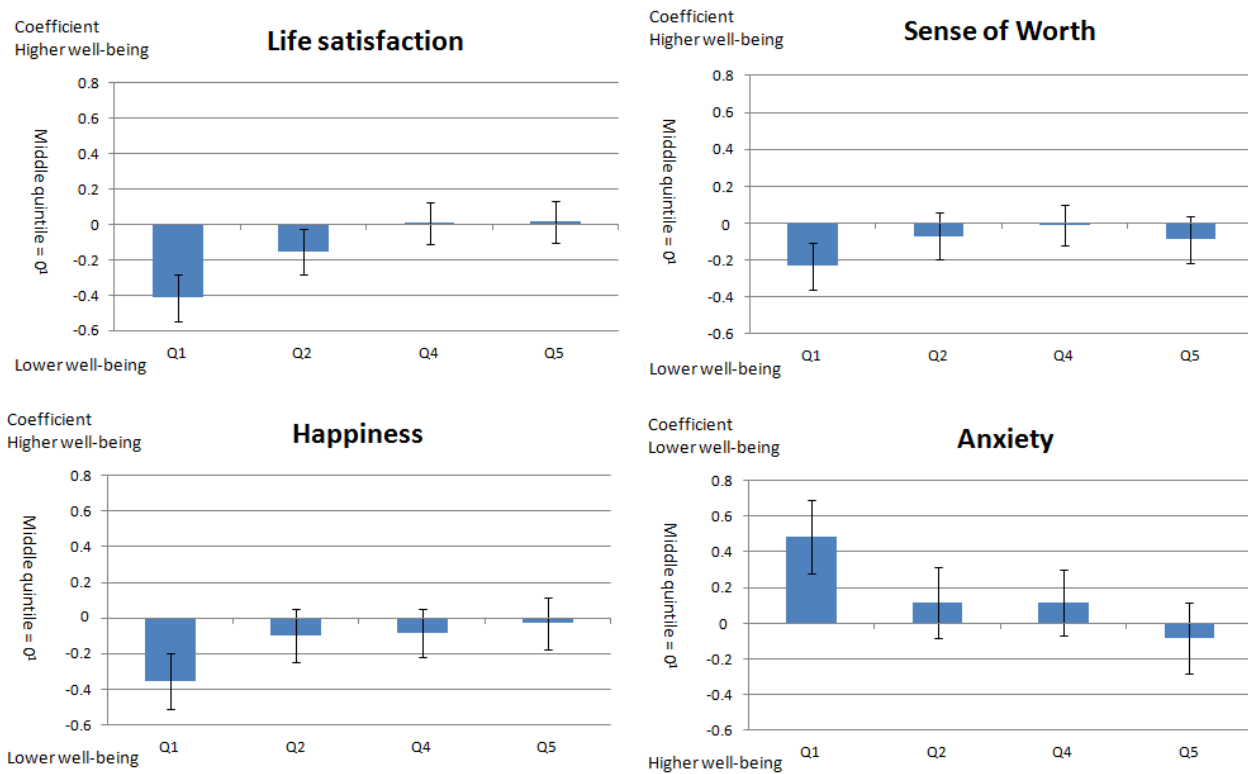Source: Wealth and Assets Survey, Office for National Statistics

Notes:

1. † denotes a positive significant relationship at the 5% level. ‡ denotes a negative significant relationship at the 5% level.

2. *** denotes statistical significance at the 1% level.

3. Q1 refers to quintile 1 (that is the lowest 20% of households when ranked in order of total household wealth), Q2 to quintile 2 etc.

Figure 4 demonstrates more clearly the relationship between an individual's personal well-being and the net financial wealth of the household in which they live. The life satisfaction chart re-iterates the conclusions drawn from the earlier tables. There is a clear increase in the likelihood of an individual reporting higher levels of life satisfaction associated with higher levels of net financial wealth of the households in which they live. This association is also seen for happiness – higher levels of happiness as net financial wealth increases – and anxiety – lower levels of anxiety as net financial wealth of the household increases. The only measure of personal well-being that does not show any significant association with the net financial wealth of the household is sense of worth.

Figure 4: Relationships between net financial wealth quintile groups and personal well-being, after controlling for individual characteristics, July 2011 to June 2012

Great Britain

Source: Wealth and Assets Survey - Office for National Statistics

Notes:

1. People in households in the third quintile of the net financial household wealth distribution are represented at the baseline (zero)

2. Q1 refers to quintile 1 (that is the lowest 20% of households when ranked in order of total household wealth), Q2 to quintile 2 etc

Notes for Results

1. Income, expenditure and personal well-being

7 . Overall conclusions

Analysis of this nature has enabled a deeper understanding of the relationships between wealth, income and well-being. The results from the Wealth and Assets Survey show that overall wealth has a positive effect on individuals increasing levels of life satisfaction, sense of worth and happiness while at the same time, decreasing levels of anxiety.

The levels of total household income are less strongly related, with relationships found only with life satisfaction and sense of worth.

When the type of wealth is considered, financial wealth is clearly seen to be the most strongly related to personal well-being. The results indicate that overall, as net financial wealth increases so does levels of life satisfaction. If this is considered across the distribution of net financial wealth, individuals living in households in the lowest quintile are more likely to report low levels of personal well-being than similar individuals living in households in the middle net financial wealth quintile.

By looking at wealth groups within the types of wealth, net financial wealth for the lowest wealth group again has a very negative effect on people's well-being. For this group the levels of life satisfaction, sense of worth and happiness are all significantly lower than for similar individuals living in households in the middle of net financial wealth distribution. For individuals living in households in the lowest net financial wealth group, levels of anxiety are also higher which shows that for all measures of personal well-being, net financial wealth for this group has a negative impact.

8 . Technical appendix

Why undertake a regression analysis?

In analysis which looks at the relationship between 2 variables, it can be tempting to infer that one variable is directly related to the other. For example, life satisfaction is higher for households in the top fifth of the wealth distribution than those in the bottom, but does this mean we can assume that the differences observed in relation to life satisfaction ratings are primarily about differences in wealth or income? For instance, older people tend to have more wealth and it is well documented that subjective well-being varies across age groups (Oguz, Merad and Snape, 2013)[1]. Similarly, people with poorer health tend to report lower level of subjective well-being and have lower income. It could very well be that wealthier (high income) people report higher well-being because they have characteristics that are associated with higher subjective well-being, and not because wealth or income in itself are directly related to subjective well-being.

Regression method is used to identify how personal well-being and wealth and income are associated once the confounding effects of other individual characteristics are accounted for. Regression analysis allows us to do this by holding all the variables in the model equal while measuring the size and strength of the relationship between 2 specific variables. If the regression results show a significant relationship between wealth, income and life satisfaction, then this means that 2 people who have identical characteristics apart from their wealth and income are very highly likely to rate their subjective well-being levels differently. Therefore, the main benefit of regression analysis is that it provides a method of isolating the factors which matter most to an individual's personal well-being.

However, every analytical method has its limitations and regression analysis is no exception. The following sections summarise some important considerations which should be borne in mind in terms of the statistical assumptions underlying the techniques used here, and the types of inference which can be drawn from the findings.

Using linear regression models for ordered responses and the robustness of the OLS estimates

An important implicit assumption in linear regression models estimated by the ordinary least square (OLS) method is that the dependent variable (the outcome we are trying to explain, such as the personal well-being rating) is continuous. Continuous data are data that can take any value (usually within a range). For example, household wealth can take any value. The personal well-being survey responses, however, are discrete, that is, they can only take on a relatively small number of whole integer values, between 0 and 10 with no other values possible, such as halves, in between.

OLS regression also assumes that the values of the dependent variable (for example, personal well-being ratings) are cardinal. This means that the interval between any pair of categories such as between 2 and 3 is assumed to be of the same magnitude as the interval between any other similar pair such as between 6 and 7. As the personal well-being responses are based on subjective ratings, it is not possible to say with certainty that the distance between 2 and 3 is the same as the distance between 6 and 7 on the 0 to 10 response scale. For example, it may be that only small changes in circumstances are required to move people from 2 to 3 in their rating of life satisfaction, but it may take a lot more for them to jump from 6 to 7. This suggests that the linear regression approach may not be ideally suited to modelling this kind of dependent variable.

There are a number of alternatives to linear regression models for modelling discrete response variables, such as logit or probit regression. In these models the categories of the responses are treated separately which means there is no implied order of the categories, for example 4 is not necessarily higher than 3. An important disadvantage of these methods is that the information contained in the ordering of the personal well-being ratings is lost. A way of overcoming this issue is to create 2 categories, for example ratings of life satisfaction above or below 7 on the 0 to 10 scale, but the resulting categories are artificial and do not capture people's actual ratings of their well-being.

An alternative method is to treat the response variable as ordinal and use regression techniques, such as ordered logit or ordered probit that are developed to deal with ordinal data. Ordinal data values can be ranked or ordered on a scale such as from 0 to 10 with each higher category representing a higher degree of personal well-being (or lower personal well-being in the case of anxiety) and unlike the linear regression models, ordered probit or ordered logit regression does not assume that the differences between the ordinal categories in the personal well-being rankings are equal. They capture the qualitative differences between different scores. It is important to note that ordinal probit/logistic performs several probit/logistic regressions simultaneously, assuming that the models are identical for all scores. The latter assumption can be relaxed but the interpretation of the results becomes more difficult.

In common with much of the existing literature modelling subjective well-being, this analysis has used ordered probit models to explore the factors contributing to a person's personal well-being. As Greene (2000) points out, the reasons for favouring one method over the other (such as ordered probit or ordered logit) is practical and in most applications it seems not to make much difference to the results.

The major advantage of such models is that it takes the ordinal nature of the personal well-being ratings into account without assuming equality of distance between the scores. Similarly to linear regression models, it identifies statistically significant relationships between the explanatory variables, for example income, wealth, age, disability, and relationship status, and the dependent variable which in this case is the rating of personal well-being. A difficulty that remains is that the estimated coefficients are difficult to explain clearly to a wide audience.

The existing literature also suggests that OLS may still be reasonably implemented when there are more than four levels of the ordered categorical responses, particularly when there is a clear ordering of the categories as is the case for the personal well-being questions which have response scales from 0 to 10 (Larrabee 2009). Several studies applied both methods to personal well-being data and found that the results are very similar between the OLS models and the theoretically preferable methods such as ordered probit. For example, see Ferrer-i-Carbonell and Fritjers (2004) for a detailed discussion of this issue.

The main advantage of OLS is that the interpretation of the regression results is more simple and straightforward than in alternative methods.

For the sake of completeness, the analysis was conducted using both OLS and probit regression methods. This also acts as a sensitivity check for the robustness of the OLS results as the key assumptions for the OLS regression may not hold for the ordered personal well-being data.

It should be noted that this does not imply that the OLS regression estimates were completely "robust". Post regression diagnostics identified some violations of the OLS regression assumptions such as model specification and the normality of residuals for anxiety in particular. However, as some studies (for example, see Osborne and Waters, 2002), suggest that several assumptions of OLS regression are "robust" to violation, such as normal distribution of residuals, and others are fulfilled in the proper design of the study such as the independence of observations. In this analysis, using the survey design controlled for the potential dependence of the individual observations with each other and applying the survey weights provided some protection against model misspecification.

Additionally, estimating the models using different specifications as well as 2 methods (OLS and ordered probit) confirmed that the magnitude and the statistical significance of the parameter estimates did not notably change and the general inferences from the analysis remained the same.

The explanatory power of the models

It is important to note that the explanatory power of the regression models used in this analysis are similar to that of other reported regression analyses undertaken on personal well-being (ONS, 2013a). As with these previous studies, there are substantial differences in the ability of the models as a whole to explain different aspects of well-being.

The lowest proportion of variance explained by the statistical models was for anxiety, at between 6 to 7%. A higher proportion of the variance in individuals' happiness and their sense that the things they do in life are worthwhile was explained by the models at around 11% and 13% respectively. As is consistent with previous studies (Kahneman and Deaton, 2010 and ONS, 2013a, b), a much larger proportion of the variation in individual's life satisfaction was explained, at 18 to 19%. On the whole the levels of explanatory power observed in this analysis are very similar to those found on other analyses of sample surveys, such as ONS (2013a, b) and Headey, Muffels and Wooden (2004).

The limited explanatory power of the model could be due to leaving out important factors which contribute to personal well-being. For example, genetic and personality factors are thought to account for about half of the variation in personal well-being. It has not been possible to include variables relating to personality or genes in the models as the Wealth and Asset Survey does not include data of this type. However this does not imply that the coefficients of the wealth and income variables are estimated with a biased: the estimated coefficients are unbiased as long as all the variables that influence both wealth (income) and personal well-being are included in the regression model.

The subjective nature of the outcome variable also means that it is probably measured with some imperfect reliability. The lower the reliability of the outcome variable, the more unclear its correlations with other variables will tend to be.

The residuals from the linear models are well behaved (that is, normally distributed with a mean close to 0) for life satisfaction individuals' happiness and their sense that the things they do in life are worthwhile. However, the residuals from the model explaining anxiety are not normally distributed. Therefore, great care should be paid when interpreting the significance of the coefficient in the models explaining anxiety.

Omitted variable bias

Ideally, a regression model should include all the relevant variables that are associated with the outcome (that is, variable being analysed such as personal well-being). In reality, however, we either cannot observe all the potential factors affecting well-being (such as personality) or are limited by whatever information is collected in the survey data used in the regression analysis.

If a relevant factor is not included in the model, this may result in the effects of the variables that have been included being mis-estimated. When the omitted variables are also correlated with the independent variables of interest in the model, the coefficient estimates of those variables will be biased and inconsistent. However, the estimated coefficients are less affected by omitted variables when these are not correlated with the included variables (that is, the estimates will be unbiased and consistent). In the latter case, the only problem will be an increase in the estimated standard errors of the coefficients which are likely to give misleading conclusions about the statistical significance of the estimated parameters, since coefficients that are not significant may have been significant of these omitted variables had been included in the model.

Multi-collinearity-dependence (or correlations) among the variables

If two or more independent variables in the regression model are highly correlated with each other, the reliability of the model as a whole is not reduced but the individual regression coefficients cannot be estimated precisely. This means that the analysis may not give valid results either about individual independent variables, or about which independent variables are redundant with respect to others. This problem becomes increasingly important as the size of correlations between the independent variables (that is, multi-collinearity) increases.

As there is no formal statistical test that can be used to identify excessive multi-collinearity when the covariates in the model are dummy variables, an informal method of cross-tabulating each pair of variables can be used, along with analysis of the Pearson correlation coefficients between variables and the Variance Inflation Factors (VIFs) of each of explanatory variables. When very high correlations between the variables were observed, the explanatory regressions were rationalised by removing the variable with the weaker relationship with well-being.

There is a high degree of correlation between net household income and total household wealth. Both are included simultaneously in our models in order to separate their effects on well-being.

The main concern is that some type of income could be a direct function of some type of wealth: income from dividends and interests is a function of financial wealth. This would imply that total net income and total household wealth are not independent. However, since in our sample financial wealth makes up less than 12% of total household wealth it is not likely to be a major threat to the validity of our results.

Causality

Regression analysis based on cross-sectional observational data cannot establish with certainty whether relationships found between the independent and dependent variables are causal. This is particularly the case in psychological contexts where there may be a reciprocal relationship between the independent and the dependent variables.

For example, the usual assumption is that individual characteristics or circumstances like marital or employment status are independent variables which may affect personal well-being (viewed here as a dependent variable). However, some of the association between employment and well-being may be caused by the impact of personal well-being on employment.

Furthermore, as the data used in the regression analysis here are collected at one point in time (that is, cross-sectional), they are not able to capture the effect of changes over time and identify which event preceded the other. For example, it is not possible to tell from this data whether movement out of employment precedes a drop in well-being or whether a drop in well-being precedes movement out of employment. We can only definitely say that unemployment is significantly related to lower levels of well-being compared to people who are employed. Therefore, while the regression analysis here can demonstrate that a relationship between 2 variables exists even after holding other variables in the model equal, these findings should not be taken to infer causality.

The coefficients reported in this article cannot be taken as the difference in well-being experienced immediately before and immediately after a change in income or wealth. Previous studies (such as Di Tella et al., 2003) have suggested that an increase in economic prosperity can lead to a large increase in well-being immediately after the change occurs. However, over time people can "adapt" to their new level of prosperity, and their reported well-being appears to fall over time back to a level closer to that before the change. Brickman et al. (1978) appear to find this even in the case of extreme changes in prosperity, by observing the well-being of lottery winners.

As households with a low wealth or income in a particular year are likely to have had low wealth and income in the previous year, and households with a high wealth and income are likely to have had a high wealth and income in the previous year (Jenkins, 2011), many individuals in this analysis will have had time to fully adapt to their current levels of wealth and income. However, some individuals in this data set will have experienced recent changes in their level of wealth or incomes, and so the coefficients reported in this analysis cannot be assumed to be the effect on well-being of different wealth and income levels after individuals have fully adapted to these changes.

It should also be noted that the data used in this analysis are from responses to the Wealth and Asset Survey between July 2011 and June 2012. This was a period of low economic growth, and it cannot necessarily be assumed that the relationships during this time will be representative of the relationship between wealth and income in different economic conditions.

Notes for Technical appendix

1. [Measuring National Well-being - What matters most to Personal Well-being?](#)

9 . Main analysis variables

Equivalisation

Equivalisation is a process that makes adjustments, so that the standard of living of households with different compositions can be compared. The Organisation for Economic Co-operation and Development (OECD) have developed guidelines for producing and analysing income and wealth statistics. The following is an extract from the section on the equivalisation of wealth[1]:

In the case of household income, there are internationally recognised equivalence scales that are used to standardise the estimates with respect to household size and composition while taking into account the economies of scale that arise from living together, in particular through the sharing of dwellings. In the case of household wealth, however, no internationally agreed equivalence scales exist, and there is no consensus on whether the scales used for income are appropriate for wealth. In studies jointly analysing income and wealth, the equivalence scale applied to income is also applied to wealth (OECD, 2013).

The use of equivalence scales in the case of wealth depends on the purpose of the analysis. Equivalence scales should not be used when analysing the characteristics of individual components of wealth. If, on the other hand, wealth is treated as a source of income streams that can be used to finance consumption and contribute to economic wellbeing in the household, wealth might be equivalised just as income. Equivalised estimates are often expressed in terms of single-person household equivalents (that is, the level of wealth that would be required by a lone person household to have the same level of economic well-being as the household in question).

Failure to equivalise could provide a misleading picture of the distribution of wealth, for example by overstating the share of single-person households at the bottom of the distribution.

To date data from the Wealth and Assets Survey (WAS) have not been equivalised and, based on the guidance above, further work needs to be carried out to assess the appropriateness of the scale to be used for this process.

Consideration was given to equivalising income for this article, but again, this has not yet been done for income data from the WAS. It was, therefore, decided to proceed without equivalising either wealth or income on this occasion.

Some of the control variables used in the regression model – for example, presence of children in the household, would have partially reduced the impact of not equivalising. Nevertheless, the conclusions drawn may have been affected by this decision.

Wealth and income

For the regression models in this article, a natural logarithmic transformation has been applied to wealth and income.

Looking at the absolute difference in well-being resulting from a percentage difference in wealth reflects the widely held notion that an absolute increase in wealth of, for example £10,000, is likely to have a larger impact on the individual if they have not much wealth than if they are very wealthy; but that a percentage difference in wealth is likely to have similar effects on people of different income levels. This is an application of Weber's Law, which states that the size of a just noticeable difference in a stimulus (such as a sound), is generally a fixed proportion of the intensity of the original stimulus. Evidence from the United States (Kahneman and Deaton, 2010) suggests that this may apply to responsiveness of personal well-being to differences in income.

In addition to helping the models better fit the relationship between personal well-being and income and expenditure, applying a logarithmic transformation reduces the skewness of the income distribution due to very high income and expenditure cases, reducing the influence of these outliers and helping to "normalise" the income and expenditure distributions.

Use of a logarithmic transformation does, however, necessitate further calculations in order to work out the difference in personal well-being associated with a percentage difference in income. In the following formulae, is the regression coefficient produced for log income or log expenditure, is the percentage difference in income or expenditure for which an associated difference in well-being is sought, and ln is the natural logarithmic function.

The difference in well-being from a % increase in income or expenditure = x ln(1 + %))

The difference in well-being from a % decrease in income or expenditure = x ln(1 - (%))

However, note that in models that include log-transformed variables the coefficients are usually interpreted as marginal effects because a very small change in the log transformed variable the effect on the dependent variable can be approximated by , as ln(1+) if 0. For instance, if =1% then the difference in well-being is 0.00995× , which can be approximate into .

Wealth components

This article also looks at the differences in well-being associated with differences in types of wealth. Wealth is divided in 4 components: private pension wealth, net property wealth, net financial wealth and physical wealth.

Since physical wealth can only take strictly positive values, the natural logarithmic transformation was applied without any further changes to the variable.

Private pension wealth only takes positive value but may be nil. Therefore an arbitrary constant (0.01) is added to the variable before the logarithmic transformation is applied.

Net property wealth and net financial wealth can take negative values, so the variable is translated by the additive inverse of its minimum prior to applying the natural logarithmic transformation.

Wealth and income quintiles

In order to analyse how well-being differs across the total household wealth and total household income distributions, while holding other factors equal, further regression models were produced with the log of the wealth or income variables replaced with the quintile of the household wealth or income distribution a person is living in.

This approach is less appropriate for calculating the statistical significance of the relationship between household wealth or income and well-being than analysing the relationship between the logarithm of household wealth or income and well-being, as information about differences in well-being associated with small differences in income within fifths of the income distribution is lost. However, including the fifth of the wealth or income distribution that a household occupies in the regressions can provide some interesting insights into the implications of the distribution of income for personal well-being.

The figures in the quintile tables in this article can simply be interpreted as the difference in personal well-being between an individual in any quintile relative to the personal well-being of an individual in the middle quintile, holding other factors equal.

Notes for Main analysis variables

1. OECD Guidelines for-Micro-Statistics on Household Wealth Chapter 7

10. References

1. Brickman, P., Coates, D. And Janoff-Bulman, R., (1978). 'Lottery Winners and Accident Victims: Is Happiness Relative?', Journal of Personality and Social Psychology, Vol. 36, No. 8, 917-927.

2. Di Tella, R., New, J.H.-D. and MacCulloch, R., (2010). 'Happiness Adaptation to Income and to Status in an Individual Panel', Journal of Economic Behavior and Organization, doi:10.1016/j.jebo.2010.09.016.

3. Ferrer-i-Carbonell, A. and Frijters, P. (2004). 'How important is methodology for the estimates of the determinants of happiness', The Economic Journal, 114, 641-659.

4. Fleche, S., Smith, C. and Sorsa, P. (2011), 'Exploring determinants of subjective wellbeing in OECD countries – evidence from the World Value Survey', OECD Economics Department Working Paper, No. 921.

5. Greene, W. H. (2000) 'Econometric Analysis', Upper Saddle River, NJ: Prentice-Hall, fourth edition.

6. Headey, B., Muffels, R. and Wooden, M. (2004) 'Money Doesn't Buy Happiness ... Or Does It? : A Reconsideration Based on the Combined Effects of Wealth, Income and Consumption', IZA Discussion paper series, No. 1211.

7. Jenkins, S. (2011), 'Changing Fortunes: Income Mobility and Poverty Dynamics in Britain', Oxford University Press.

8. Kahneman, D. and Deaton, A. (2010) 'High income improves evaluation of life but not emotional well-being'. Proceedings of the National Academy of Sciences of the United States of America, Vol.107, No.38, 16489–16493.

9. Larrabee, B. (2009), 'Ordinary Least Squares Regression of Ordered Categorical Data: Inferential Implications for Practice' Kansas State University.

10. OECD (2013), 'OECD Framework for Statistics on the Distribution of Household Income, Consumption and Wealth', OECD Publishing.

11. Office for National Statistics (2013a) What matters most to personal well-being?

12. Office for National Statistics (2013b) Commuting and Personal Well-being, 2014.

13. Osborne, Jason & Elaine Waters (2002). Four assumptions of multiple regression that researchers should always test. Practical Assessment, Research & Evaluation, 8(2).

14. Stevenson, B. and Wolfers, J. (2008), 'Economic Growth and Subjective Well-Being: Reassessing the Easterlin Paradox', NBER Working Paper, No. 14282.

11. Background notes

1. Details of the policy governing the release of new data are available by visiting www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html or from the Media Relations Office email: media.relations@ons.gsi.gov.uk