THE UNIVERSITY OF WARWICK

August 2012 No.94

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WORKING PAPER SERIES

Centre for Competitive Advantage in the Global Economy

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A Reassessment of the Relationship Between GDP and Life Satisfaction

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Abstract: Determining the relation between life satisfaction and aggregate income at country level has been problematic, because cross-country and times-series analysis generally give different conclusions. Here we analyze this relation without imposing any polynomial structure to the estimated model and eliminating potentially confounding country-specific factors. We show the existence of a bliss point in the interval between 26,000$ and 30,000$ (2005 in PPP) in relationship between individual life satisfaction and GDP. An almost identical result is found when the relationship between aggregate income of Western European regions and life satisfaction of their residents is analyzed: in this case, data suggest a bliss point between 30,000$ and 33,000$. In both samples, we find first evidence of a decreasing level of life satisfaction after the bliss points. Therefore, the analysis overall shows the existence of an hump-shaped pattern between GDP and life satisfaction.

We discuss possible explanations of the hump-shaped pattern linked to external effects of the aggregate income on life satisfaction due, for example, to habit formation and income comparison and present an econometric test of this potential explanation based on some recent findings of the five-factor personality theory.

JEL Classification: D60; D870; C33.

Keywords: Life Satisfaction, GDP, Income, Personality

*__Acknowledgements:__ The authors thank several coauthors and colleagues for discussions on related research, especially Wiji Arulampalam, Sascha Becker, Gordon Brown, Dick Easterlin, Peter Hammond, Alessandro Iaria, Graham Loomes, Kyoo il Kim, Rocco Macchiavello, Anandi Mani, Fabien Postel-Vinay, Dani Rodrik, Jeremy Smith, Chris Woodruf, Fabian Waldinger. Proto thanks the ESRC (grant RES-074-27-0018); Rustichini thanks the NSF (grant SES-0924896) and ESRC (grant RES-062-23-1385)

1 Introduction

At present, welfare of nations is measured indirectly: Gross Domestic Product is used to asses the aggregate development of a country. Subjective and self-reported measures have traditionally been considered unreliable among economists. However, from a medical point of view, growing evidence points to a robust correlation between answers to subjective well-being questions and objective measures of personal well-being.[1] Furthermore, an important piece of empirical evidence, comparing explicit indexes of well being, has been recently provided by Oswald and Wu (2010) showing for the US a state-by-state remarkably precise match between classical objective measure (like air quality, climate, etc.) of well-being and subjective measure. Thus, even if prone to idiosyncratic distortions, subjective measures correlate with objective measures, so their significance is supported.

Perhaps because of these considerations, the Commission on the measurement of economic performance and social progress created at the beginning of 2008 on French government's initiative, and formed by a distinguished group of social scientists, put subjective well-being into the limelight as a possible supplement to traditional measures of development such as GDP (Stiglitz et al., 2009). Also the British government as shown considerable interest in developing subjective wellbeing measure in recent years as an instrument for policy (e.g. Michealson et al., 2008).[2]

The debate on whether GDP growth increases happiness, or more precisely whether higher income in a country is associated in general with higher life satisfaction among the citizens is considered of crucial importance for scientific and for policy reasons. For

[1] See Clark et al. (2008) for an extensive survey on this literature.

[2] Key milestones include the Local Government Act 2000 giving power to Local Authorities to promote social wellbeing, publication of the Prime Ministers Strategy Unit paper Life Satisfaction: The state of knowledge and implications for Government in 2002 and the UK Sustainable Development Strategy which committed the Government to exploring the policy implications of wellbeing research (Waldron, 2010).

example, if one thinks that the answer is fundamentally positive, then there is no need for alternative measures of the wealth of a nation, and traditional values gross domestic product measures suffice. If the answer is no, then there is a fundamental need to re-evaluate what public policies take as objective.

The scientific debate on the relation between Gross Domestic Product and self reported indices of life satisfaction is still open. In a well-known finding, Easterlin reported no significant relationship between happiness and aggregate income in time-series analysis. For example, the income per capita in the USA in the period 1974-2004 almost doubled, but the average level of happiness shows no appreciable trend upwards. This puzzling finding, appropriately called the Easterlin Paradox (Easterlin, 1974) has been confirmed in similar studies by psychologists (Diener et al., 1995) and political scientists (Inglehart, 1990), and for European countries, Easterlin (1995).[3]

Life satisfaction appears to be monotonically increasing with income when one studies this relation at a point in time across nations (Inglehart, 1990; Deaton, 2008; Stevenson and Wolfers, 2008). It has been suggested that a way to reconcile the cross-sectional evidence with the Easterlin's Paradox is that the positive gradient in happiness disappears after a certain bliss point (Layard, 2005; Inglehart, 1990; Inglehart et al., 2008; di Tella et al., 2010). This last interpretation has been questioned by Deaton (2008) and Stevenson and Wolfers (2008) who claim that there is a positive gradient between GDP and life satisfaction in developed countries and, from the opposite perspective, by Easterlin et al. (2010), who provide some evidence of no long-run effect even for developing countries.

We perform our analysis without imposing a particular functional form to the econometric model. We partition all individuals' observations in different quantiles according

[3]There is some disagreement in the time-series based analysis: Oswald (1997) shows evidences of a small positive temporal correlation between life satisfaction and GDP in industrialized countries and Stevenson and Wolfers (2008) find significant happiness gains in Japan the post-war period.

to per capita GDP of the country of residence. Therefore, the 1st quantile of the distribution contain the fraction of individuals living in the poorest country, and the last quantile a similar fraction of individuals leaving in the richest countries. We initially consider a partition in 15 quantiles, but then we repeat the analysis for 30 and 50 quantiles partitions. Estimating the impact of each dummy variable, indicating the different quantiles, on individuals' life satisfaction we find, in the 15 quantiles analysis, an increasing coefficient until the 12th quantile, then coefficient seem to decrease to become statistically smaller in the 15th quantile. A similar analysis is performed for the European regions, with the only difference that individuals are subdivided in 5 quintiles and 10 quantiles: the coarser grid is chosen because of the smaller variance in the regional GDP.

The above findings imply a non monotonic pattern between GDP and individuals life satisfaction, consistent with a hump-shaped relation with a bliss point in the interval between 26,000 and 30,000 2005 USD, in PPP. We also find a positive relation between aggregate income and life satisfaction across poorer countries: this relation seems to turn negative in richer countries. Most of the variation of life satisfaction due to GDP is explained by the effect in countries with per capita GDP below 10,000 USD. The probability of reporting the highest level of life satisfaction is more than 10% lower in the poor countries with a GDP below 5,600 USD than in the richest counties with a GDP above 36,600 USD. For counties with an income above 10,000 USD the probability of reporting the highest level of life satisfaction changes within a range of 3% maximum. This pattern is robust to the introduction of a number of demographic and occupational controls and to the year fixed effect.

Our findings are not in contrast with the previous cross sectional analysis. The differences with this literature are easily explained by the method we use: in fact our data replicate results in the cross-country based literature when similar methods are used. For example, we will see that when one uses all countries and waves in the World

Value Survey, data show a monotonic relation between GDP and life satisfaction if we do not introduce country-specific dummies. Similarly, our findings are not in contrast with the previous times-series based analysis, mostly focused on developed countries, but it allows to pool data to an extent which is larger than what is allowed by separate times-series analysis at country level.

The possibility of controlling for the country specific effect makes it possible to control for time-invariant country-specific unobservable variables, therefore eliminating a potential source of country-specific measurement errors and omitted-variable bias. Introducing this control is an element of crucial importance for analysis based on survey, because the questionnaires are generally different across countries and there are pervasive effects due to culture or language and social capital. Stevenson and Wolfers (2008) and Sacks et al. (2010) estimated the effect of life satisfaction over GDP, using the WVS and controlling for country effect, but they impose a logarithm structure to the model.

Measurement errors of life satisfaction indices are various: for example, a well known error is the differential item functioning, defined as the inter-personal and inter-cultural variation in interpreting and using the response categories for the same question (Holland and Wainer, 1993).[4] If this differential item functioning generates a systematic measurement error in the life satisfaction reports, this could lead to either a positive or negative bias depending on the correlation between the measurement error and other variables in the regression. For example, if Western countries tend to over-report their life satisfaction, this could generate a positive bias in cross-country estimates of the impact of Income on life satisfaction. Omitted-variable bias could be equally problematic. For example, if cultural elements determine a time invariant preference for public good supply in some country, or if income distribution – usually very persistent in time– is

[4]Angelini et al. (2009) and Bonsang and van Soest (2010) using vignettes to correct for Individual-Specific Scale Biases show that variations in response scales explain a large part of the cross European country differences found in raw data.

correlated with both life satisfaction and GDP, this would result in a bias in the relation between GDP and life satisfaction. Controlling for country specific effect eliminates all biases than could be generated by the time invariant unobservables mentioned in the examples.[5]

To further validate this result we conduct a cross sectional analysis on more homogeneous territorial units, and consider all regions in the European Union before the first enlargement (we will refer to this group of country as EU14) to eliminate potentially confounding factors at country level. As expected, we obtain similar non monotonicity in the relation between individual life satisfaction and regional GDP, without controlling for regional or country effects. Data show a positive relation between aggregate income and life satisfaction across poorer regions, and then this relation turns negative for richer regions with a bliss point between 30,000 and 33,000 2005 USD in PPP.

The existence of a non monotonic relation for rich countries provides important insight in the analysis of the determinant of individual life satisfaction. Accordingly, in the last main section of the paper we investigate the reason of the non monotonic relation emphasized by our results. It is known that life satisfaction is increasing in personal income at a decreasing rate (e.g. Blanchflower and Oswald, 2004; Layard et al., 2008; Kahneman and Deaton, 2010). However, considering the relation between GDP and life satisfaction, a considerable literature following the Easterlin paradox suggest that this link is complicated by the existence of other effects acting with an opposite sign: (i) the aspirations adapt to the new situations, an idea originally proposed by Brickman and Campbell (1971);[6] (ii) the effect of the relative income on individual life satisfaction – the so-called "Keeping up with the Joneses" hypothesis– an idea that can de dated back

[5]Furthermore, the panel structure of the WVS offers the possibility to include the year fixed-effect that, together with individual employment status and personal income, allows to control for the main effects of the short-run business cycles that it is well known to have an impact on life satisfaction (DiTella et al., 2001; Easterlin et al., 2010).

[6]Easterlin (2005), Stutzer (2004), McBride (2006) provides some empirical evidence on how aspirations increase in income

to Duesenberry (1949).[7]

We will show with a simple example that if the relation between GDP and life satisfaction is the result of combined effects of personal income, increasing aspiration and/or increasing target in terms of income comparison, the net effect is not obviously monotonic. We test this possibility using the EU14 data and we find the usual positive effect due to the personal income and a negative effect due to the negative distance between personal income and regional GDP. Using modern personality theory we will argue that this second effect can be related to the negative effect induced by the distance from the target income.

The paper is organized as it follows: in the next section we present the data. In section 3 we present the country based analysis. Section 4 is devoted to the region based analysis. In section 5 we discuss the possible reason for the non monotonic patterns emphasized above. Section 6 concludes.

2 Data

We use the World Value Survey (WVS) for both the country level and European regional analysis. In the WVS the variable used to measure personal satisfaction is the answer to the question: *"All things considered, how satisfied are you with your life as a whole these days?"* coded on a scale from 1 (dissatisfied) to 10 (satisfied). The data are generally available for five waves: 1981-1984, 1989-93, 1994-99, 1999-04, 2005-08; we exclude few country-waves explicitly considered not representative in the WVS. Individuals in the sample are different in each wave. From the WVS we will also consider the personal income measure, coded in 10 steps in the WVS dataset and considered comparable

[7]Clark and Oswald (1996), Blanchflower and Oswald (2004), Luttmer (2005), Senik (2009) among others present empirical validations of this hypothesis. See Clark et al. (2008) for an extensive survey of the theoretical and empirical literature explaining the Easterlin Paradox.

across countries. Education, in term of age of leaving education, coded from 1 to 10, ranging from less than 12 until to more than 21. The categories for Employment status are: Full time, part time, self-employed, retired, housewife, student, unemployed, other. Town size is coded in 1 to 8 sizes, ranging from less than 2000 until 500,000 and more.

The Country per capita GDP is from the World Bank World Development Indicators data-set, and they are in constant 2005 US international dollars PPP adjusted. In the paper we partition the observation in 15, 30 and 50 quantiles, according to the GDP data, the different country/wave in the 15 quantiles partition are presented in the section A.1 of the appendix. Table 2 provides a description of the main variables.

In the second analysis we focus on the 14 European countries before the accession of the east European countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom) and consider the observation at regional levels. The European regions are defined following the *Nomenclature of Territorial Units for Statistics* (NUTS2) used by the EU; we have data for 171 regions. The regional per capita GDP data are from the Eurostat dataset; the values in Euros are Purchasing Power Parity (PPP) adjusted. We then transform the regional GDP data in constant 2005 USD using the Consumer Price Index (CPI) of World Bank-World Development Indicators dataset.[8] Table 1 provides a description of the main variables for the European region based analysis, while the list of the countries in each quantile for the 5 quantile partition is provided in section A.2 of the appendix.

3 Country Based Analysis

We perform the following analysis by using as main explanatory variables dummies indicating the different quantiles of the per capita GDP distribution among countries. We

[8]In a few cases the WVS regional classification did not match exactly the EUROSTAT classification, so we needed to aggregate some of the WVS regions (details are available upon request)

will show that the coefficient of the quantile dummies reveal a pattern of life satisfaction strongly increasing with GDP in low income countries, then it becomes much less steep after 10,000 USD and, interestingly enough, life satisfaction shows a tendency to decline with GDP for the richest countries.

We start by partitioning all individual observations in 15 quantiles of about 21,000 observations each.[9] We estimate different variations of the following model:

$$satisfaction_{i,j,t} = \alpha_j + \beta_{1,z} quantile(z)_{j,t} + \eta_t + \Gamma K_{i,j,t} + u_{i,j,t} \quad (1)$$

where i, j, t denotes the individual i, country j and period t respectively. The term $quantile(z)_{j,t}$ is a dummy variables equal to 1 if the country j at time t belongs to the quantile z and 0 otherwise; α_j are country dummies, η_t are period dummies, $K_{i,j,t}$ is a vector of individual characteristics and $u_{i,j,t}$ is an error term.

For expositional simplicity we will always consider last quintile, the one containing the richest countries, as the base to compare all other group and we will therefore omit it in all the specifications of model (1) that will follow. In order to take into account the ordinal nature of life satisfaction variable we use an ordered probit estimator, and to take into account the possible heteroscedasticity in the data we cluster the errors at wave and country level to calculate the standard errors.

It is perhaps useful to note that the ordered probit estimator for this model is not inconsistent even if we are using country-specific dummies. The reason is that we are using individual data, this avoids the incidental parameters problem generated by the increase of parameters with the number of observations n following the introduction of the individuals' fixed effects.[10]

In table 3 we present different variations of the simplest specification of model (1),

[9]The resulting GDP brackets of each quantile are in the horizontal axis of figure 1 of the appendix and the county-wave combinations in each bracket are presented in section A.1 of the appendix.

[10]See Greene 2008, part 4.2 for a discussion on this argument.

without time dummies, η_t and the controls $K_{i,j,t}$. We will henceforth define this as the baseline specification. Given that we use the last quantile as the base level, a positive (negative) and significant coefficient implies a positive (negative) and significant differential effect on life satisfaction with respect to the last quantiles. Hence the existence of positive and significant coefficients of any of the quantile dummies reveal a non monotonically-increasing pattern. In particular from column 1 of table 3, we note that the coefficients of the different quantiles reveal a statistically significant non monotonic pattern. There is a significantly positive differential effect (i.e. the coefficients are negative and significant) between life satisfaction of individuals living in the richest countries (with a GDP larger than 38K 2005 USD in the 15^{th} quantile) and individuals living in countries with less than about 10K USD (individuals in the 7th quantile and below). The coefficients are statistically non different from 0 within the interval 11K and 25K (between quantile 7^{th} and 11^{th}), then they turn positive until the 14^{th} quintile. Therefore, column 1 of table 3 suggest non monotonic relationship between GDP and life satisfaction .

Table 1 presents the marginal effects of the estimated model presented in the 1^{st} column of table 3. The 1^{st} column of table 1 shows the estimated marginal effects of the different quantiles on the probability of declaring the highest level of life satisfaction, 10. The $2^n d$ column shows the elasticities obtained by estimating an OLS model, therefore assuming a cardinal structure to the life satisfaction reports. In both cases we note that the peak in life satisfaction is achieved in the interval 26,500 - 29,900 USD (12th quantile), and that the dummies related to this interval is statistically larger than the baseline dummies (related the last quantile), this suggest the existence of an hump shaped pattern for rich countries. Individuals in the 12th quantile have about 2% more chance of declaring the highest level of satisfaction than individuals in the last quantile. Furthermore, we note that the probability of being fully satisfied is more than 10% lower

in the poor countries in the first 3 quantiles than in the richest counties of the last quantile (figure 1 of the appendix plots the marginal effects of the estimated quantile coefficients presented in table 1).

These results are consistent with the result in column 4 of table 3, where we imposed a quadratic structure to the estimated model, whose interpolating line reach its peak at about 31K (statistically different from the upper bound of 64K). Comparing the 1^{st} with the 2^{nd} column of table 3, we note that the relation between life satisfaction and country GDP seems monotonic when we do not include the country specific effect; this is consistent with the current literature (e.g. Deaton, 2008; Stevenson and Wolfers, 2009). In section A.1 of the appendix, we can observe the country wave combination belonging to the last quantile.[11] The hump-shaped relation is robust to the exclusion of Singapore and Luxembourg, as we can see from the 3rd column of table 3.

In table 5 we show the estimation results of a more complete specification of model (1). The non monotonic pattern holds when we introduce controls for year effect and individual demographic (column 1) and education and employment status (column 2). Note that also the introduction of the personal income (in column 3) does not seem to change qualitatively the non monotonic relation between GDP and life satisfaction. It is therefore arguable that the relation between aggregate incomes and life satisfaction is due to external effects. In the last main section of the paper we will try to shed some light on the mechanisms generating this pattern. Finally note from the 4^{th} column of table 5 that data are consistent with a quadratic model, where the interpolating line has a maximum at around 30K, similar to the one in column 4 of table 3.[12]

In order to have a better description of the pattern governing the non monotonic

[11]The countries are Australia, Luxembourg, Netherlands, Norway, Singapore, Sweden, Switzerland, UK, US; each represented in one or more waves

[12]We run the same regression (unreported) by using the logarthm of GDP as regressor and we find a (statistically significant) coefficient of 0.47, close to the 0.5 reported by Sacks, Stevenson and Wolfers (2010) in a regression using a similar econometric model

relation between GDP and life satisfaction, especially in the richest countries, and also to check the robustness of the above results, we estimate model (1) using smaller partitions and hence grouping the data in a larger number of quantiles. In table 6, we show the coefficients of the 30 quantiles in the baseline specification of model (1) and their confidence intervals, where errors are clustered at country and wave levels. We can therefore observe their statistical difference from 0, the base coefficient indicating the 30^{th} quintile. All coefficients between 21^{st} and 28^th quantiles are above the one in the 30^{th}. Also this pattern seems hump-shaped, with the coefficient increasing until the 23^{rd} quantile– corresponding to a GDP interval 25K-26K– and then decreasing.

A hump shaped pattern is also consistent with figure 1, where we partitioned the country-wave observations in 50 quintiles and we interpolate a cubic line. The quadratic and cubic coefficients of the interpolating line are both significant at 1 % level and, we can observe a maximum around the 40th quantile, corresponding to a GDP interval 28.3K- 2.8.5K. In figure 2, we display only the coefficients of the 25 richest quantiles, corresponding to the top 50% GDP, and its quadratic interpolation with the 95 % confidence interval. We observe that the quadratic interpolation features a peak at around the 40^{th} quantile; from a visual inspection of the figure we note that a monotonic pattern within the 95 % confidence interval can be rejected.

4 Region Based Analysis

We showed that when one controls for country heterogeneity introducing a country specific effect, life satisfaction is not monotonically increasing with GDP. In order to validate the former result we now analyze the relation between GDP and life satisfaction among more homogeneous territorial units. We restrict our selection to all countries belonging to the EU before the enlargement to the eastern European countries, we refer to

this group as EU14 countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom), in order to have more variation and observations we consider the data at regional level.[13] Given the higher level of homogeneity within the group of countries we are considering, we expect that a relation similar to the one we have seen holds for this selection, without controlling for country (or region) effects.

In a similar way as before we group observations in 5 quantiles based on GDP for each region-wave, with about 6,500 observations per quantile in the 5 quantiles. Later we show similar results when we consider a partition in 10 quantiles. The list of region-wave per quantile are presented in section A.2 of the appendix. In table 7 we present the results, with data partitioned in 5 quantiles, as before the last quantile is the base one, and for this reason it has been omitted, given the small amount of observations in several regions we calculated the standard errors by clustering the errors at quantile levels.

Column 1 of table 7 shows that life satisfaction invariably increases in the first 4 quintiles and decreases in the last. In this column– consistently with to the logic of this second test– we are not controlling for country, or regional heterogeneity. In column 2 of table 7 we show that the result is robust to the introduction of country specific effect. In column 3 we introduce town sizes dummies to control for congestion, employment status, education and year fixed effect. Note that the year fixed effect is a particularly effective control for economic cycles given the high degree of economic integration among the European regions in the sample. Finally, in column 4 of table 7 we observe that the hump-shaped relation between regional GDP and life satisfaction is robust to the introduction of individual income.

This non monotonic pattern can be observed from figure 3 as well. We aggregated all

[13]This information is present in the WVS dataset for European Countries. We could not perform a similar exercise using US observations in the WVS since there is no indication of the state the individual belongs to, and data can only be decomposed in 4 macro-regions.

waves for which the information on the regional residence and the data on the regional GDP are available, i.e. waves 1994-99, 1999-2004, 2005-08. The solid line in both panels of figure 3 represents the Lowess function, which displays for each value of the independent variable (Regional GDP) a smoothed value of the dependent variable (Average life satisfaction). The dotted lines are the quadratic interpolations. Both the linear and quadratic coefficients of the quadratic interpolations are highly significant and consistent with a peak internal to the regional GDP intervals. Note that in the panel without outliers, the estimated Lowess function follows close the quadratic interpolation.

Figure 3 may suggest that the declining segment of the curve is strongly determined by only two observations, Bruxelles and Paris. We repeated all regressions in table 7 excluding these two observations: results are presented in table 8. From column 1 we note that the coefficient of the 4th quantile dummy is still significantly positive, although smaller in magnitude. Hence the non monotonic relation between regional GDP and life satisfaction is robust to this exclusion. In column 2 to 4 we added some more controls, finding similar results (although in one case the coefficient of the 4th quantiles looses its statistical significance).

In table 9 we partition the regional data in 10 quantiles to check the robustness of the above results. From column 1 we note that there is an increasing positive effect until the 7th quantile then the coefficients of the quantile dummies decrease. However this is true until the 9th quintile since the coefficient of the 9th quantile is negative, reversing the decreasing pattern. Column 2 and 3 show that this reversion at the last quantile disappear when we control for either town size or country effect (in the top panel of figure 3 of the appendix, we display the value of the coefficient of of the 10 quantile dummy relative to the estimation of column 2). We note a pattern that seem monotonically increasing (apart for the exception of the 2nd quantile) until the 7th quantile then it is decreasing. This suggest an hump shaped pattern with a maximum in

the 7th quantile, corresponding to a regional GDP within the interval 30K-33K. Columns 4 and 5 finally show that the hump-shaped pattern is robust to the introduction of a number of individual controls as in the previous table.

In order to check how much of the above results are dependent from the outliers we observed in figure 3 , we repeated the analysis above, by excluding the 10th quantile (containing both Paris and Bruxelles) and using the 9th as base level. Results are displayed in table 10 (and in the bottom panel of figure 3 of the appendix), where we note a similar pattern than in the analysis with all 10 quantiles. A pattern generally increasing in the first 7th quantile then decreasing.

5 Explaining the non monotonic pattern

What is the reason of the hump-shaped relation? It is well known that life satisfaction is increasing in personal income at a decreasing rate (e.g. Blanchflower and Oswald 2004). Layard et al. (2008) find that the marginal life satisfaction with respect to income declines at a rate faster than the one implied by a logarithm utility function. This finding is substantially supported by Kahneman and Deaton (2010) that, using USA data, argue that the effect of income on the emotional dimension of well-being is strictly increasing until an annual income of 75,000 USD, but has no further positive influence for higher values.

There is however a significant amount of evidence, mostly aimed at explaining the Easterlin paradox, suggesting that this link is complicated by the existence of other effects. One potential explanation of the paradox is that individuals adapt over time to new conditions, so the levels of subjective well-being tend to revert to a baseline level which may depend on a reference point, an idea originally proposed by Brickman and Campbell (1971). A natural reference point ia an aspiration level: hence to the extent

that an increase in income leads to an increase in aspirations, changes in income may not have a long-run effect on subjective well being. The use of aspiration to describe the relation between income and life satisfaction is also consistent with much of the existing psychological literature on happiness, and it can be linked to the widespread idea that levels of subjective well being tend to revert to baseline levels depending on subjective reference points: Headey et al. (2010) recently reassessed this idea.[14]

A different explanation of the Easterlin Paradox takes relative rather than absolute income as the relevant concept, an idea that can de dated back to Duesenberry (1949).[15] Increase in the aggregate GDP is likely to result in an increase in the personal income of the majority of the residents, but it also affects individual aspirations and reference income. Therefore the relation between GDP and life satisfaction is possibly determined by different effects acting in different directions and there is no reason why the aggregate effect should be monotonic.

The following simple example can clarify the idea. Assume that individual life satisfaction is a increasing and concave function $u(y_i)$ of the personal income y_i; moreover it also negatively depends on the difference between personal income and target level $\overline{y_i}$, so that life satisfaction $= u(y_i) - v(\overline{y_i} - y_i)$, where v is an increasing function. The value $\overline{y_i}$ can reflect the income of a reference group (i.e. the "Joneses"), or to an aspiration level for individual i. For expositional simplicity, assume that the majority of individuals have the same personal income, and let it be fraction, $a \leq 1$ of the per capita GDP, y; and they have the same level of aspiration $\overline{y_i} = by$, with $b > 1$, so that the target income for most individuals is increasing with the GDP. Therefore, even if the personal income increases with the GDP, the level of life satisfaction can be non monotonic in the GDP,

[14]Recent evidence provided by Benjamin et al. (2011) showed the negative effect of high aspiration can also be rationally predicted by individuals that, nevertheless may still choose non-happiness maximizing options compatible with high income aspirations.

[15]See Clark et al. (2008) for an extensive survey of the theoretical and empirical literature explaining the Easterlin Paradox.

y.[16]

To check the existence of this effect in our data, in table 12 we estimate a model, based on the EU14 regional data, where life satisfaction depends on the the logarithm of the personal income, the logarithm of the Regional GDP, the difference between personal income and regional GDP, as well as other individual and country specific control variables. [17] In the WVS, data on household income is expressed in 10 or 11 country-specific brackets, we derived the personal income by taking the middle value of each bracket then we transformed the data in 2005 USD PPP adjusted. The summary statistics of the derived personal income variable, in 10,000 USD, is presented in table 11.

We introduce the difference between personal income and regional GDP separately as a positive difference, $(Income - Reg.GDP)^+$ (equal to 0 if $Income < Reg.GDP$) and negative difference $(Reg.GDP - Income)^+$ (equal to 0 if $Income < Reg.GDP$). The term $(Reg.GDP - Income)^+$ is a proxy for the difference $\overline{y} - y$ as defined above. Given that the median income is generally smaller than the average income, for the majority of the population $Income < Reg.GDP$. This is consistent with the observations in our sample, where we $Income < Reg.GDP$ for about 61% of the observations. We therefore expect this term being negative with respect to life satisfaction. table 12 confirms this prediction. We note that life satisfaction is negatively correlated with the difference between regional and personal income, when this difference is negative. At the same time the positive difference does not significantly affect life satisfaction.

The role of personality traits

The asymmetry between positive and negative difference suggests an interpretation of the target in terms of prospect theory, where losses have, in absolute terms, a larger impact

[16] Using the simple functional form: $u(y) = ln(y_i)$ and $v(\overline{y_i} - y_i) = \overline{y_i} - y_i$. The life satisfaction will be hump shaped with a peak in $y = \frac{1}{a-b}$.

[17] Considering the Logarithm of the differences does not qualitatively effect the result of the estimation.

than gains. In this respect the data in the WVS allows to perform a further test using modern studies on personality theory (see DeYoung C. G., Gray J. R. (2010) for a recent survey). In particular Neuroticism has been recently associated to higher sensitivity to negative emotions like anger, hostility or depression (Clark, L.A., and Watson, D. (2008)) and with structural features of the brain system associated with sensitivity to threat and punishment (DeYoung, C. G., Peterson, J. B., Sguin, J. R., Pihl, R. O., and Tremblay, E. (2008)). Neuroticism also signals low levels of serotonin in turns associated with aggression, poor impulse control, depression, and anxiety (Spoont, M. R. (1992); Depue, R. A. and Collins, P. F. (1999)). For this reason modern studies identify neuroticism with sensitivity to negative outcomes, and more broadly, in terms of prospect theory, loss aversion. Therefore, it is arguable that the elasticity between individual life satisfaction and $(Reg.GDP - Income)^+$ could be modulated by Neuroticism.

Measures of personality traits are not available in the WVS, but using the standard procedure of performing factor analysis on all the 20 personality questions – available in the wave 1989-93 of the WVS dataset–, we determine the personality traits neuroticism and extraversion. Details on the way Neuroticism and Extraversion have been generated and the list of the personality questions are presented in the appendix B. The summary statistics of Neuroticism and Extraversion variables are presented in table 11.

Table 13 confirms our prediction that elasticity between individual life satisfaction and $(Reg.GDP - Income)^+$ is modulated by Neuroticism. $Neuroticism * (Reg.GDP - Income)^+$ is negative and significant suggesting a stronger negative effect of the difference Reg.GDP-Income, for more neurotic individuals. Note that our derived personality traits affect life satisfaction in a way consistent with findings of the literature using measures of personality derived by surveys: It is a well known finding that extraversion is positively correlated with life satisfaction and the opposite is true for neuroticism.

6 Conclusions

We have reexamined the relation between life satisfaction and GDP using a methodology that avoids to impose particular functional forms on the model and found robust evidence of the existence of a bliss point in the interval of GDP between 26,000$ and 30,000$ (2005 in PPP). This finding lends support to the argument the way to reconcile the cross-sectional evidence – showing a positive relation between GDP and life satisfaction, and the times-series evidence – generally finding no relationship – is that that the positive effect of GDP disappears after a certain bliss point (Layard, 2005; Inglehart, 1990; Inglehart et al., 2008; di Tella et al., 2010).

Furthermore, our analysis shows first evidence of a non monotonic relation between GDP and Life Satisfaction, with life satisfaction slightly decreasing after the bliss point. In light of our additional result the non monotonicity of the relation seems natural: with a simple example, we have shown that if the relation between life satisfaction and GDP is the result of combined effects of personal income, increasing aspiration and/or increasing target in terms of income comparison, the net effect may be non-monotonic. Our tests give support to the idea of a positive effect due to the personal income and a negative effect due to the negative distance between personal income and regional GDP.

Accordingly, we have shown that this second effect can be related to the negative effect induced by the distance from an aspiration income. Furthermore, using recent findings of the modern personality theory, we argued that neuroticism might be linked to loss aversion in a prospect theory model. The way the relation between personal income and life satisfaction is affected by neuroticism is also consistent with this interpretation. Individual welfare is affected by the gap between realized and desired income. When the gap is negative, for lower level of income, extra income decreases in absolute terms this negative gap; therefore individuals with higher neuroticism score, that are more sensitive to reduce negative outcomes, become more satisfied.

7 Tables and Figures

Figure 1: **Effect of GDP quantiles on life satisfaction in the 50-quantile partition of all WVS data.** Coefficients of the dummies indicating the different 50 quantiles derived from the basic ordered probit regression (controlling for the country specific effect). The continuos line is the estimated cubic interpolation: $Coefficient = -.51 - 0.23Quantile + 0.002Quantile^2 - 0.00003Quantile^3$ with $se = [.105; .017; .0008; .00003]$. GDP in 10K, 2005 UDS, PPP adjusted

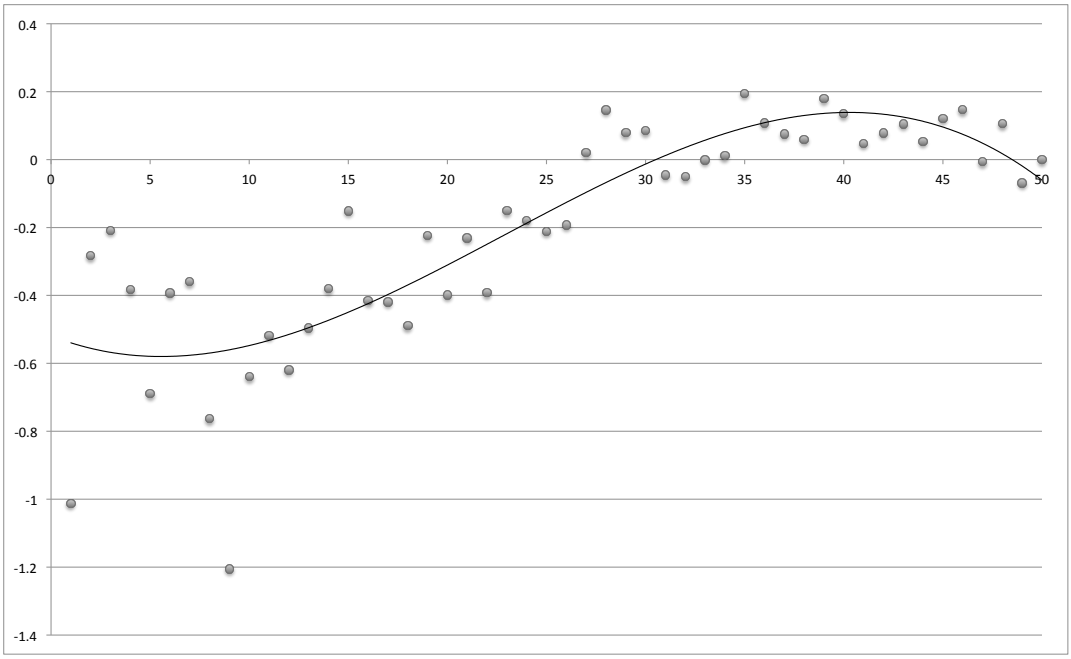


Figure 2: **Effect of GDP on life satisfaction the countries above the 25^{th} quantile, in the 50-quantile partition** . All Data are partitioned in 50 quantiles, ordered by per capita GDP levels. Each circle represents the ordered probit coefficients of the dummies related to the last 25 quantiles on life satisfaction, controlling for the country specific effect. The continuous line represents a quadratic interpolation with the 95% confidence interval.

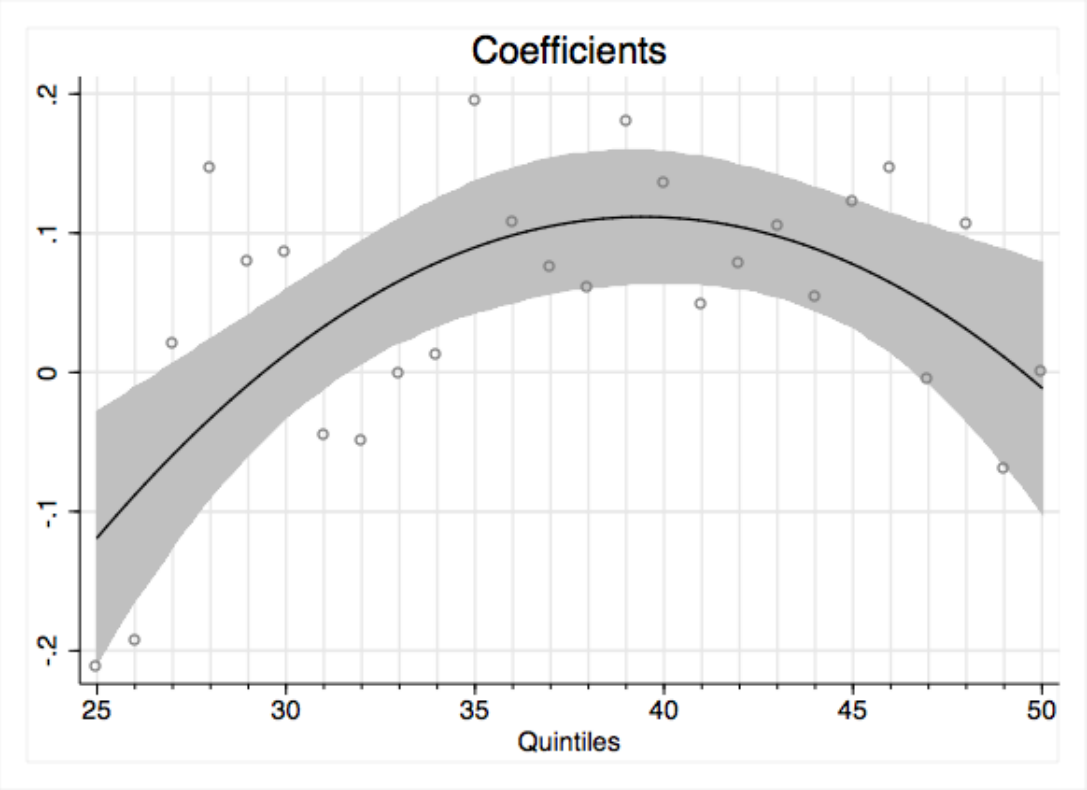


Figure 3: **Average life satisfaction and aggregate Incomes in EU14 Regions**. A circle in the scatter plot represents the regional average life satisfaction and average regional GDP. Both variables are averages pooling together the waves 1994-99, 1999-2004 and 2005-08. The weights are the sample sizes for each region. The continuous line represents the Lowess function, the dotted line is the quadratic interpolation, where data are weighted by the sample size. Equation in the left panel: $Av.LifeSat = 5.86 + 0.77GDP - .082GDP^2$ with $se = [.25; .13; .015]$. Equation in the right panel $Av.LifeSat = 5.41 + 1.06GDP - .12GDP^2$ with $se = [.52; .33; .052]$ Per capita regional GDP measures are in 10K 2005 USD and are PPP adjusted.

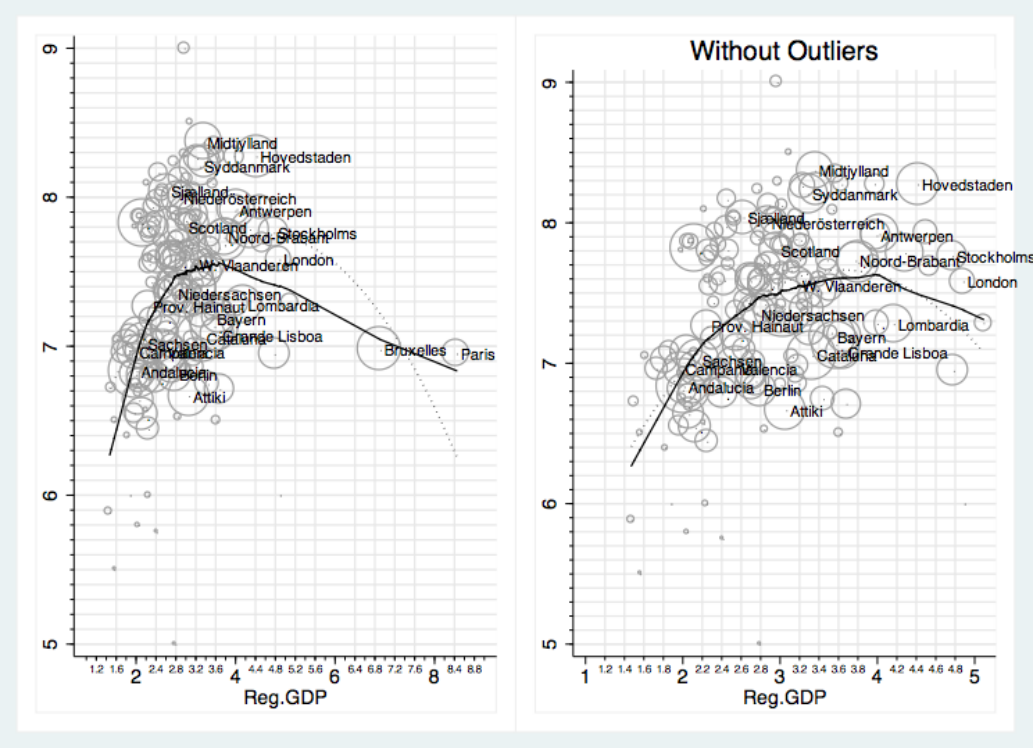


Table 1: **WVS dataset waves 1990-2006 EU14, Main Variables**

Variable	Mean	Std. Dev.	Min.	Max.	N
Life Sastisfaction	7.37	1.934	1	10	56307
Reg.GDP	3.056	1.064	1.471	8.446	32275
Income Steps	4.848	2.555	1	10	44527
Age	44.958	17.34	18	98	56493
Male	0.471	0.499	0	1	56629
size of town	4.895	2.318	1	9	49197
Academic achievement	6.221	2.978	1	10	51946

Table 2: **WVS dataset waves 1982-2006 All Countries, Main Variables.**

Variable	Mean	Std. Dev.	Min.	Max.	N
Life Sastisfaction	6.645	2.44	1	10	321152
GDP	1.675	1.239	0.027	6.468	311921
Income Steps	4.66	2.442	1	11	282271
Age	41.835	16.385	18	101	316969
Male	0.478	0.499	0	1	321112
Academic achievement	6.53	3.034	1	10	246012

Table 3: **GDP and life satisfaction in all WVS countries and waves. Ordered Probit Estimation**. Dependent variable: life satisfaction. Country data refer to waves 1981-1984, 1989-93, 1994-99, 1999-04, 2005-08. Dummy of the last quantile (the 15^{th}) is omitted. GDP is the per capita GDP in PPP, in 10K, 2005 UDS. Standard errors clustered at country and wave levels (in brackets). The countries excluded in column 3 are Luxembourg and Singapore.

	All Country 1981-2006 b/se	All Country 1981-2006 b/se	with Exclusions 1981-2006 b/se	All Country 1981-2006 b/se
GDP				0.6602***
				(0.1281)
GDP^2				–0.1005***
				(0.0229)
1^{st} quantile	–1.5414***	–0.9139***	–0.6421**	
	(0.2019)	(0.1161)	(0.2978)	
2^{nd} quantile	–0.9741***	–0.8906***	–0.7692***	
	(0.1512)	(0.1146)	(0.1645)	
3^{rd} quantile	–0.9038***	–0.9118***	–0.8437***	
	(0.1464)	(0.1382)	(0.1474)	
4^{th} quantile	–0.5146***	–0.8000***	–0.5150***	
	(0.0991)	(0.0897)	(0.0983)	
5^{th} quantile	–0.4921***	–0.2881	–0.4852***	
	(0.1079)	(0.2273)	(0.1073)	
6^{th} quantile	–0.4249***	–0.7808***	–0.4216***	
	(0.1023)	(0.1054)	(0.1013)	
7^{th} quantile	–0.2415**	–0.4291***	–0.2389**	
	(0.1035)	(0.1062)	(0.1026)	
8^{th} quantile	–0.1083	–0.3701***	–0.1051	
	(0.1038)	(0.0867)	(0.0991)	
9^{th} quantile	–0.0288	–0.3951***	–0.0287	
	(0.0729)	(0.1071)	(0.0724)	
10^{th} quantile	0.0169	–0.2857***	0.0170	
	(0.0502)	(0.0669)	(0.0500)	
11^{th} quantile	0.0317	–0.1383*	0.0317	
	(0.0370)	(0.0731)	(0.0369)	
12^{th} quantile	0.0844***	–0.0621	0.0842***	
	(0.0321)	(0.0590)	(0.0320)	
13^{th} quantile	0.0389	–0.1952***	0.0388	
	(0.0306)	(0.0648)	(0.0305)	
14^{th} quantile	0.0726**	–0.0855	0.0724**	
	(0.0354)	(0.0714)	(0.0352)	
Country Effect	Yes	No	Yes	Yes
N	307299	307299	313901	307299

Table 4: **Marginal effects of the GDP quantiles on life satisfaction, in the 15-quantile partition of all WVS data** *1^{s}t column:* elasticity of the quantile dummy variables to the probability that satisfaction = 10, the maximum level. *2^{n}d column:* elasticity of the quantile dummy variables estimated using a linear model (OLS with country specific effect). The base level is the last quantile (the 15^{th}), grouping the countries with per capita GDP larger than 36.81K. The coefficients are derived from the estimation of the baseline specification of model (1). Errors clustered at country and wave levels. GDP in 10K, 2005 UDS, PPP adjusted

	Life satisfaction=10	OLS
	1981-2006	1981-2006
	b/se	b/se
1^{st} quantile	-0.1229***	–3.6199***
	(0.0110)	(0.4722)
2^{nd} quantile	-0.10534***	–2.3267***
	(0.0109)	(0.3508)
3^{rd} quantile	-0.1027***	–2.1651***
	(0.0114)	(0.3379)
4^{th} quantile	-0.0725***	–1.2369***
	(0.0138)	(0.2188)
5^{th} quantile	-0.0705***	–1.1868***
	(0.0194)	(0.2410)
6^{th} quantile	-0.0633***	–1.0284***
	(0.0163)	(0.2261)
7^{th} quantile	-0.0395*	–0.5903***
	(0.1377)	(0.2261)
8^{th} quantile	-0.0191	–0.2772
	(0.0170)	(0.2128)
9^{th} quantile	-0.0053	–0.1297
	(0.0125)	(0.1513)
10^{th} quantile	.0032	–0.0200
	(0.0083)	(0.1057)
11^{th} quantile	0.0060*	0.0303
	(0.0036)	(0.0717)
12^{th} quantile	0.0165***	0.1333**
	(0.0046)	(0.0600)
13^{th} quantile	0.0074**	0.0479
	(0.0033)	(0.0580)
14^{th} quantile	0.0141***	0.1173*
	(0.0036)	(0.0660)
Country Effect	Yes	Yes
N	307299	307299

Table 5: **GDP and life satisfaction in all WVS countries and waves. Ordered Probit Estimation**. Dependent variable: life satisfaction. Country data refer to waves 1981-1984, 1989-93, 1994-99, 1999-04, 2005-08. Dummy of the last quantile (the 15^{th}) is omitted. Emplostat represents dummies variables for: Unemployed, Full time, Part time, Self Employed, Retired, House-Keeper. Education is a series of 10 dummies controlling for different year of training. GDP is the per capita GDP in PPP, in 10K, 2005 UDS. Standard errors clustered at country and wave level (in brackets).

	All Country 1981-2006 b/se	All Country 1981-2006 b/se	All Country 1981-2006 b/se	All Country 1981-2006 b/se
GDP				0.5664***
				(0.1317)
GDP^2				–0.0826***
				(0.0212)
7^{th} quantile	–0.2512*	–0.4715***	–0.1867	
	(0.1434)	(0.1297)	(0.1651)	
8^{th} quantile	–0.1624	–0.4437***	–0.0062	
	(0.1555)	(0.1350)	(0.1731)	
9^{th} quantile	–0.0019	–0.1581	0.1027	
	(0.1216)	(0.1001)	(0.1384)	
10^{th} quantile	0.0765	0.0877	0.1204	
	(0.0896)	(0.0782)	(0.0932)	
11^{th} quantile	0.0916	0.0720	0.1609*	
	(0.0803)	(0.0792)	(0.0888)	
12^{th} quantile	0.1032*	0.1010*	0.0921	
	(0.0586)	(0.0560)	(0.0610)	
13^{th} quantile	0.0659	0.0519	0.0681	
	(0.0493)	(0.0483)	(0.0500)	
14^{th} quantile	0.0880**	0.0915**	0.1083**	
	(0.0432)	(0.0409)	(0.0478)	
1^{st} to 7^{th} quantile	Yes	Yes	Yes	No
2^{nd} to 11^{th} Income Steps	No	No	Yes	No
Education	No	Yes	No	No
Employment status	No	Yes	No	No
Country Effect	Yes	Yes	Yes	Yes
Year Effect	Yes	Yes	Yes	Yes
age, age^2, Male	Yes	Yes	Yes	Yes
N	298479	226419	260393	298479

Table 6: **GDP and life satisfaction in all WVS countries and waves. Ordered Probit Estimation in the 30-quantile partition**. Dependent variable: life satisfaction. Country data refer to waves 1981-1984, 1989-93, 1994-99, 1999-04, 2005-08. Dummy of the last quantile (the 15^{th}) is omitted. Emplostat represents dummies variables for: Unemployed, Full time, Part time, Self Employed, Retired, House-Keeper. Education is a series of 10 dummies controlling for different year of training. GDP is the per capita GDP in PPP, in 10K, 2005 UDS. Standard errors clustered at country and wave level (in brackets).

	All Country 1981-2006 b/se	All Country 1981-2006 b/se	All Country 1981-2006 b/se	All Country 1981-2006 b/se
15^{th} quantile	–0.3024***	–0.2229	–0.6488***	0.8329***
	(0.1048)	(0.1726)	(0.1722)	(0.1437)
16^{th} quantile	–0.0075	–0.0438	–0.4098**	1.0151***
	(0.1198)	(0.1842)	(0.1760)	(0.1814)
17^{th} quantile	–0.0368	–0.0054	–0.2822*	1.0287***
	(0.1286)	(0.1648)	(0.1631)	(0.1695)
18^{th} quantile	–0.0025	0.0551	–0.1172	1.0786***
	(0.0773)	(0.1416)	(0.1330)	(0.1580)
19^{th} quantile	0.0049	0.1003	0.1081	1.1323***
	(0.0778)	(0.1185)	(0.1194)	(0.1841)
20^{th} quantile	0.1014	0.1305	0.0860	1.0353***
	(0.0749)	(0.1095)	(0.1005)	(0.1857)
21^{st} quantile	0.1369***	0.2016*	0.1060	1.1982***
	(0.0529)	(0.1092)	(0.1114)	(0.1905)
22^{th} quantile	0.0671	0.1076	0.0723	1.0791***
	(0.0563)	(0.0960)	(0.0974)	(0.1964)
23^{rd} quantile	0.1804***	0.1453*	0.1038	1.0372***
	(0.0545)	(0.0854)	(0.0802)	(0.2038)
24^{th} quantile	0.1080**	0.1261*	0.0870	1.0313***
	(0.0486)	(0.0737)	(0.0708)	(0.2071)
25^{th} quantile	0.1150**	0.0765	0.0388	1.0004***
	(0.0454)	(0.0680)	(0.0670)	(0.2097)
26^{th} quantile	0.1044*	0.1063	0.0722	1.0229***
	(0.0539)	(0.0681)	(0.0724)	(0.2100)
27^{th} quantile	0.1536**	0.1346**	0.0844	1.0838***
	(0.0613)	(0.0676)	(0.0667)	(0.2122)
28^{th} quantile	0.1083**	0.0936	0.0940	1.0459***
	(0.0486)	(0.0609)	(0.0574)	(0.2188)
29^{th} quantile	0.0913*	0.0457	0.0266	0.9487***
	(0.0524)	(0.0609)	(0.0574)	(0.2222)
1^{st} to 14^{th} quantile	Yes	Yes	No	Yes
2^{nd} to 11^{th} Income Steps	No	No	No	Yes
Education	No	No	Yes	No
Employment status	No	No	Yes	No
Country Effect	Yes	Yes	Yes	Yes
Year Effect	No	Yes	Yes	Yes
age, age^2, Male	Yes	Yes	Yes	Yes
N	298479	298479	226419	260393

Table 7: **Regional GDP and life satisfaction in EU14 regions** Ordered Probit Estimation. Data refer to waves 1994-99, 1999-04, 2005-08. Dummy of the last quantile (the 5^{th}) is omitted. Reg.GDP is the per capita regional GDP in PPP, in 10K, 2005 UDS. Standard errors clustered at quantile level (in brackets).

	EU14 1996-2006 b/se	EU14 1996-2006 b/se	EU14 1996-2006 b/se	EU14 1996-2006 b/se	EU14 1996-2006 b/se
Reg.GDP					0.3041***
					(0.0335)
Rge.GDP^2					–0.0320***
					(0.0037)
1^{st} quantile	–0.1366***	–0.0896***	–0.0929***	–0.0502***	
	(0.0022)	(0.0204)	(0.0217)	(0.0188)	
2^{nd} quantile	–0.1153***	–0.0627***	–0.1682***	–0.1424***	
	(0.0018)	(0.0118)	(0.0237)	(0.0256)	
3^{rd} quantile	–0.0702***	–0.0093	–0.0785***	–0.0583***	
	(0.0008)	(0.0238)	(0.0078)	(0.0102)	
4^{th} quantile	0.0594***	0.0361***	0.0733***	0.1045***	
	(0.0013)	(0.0097)	(0.0095)	(0.0140)	
Income Step 2				0.0669*	
				(0.0390)	
Income Step 3				0.1806***	
				(0.0391)	
Income Step 4				0.2944***	
				(0.0295)	
Income Step 5				0.3494***	
				(0.0354)	
Income Step 6				0.4181***	
				(0.0377)	
Income Step 7				0.5705***	
				(0.0528)	
Income Step 8				0.5696***	
				(0.0520)	
Income Step 9				0.5930***	
				(0.0473)	
Income Step 10				0.6697***	
				(0.0470)	
Age			–0.0080**	–0.0185***	–0.0067*
			(0.0038)	(0.0042)	(0.0035)
Age^2			0.0001**	0.0002***	0.0001**
			(0.0000)	(0.0000)	(0.0000)
Male			–0.0173	–0.0341	–0.0122
			(0.0229)	(0.0234)	(0.0164)
Education	No	No	Yes	Yes	No
Employment Status	No	No	Yes	No	No
Year Effect	No	No	Yes	No	No
Town Size	No	No	Yes	Yes	No
Country Effect	No	Yes	No	No	No
N	32091	32091	23623	18192	31994

Table 8: **Regional GDP and life satisfaction in EU14 regions without Bruxelles and Paris** Ordered Probit Estimation. Data refer to waves 1994-99, 1999-04, 2005-08. Dummy of the last quantile (the 5^{th}) is omitted. Reg.GDP is the per capita regional GDP in PPP, in 10K, 2005 UDS. Standard errors clustered at quantile level (in brackets).

	EU14 1996-2006 b/se	EU14 1996-2006 b/se	EU14 1996-2006 b/se	EU14 1996-2006 b/se	EU14 1996-2006 b/se
Reg.GDP					0.3344***
					(0.1245)
Rge.GDP^2					–0.0362*
					(0.0195)
1^{st} quantile	–0.1732***	–0.1141***	–0.1342***	–0.0878***	
	(0.0033)	(0.0157)	(0.0219)	(0.0194)	
2^{nd} quantile	–0.1518***	–0.0958***	–0.2118***	–0.1812***	
	(0.0028)	(0.0095)	(0.0258)	(0.0273)	
3^{rd} quantile	–0.1066***	–0.0403*	–0.1205***	–0.0931***	
	(0.0016)	(0.0217)	(0.0111)	(0.0121)	
4^{th} quantile	0.0235***	0.0100	0.0319***	0.0689***	
	(0.0011)	(0.0070)	(0.0108)	(0.0136)	
Income Step 2				0.0579	
				(0.0377)	
Income Step 3				0.1751***	
				(0.0394)	
Income Step 4				0.2805***	
				(0.0307)	
Income Step 5				0.3334***	
				(0.0344)	
Income Step 6				0.3994***	
				(0.0447)	
Income Step 7				0.5544***	
				(0.0557)	
Income Step 8				0.5498***	
				(0.0546)	
Income Step 9				0.5784***	
				(0.0478)	
Income Step 10				0.6424***	
				(0.0471)	
Age			–0.0075**	–0.0175***	–0.0064*
			(0.0036)	(0.0034)	(0.0035)
Age^2			0.0001**	0.0002***	0.0001*
			(0.0000)	(0.0000)	(0.0000)
Male			–0.0194	–0.0336	–0.0120
			(0.0231)	(0.0245)	(0.0169)
Education	No	No	Yes	Yes	No
Employment Status	No	No	Yes	No	No
Year Effect	No	No	Yes	No	No
Town Size	No	No	Yes	Yes	No
Country Effect	No	Yes	No	No	No
N	31240	31240	22835	17556	31147

Table 9: **Regional GDP and life satisfaction in EU14 regions Regional GDP and life satisfaction in EU14 regions** Ordered Probit Estimation. Data refer to waves 1994-99, 1999-04, 2005-08. Dummy of the last quantile (the 10^{th}) is omitted. Reg.GDP is the per capita regional GDP in PPP, in 10K, 2005 UDS. Standard errors clustered at quantile level (in brackets).

	EU14 1996-2006 b/se	EU14 1996-2006 b/se	EU14 1996-2006 b/se	EU14 1996-2006 b/se	EU14 1996-2006 b/se
1^{st} quantile	–0.2907***	–0.3324***	–0.1042***	–0.1232***	–0.1750***
	(0.0044)	(0.0240)	(0.0272)	(0.0328)	(0.0513)
2^{nd} quantile	–0.0017	–0.0597***	–0.0330	–0.0552*	–0.0950***
	(0.0011)	(0.0192)	(0.0231)	(0.0284)	(0.0291)
3^{rd} quantile	–0.1692***	–0.2787***	–0.0852***	–0.1935***	–0.1909***
	(0.0028)	(0.0255)	(0.0150)	(0.0336)	(0.0435)
4^{th} quantile	–0.0930***	–0.1388***	–0.0136	–0.1327***	–0.1065***
	(0.0015)	(0.0224)	(0.0132)	(0.0312)	(0.0348)
5^{th} quantile	–0.1042***	–0.1090***	–0.0332*	–0.0754***	–0.0784***
	(0.0016)	(0.0148)	(0.0184)	(0.0160)	(0.0244)
6^{th} quantile	–0.0679***	–0.0614***	0.0495*	–0.0638***	–0.0794***
	(0.0010)	(0.0093)	(0.0298)	(0.0098)	(0.0177)
7^{th} quantile	0.0704***	0.0567***	0.0384***	0.0958***	0.0615**
	(0.0007)	(0.0161)	(0.0135)	(0.0192)	(0.0251)
8^{th} quantile	0.0177***	0.0259*	0.0566***	0.0694***	0.0993***
	(0.0007)	(0.0156)	(0.0217)	(0.0213)	(0.0232)
9^{th} quantile	–0.0300***	–0.0070	0.0229	0.0168	–0.0423
	(0.0014)	(0.0140)	(0.0167)	(0.0202)	(0.0264)
Age				–0.0080***	–0.0175***
				(0.0029)	(0.0030)
Age^2				0.0001***	0.0002***
				(0.0000)	(0.0000)
Male				–0.0182	–0.0220
				(0.0239)	(0.0260)
Education	No	No	No	Yes	No
Employment Status	No	No	No	Yes	No
Year Effect	No	No	No	Yes	Yes
Town Size	No	Yes	No	Yes	Yes
Income steps 2 to 10	No	No	No	No	Yes
Country Effect	No	No	Yes	No	No
N	32091	26781	32091	23623	20401

Table 10: **Regional GDP and life satisfaction in EU14 regions without regions in the 10th quantile** Ordered Probit Estimation. Data refer to waves 1994-99, 1999-04, 2005-08. Dummy of the last quantile (the 10^{th}) is omitted. Reg.GDP is the per capita regional GDP in PPP, in 10K, 2005 UDS. Standard errors clustered at quantile level (in brackets).

	EU14 1996-2006 b/se	EU14 1996-2006 b/se	EU14 1996-2006 b/se	EU14 1996-2006 b/se	EU14 1996-2006 b/se
1^{st} quantile	–0.2607***	–0.3273***	–0.1226***	–0.1429***	–0.1400***
	(0.0042)	(0.0118)	(0.0130)	(0.0179)	(0.0293)
2^{nd} quantile	0.0274***	–0.0541***	–0.0557***	–0.0752***	–0.0593***
	(0.0021)	(0.0078)	(0.0149)	(0.0159)	(0.0093)
3^{rd} quantile	–0.1396***	–0.2738***	–0.1170***	–0.2113***	–0.1487***
	(0.0027)	(0.0131)	(0.0127)	(0.0209)	(0.0254)
4^{th} quantile	–0.0636***	–0.1343***	–0.0444***	–0.1544***	–0.0684***
	(0.0018)	(0.0094)	(0.0159)	(0.0156)	(0.0111)
5^{th} quantile	–0.0747***	–0.1025***	–0.0644***	–0.0919***	–0.0335**
	(0.0017)	(0.0038)	(0.0176)	(0.0135)	(0.0144)
6^{th} quantile	–0.0386***	–0.0539***	0.0190	–0.0812***	–0.0365**
	(0.0015)	(0.0056)	(0.0241)	(0.0142)	(0.0142)
7^{th} quantile	0.0997***	0.0619***	0.0150	0.0773***	0.1028***
	(0.0020)	(0.0040)	(0.0104)	(0.0092)	(0.0110)
8^{th} quantile	0.0471***	0.0321***	0.0367***	0.0508***	0.1386***
	(0.0017)	(0.0034)	(0.0111)	(0.0102)	(0.0085)
Age				–0.0063**	–0.0160***
				(0.0026)	(0.0028)
Age^2				0.0001***	0.0002***
				(0.0000)	(0.0000)
Male				–0.0237	–0.0220
				(0.0262)	(0.0289)
Education	No	No	No	Yes	No
Employment Status	No	No	No	Yes	No
Year Effect	No	No	No	Yes	Yes
Town Size	No	Yes	No	Yes	Yes
Income steps 2 to 10	No	No	No	No	Yes
Country Effect	No	No	Yes	No	No
N	29104	24331	29104	21325	18396

Table 11: WVS dataset waves 1982-2006 EU14, Derived Variables

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**N**
Log Personal Income	0.367	0.940	-2.774	3.192	32339
Personal Income	2.129	1.948	0.062	24.341	32339
Neuroticism	0	0.792	-1.165	2.639	19694
Extraversion	0	0.861	-2.184	2.312	19694

Table 12: **Individual Income, per capita GDP and life satisfaction in EU14**, Ordered Probit Estimation. Dependent variable is Individual life satisfaction; data refer to waves 1994-99, 1999-04, 2005-08, Townsize includes dummy variables controlling for 8 different town sizes. Per capita regional GDP and personal income is in 10K 2005 USD and is PPP adjusted. $(Income - Reg.GDP)^+$ is set to 0 if $Income < Reg.GDP$, and $(Reg.GDP - Income)^+$ is set to 0 if $Income < Reg.GDP$. Errors are clustered at regional level (std errors in brackets)

	EU14 1996-2006 b/se	EU14 1996-2006 b/se	EU14 1996-2006 b/se	EU14 1996-2006 b/se
ln(Income)	0.1908***	0.2379***	0.1678***	0.1293***
	(0.0421)	(0.0282)	(0.0379)	(0.0482)
ln(Reg.GDP)	0.1390*	–0.0067	0.1719**	0.5141***
	(0.0831)	(0.0660)	(0.0820)	(0.1284)
$(Income - Reg.GDP)^+$	–0.0093			0.0082
	(0.0102)			(0.0142)
$(Reg.GDP - Income)^+$	–0.0508**		–0.0600**	–0.1355***
	(0.0246)		(0.0239)	(0.0316)
Dummy(Income ≥ Reg.GDP)	0.0128	0.0061	0.0087	–0.0007
	(0.0300)	(0.0310)	(0.0299)	(0.0341)
Age	–0.0195***	–0.0188***	–0.0194***	–0.0170***
	(0.0035)	(0.0035)	(0.0035)	(0.0055)
Age^2	0.0002***	0.0002***	0.0002***	0.0002***
	(0.0000)	(0.0000)	(0.0000)	(0.0001)
Male	–0.0247	–0.0232	–0.0246	–0.0469**
	(0.0157)	(0.0156)	(0.0157)	(0.0184)
Unemployed	–0.5258***	–0.5324***	–0.5265***	
	(0.0588)	(0.0583)	(0.0587)	
Country Effect	Yes	Yes	Yes	No
Town Size	Yes	Yes	Yes	No
N	15585	15585	15585	17392

Table 13: **Individual Income, per capita GDP and life satisfaction in EU14**, Ordered Probit Estimation. Dependent variable is Individual life satisfaction; data refer to wave 1996-06, Townsize includes dummy variables controlling for 8 different town sizes. Per capita regional GDP and personal income is in 10K 2005 USD and is PPP adjusted. $(Income - Reg.GDP)^+$ is set to 0 if $Income < Reg.GDP$, and $(Reg.GDP - Income)^+$ is set to 0 if $Income < Reg.GDP$. Errors are clustered at regional level (std errors in brackets)

	EU14 1989-93 b/se	EU14 1989-93 b/se	EU14 1989-93 b/se	EU14 1989-93 b/se
ln(Income)	0.0773	0.0685	0.0643	0.0549
	(0.0576)	(0.0556)	(0.0536)	(0.0507)
ln(Reg.GDP)	0.3426*	–0.0045	0.3198	–0.0349
	(0.1997)	(0.1881)	(0.2040)	(0.1933)
$(Reg.GDP - Income)^+$	–0.1259***	–0.0424	–0.1455***	–0.0652
	(0.0470)	(0.0453)	(0.0419)	(0.0401)
Neurot*$(Reg.GDP - Income)^+$	–0.0320**	–0.0321**	–0.0355**	–0.0360**
	(0.0147)	(0.0143)	(0.0150)	(0.0149)
Extr*$(Reg.GDP - Income)^+$		0.0020		–0.0018
		(0.0145)		(0.0146)
Dummy(Income ≥ Reg.GDP)	–0.1736*	–0.1450*	–0.2186**	–0.1978**
	(0.0898)	(0.0815)	(0.0876)	(0.0792)
Neuroticism	–0.4094***	–0.4302***	–0.4016***	–0.4211***
	(0.0463)	(0.0462)	(0.0471)	(0.0477)
Extraversion		0.2834***		0.2886***
		(0.0411)		(0.0415)
Age	–0.0118***	–0.0089***	–0.0115***	–0.0087**
	(0.0033)	(0.0034)	(0.0034)	(0.0034)
Age^2	0.0001***	0.0001***	0.0001***	0.0001***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Male	–0.0657***	–0.0900***	–0.0664***	–0.0905***
	(0.0206)	(0.0209)	(0.0208)	(0.0211)
Unemployed	–0.4358***	–0.3989***	–0.4415***	–0.4077***
	(0.0440)	(0.0430)	(0.0433)	(0.0421)
Town Size	Yes	Yes	No	No
N	10492	10492	10521	10521

References

[1] Benjamin, D. J., O. Heffetz, M. S. Kimball, and A. Rees-Jones. "What Do You Think Would Make You Happier? What Do You Think You Would Choose?" (forthcoming) *American Economic Review.*

[2] Blanchflower, D. G. and Oswald, A.J. (2004). "Well-Being over Time in Britain and the USA", *Journal of Public Economics*, 88, 1359–1386.

[3] Bonsang, E. and Van Soest, A. (2010). "Satisfaction with job and income among older individuals across european countries", *Social Indicators Research*, 105, 227–254.

[4] Brickman, P.D., Campbell, D.T. (1971). *Adaptation Level Theory*, ed: Appley MH (Academic, New York), pp 287–302.

[5] Caplin, A. and Dean, M. (2008). "Dopamine, Reward Prediction Error, and Economics", *Quarterly Journal of Economics*, Vol. 123, No. 2, Pages 663-701.

[6] Cavapozzi, D., Corazzini, L. and Paccagnella, O. (2009), "Danes and Italians rate life satisfaction in the same way? Using vignettes to correct for individual-specific scale biases", Padova university mimeo

[7] Clark A. E., Etil, F., Postel-Vinay, F., Senik, C. and Van der Straeten, K. (2005). Heterogeneity in Reported Well-Being: Evidence from Twelve european Countries, *Economic Journal*, 115: C118–C132

[8] Clark, A. E. and Oswald, A.J. (1996). "Satisfaction and Comparison Income". *Journal of Public Economics*, 61, 359–381.

[9] Clark L.A. and Watson D. (2008). "Temperament: An organizing paradigm for trait psychology." In O.P. John, R.W. Robins, and L.A. Pervin (Eds.), it Handbook of personality: Theory and research (pp. 265–286). New York: Guilford Press.

[10] Deaton, A. (2008). "Income, Health and Well-Being around the World: Evidence from the Gallup World Poll". *Journal of Economic Perspectives* 22, 53-72.

[11] DeYoung, C. G., Gray, J. R. (2010). "Personality Neuroscience: Explaining Individual Differences in Affect, Behavior, and Cognition", in P. J. Corr and Matthews (Eds.), *The Cambridge handbook of personality psychology*, New York: Cambridge University Press.

[12] DeYoung, C. G., Peterson, J. B., Sguin, J. R., Pihl, R. O., and Tremblay, E. (2008). "Externalizing behavior and the higher-order factors of the Big Five", *Journal of Abnormal Psychology*, 117, 947–953.

[13] Depue, R. A. and Collins, P. F. (1999). "Neurobiology of the structure of personality: Dopamine, facilitation of incentive motivation, and extraversion". *Behavioral and Brain Sciences*, 22, 491–569.

[14] Diener, Ed., Diener, M. and Diener, C. (1995). "Factors Predicting the Subjective Well-Being of Nations". *Journal of Personality and Social Psychology*, 69, 851–864.

[15] DiTella R., MacCulloch R.J., Oswald A.J. (2001). "Preferences over inflation and unemployment: Evidence from surveys of happiness",*American Economic Review*, 91:335–341.

[16] Di Tella, R., and MacCulloch, R. (2010). "Happiness Adaptation to Income Beyond "Basic Needs". In E. Diener, J. Helliwell, and D. Kahneman (Eds.), *International Differences in Well-Being*. Oxford: Oxford University Press

[17] Duesenberry, J. S. (1949). *Income, Saving, and the Theory of Consumer Behavior.* Cambridge and London: Harvard University Press.

[18] Easterlin, R. A. (1974). "Does Economic Growth Improve the Human Lot? Some Empirical Evidence". In *Nations and Households in Economic Growth: Essays in Honor of Moses Abramovitz*, ed. R. David and M. Reder. New York: Academic Press, 89-125.

[19] Easterlin, R. A. (1995). "Will Raising the Incomes of All Increase the Happiness of All?", *Journal of Economic Behavior and Organization*, 27, 35–47.

[20] Easterlin, R. A. (2005). "Feeding the Illusion of Growth and Happiness: A Reply to Hagerty and Veenhoven", *Social Indicators Research*, 74, 429–443.

[21] Easterlin, R. A. (2005). "A Puzzle for Adaptive Theory". *Journal of Economic Behavior and Organization*, 56(4): 513–521.

[22] Easterlin, R. A. , McVey, L.A., Switek, M., Sawangfa, O., Zweig, J.S. (2010). "The happiness-income paradox revisited", ıProceedings of the National Academy of Sciences, USA. 2010 Dec 28; 107(52): 22463–22468.

[23] Holland, P. W., and Wainer, H. (1993). *Differential Item Functioning.* Hillsdale, NJ: Erlbaum.

[24] Headey, B., R. Muffels and G. G. Wagner (2010). "Long-running German panel survey shows that personal and economic choices, not just genes, matter for happiness".*Proceedings of the National Academy of Sciences*, October 19, 2010 vol. 107 no. 42 17922–17926

[25] Inglehart, R. (1990). *Cultural Shift in Advanced Industrial Society.* Princeton: Princeton University Press.

[26] Kahneman, D. and Deaton, A., (2010). "High income improves evaluation of life but not emotional well-being", *Proceedings of the National Academy of Sciences*, 107, 16489–16493.

[27] Layard, R. (2005). *Happiness: Lessons from a New Science*. London: Penguin.

[28] Layard, R., Mayraz, G. and Nickell, S., (2008). "The marginal utility of income",*Journal of Public Economics*, vol. 92(8-9), 1846–1857, August.

[29] Luttmer, E., (2005). "Neighbors as Negatives: Relative Earnings and Well-Being", *Quarterly Journal of Economics*, 120(3), 963–1002, August.

[30] McBride, M. (2006). "Money, Happiness, and Aspiration Formation: An Experimental Study". Unpublished.

[31] Michaelson, J., Abdallah, S., Steuer, N., Thompson, S. and Marks, N. (2008). "National accounts of well-being: bringing real wealth onto the balance sheet". London: NEF.

[32] Oswald, A. (1997). "Happiness and Economic Performance", *Economic Journal*, 107, 1815-1831.

[33] Oswald, A.J., Wu, S. (2010), Objective confirmation of subjective measures of human well-being: Evidence from the USA. *Science*, 327, 576-579.

[34] Senik, C. (2009). "Direct Evidence on Income Comparison and their Welfare Effects", *Journal of Economic Behavior and Organization*, 2009, 72, 408–424.

[35] Spoont, M. R. (1992). "Modulatory role of serotonin in neural information processing: Implications for human psychopathology". *Psychological Bulletin*, 112, 330-350.

[36] Sacks, D. W., Stevenson, B. and Wolfers, J. (2010). "Subjective Well-Being, Income, Economic Development and Growth". *Development Challenges in a Post-Crisis World*, forthcoming.

[37] Stevenson, B., and Wolfers, J. (2008). "Economic Growth and Subjective Well-Being: Reassessing the Easterlin Paradox". *Brookings Papers on Economic Activity*, 1, 1–87.

[38] Stiglitz, J.E., Sen, A., Fitoussi, J-P., (2009), Report of the commission on the measurement of economic performance and social progress. CMEPSP (www.stiglitz-sen-fitoussi.fr).

[39] Stutzer, A. (2004). "The Role of Income Aspirations in Individual Happiness". *Journal of Economic Behavior and Organization*, 54(1): 89–109.

[40] Waldron, S. (2010) "Measuring Subjective Wellbeing in the UK", Office for National Statistics working papers.

A Appendix

A.1 Countries' 15 Quantiles Partition

Table 1: **Country/Wave in the 1st Quantile**

	wave			
	1994-1999	1999-2004	2005-2007	Total
Bangladesh	0	1,488	0	1,488
Burkina Faso	0	0	1,470	1,470
Ethiopia	0	0	1,434	1,434
Ghana	0	0	1,477	1,477
India	2,040	0	0	2,040
Kyrgyz Republic	0	1,043	0	1,043
Mali	0	0	1,487	1,487
Moldova	984	0	0	984
Nigeria	1,996	2,022	0	4,018
Rwanda	0	0	1,441	1,441
Tanzania	0	1,157	0	1,157
Uganda	0	1,002	0	1,002
Zambia	0	0	1,377	1,377
Zimbabwe	0	1,002	0	1,002
Total	5,020	7,714	8,686	21,420

Table 2: **Country/Wave in the 2nd Quantile**

	wave			
	1994-1999	1999-2004	2005-2007	Total
Armenia	1,831	0	0	1,831
Azerbaijan	1,944	0	0	1,944
China	1,500	0	0	1,500
Georgia	1,924	0	0	1,924
India	0	2,002	2,001	4,003
Indonesia	0	996	0	996
Moldova	0	1,008	1,046	2,054
Pakistan	0	2,000	0	2,000
Philippines	1,200	1,200	0	2,400
Vietnam	0	1,000	1,495	2,495
Total	8,399	8,206	4,542	21,147

Table 3: **Country/Wave in the 3rd Quantile**

	wave			
	1994-1999	1999-2004	2005-2007	Total
Albania	996	1,000	0	1,996
Belarus	2,092	0	0	2,092
Bosnia and Herzegovina	1,200	1,200	0	2,400
China	0	1,000	0	1,000
Georgia	0	0	1,500	1,500
Guatemala	0	0	1,000	1,000
Indonesia	0	0	1,961	1,961
Jordan	0	1,223	1,200	2,423
Morocco	0	2,264	1,200	3,464
Ukraine	2,811	1,195	0	4,006
Total	7,099	7,882	6,861	21,842

Table 4: **Country/Wave in the 4th Quantile**

	wave					
	1981-1984	1989-1993	1994-1999	1999-2004	2005-2007	Total
Algeria	0	0	0	1,282	0	1,282
Belarus	0	0	0	1,000	0	1,000
Bulgaria	0	0	1,042	999	0	2,041
China	0	0	0	0	2,015	2,015
Egypt, Arab Rep.	0	0	0	0	3,051	3,051
El Salvador	0	0	1,254	0	0	1,254
Korea, Rep.	970	0	0	0	0	970
Latvia	0	0	1,200	0	0	1,200
Macedonia, FYR	0	0	995	0	0	995
Peru	0	0	1,211	1,501	0	2,712
Romania	0	1,103	1,239	1,146	0	3,488
Ukraine	0	0	0	0	1,000	1,000
Total	970	1,103	6,941	5,928	6,066	21,008

Table 5: **Country/Wave in the 5th Quantile**

	wave				
	1989-1993	1994-1999	1999-2004	2005-2007	Total
Belarus	1,015	0	0	0	1,015
Brazil	1,782	0	0	0	1,782
Bulgaria	1,034	0	0	0	1,034
Colombia	0	6,003	0	3,025	9,028
Latvia	0	0	1,013	0	1,013
Macedonia, FYR	0	0	1,055	0	1,055
Montenegro	0	0	1,060	0	1,060
Serbia	0	1,279	1,200	0	2,479
South Africa	0	2,785	0	0	2,785
Thailand	0	0	0	1,533	1,533
Total	3,831	10,067	4,328	4,558	22,784

Table 6: **Country/Wave in the 6th Quantile**

	wave					
	1981-1984	1989-1993	1994-1999	1999-2004	2005-2007	Total
Brazil	0	0	1,149	0	0	1,149
Estonia	0	0	1,021	0	0	1,021
Iran, Islamic Rep.	0	0	0	2,406	0	2,406
Lithuania	0	0	1,009	1,018	0	2,027
Peru	0	0	0	0	1,500	1,500
Poland	0	982	0	0	0	982
Russian Federation	0	0	2,040	2,500	0	4,540
South Africa	1,596	0	0	2,828	0	4,424
Turkey	0	1,030	0	4,607	0	5,637
Total	1,596	2,012	5,219	13,359	1,500	23,686

Table 7: **Country/Wave in the 7th Quantile**

	wave					
	1981-1984	1989-1993	1994-1999	1999-2004	2005-2007	Total
Brazil	0	0	0	0	1,500	1,500
Bulgaria	0	0	0	0	1,001	1,001
Estonia	0	0	0	1,005	0	1,005
Latvia	0	894	0	0	0	894
Malta	467	0	0	0	0	467
Romania	0	0	0	0	1,776	1,776
Serbia	0	0	0	0	1,220	1,220
South Africa	0	0	0	0	2,821	2,821
Turkey	0	0	1,881	0	0	1,881
Uruguay	0	0	1,000	0	1,000	2,000
Venezuela, RB	0	0	1,200	1,200	0	2,400
Total	467	894	4,081	2,205	9,318	16,965

Table 8: **Country/Wave in the 8th Quantile**

	wave					
	1981-1984	1989-1993	1994-1999	1999-2004	2005-2007	Total
Argentina	0	0	0	1,280	1,002	2,282
Chile	0	0	0	1,200	0	1,200
Croatia	0	0	1,196	1,003	0	2,199
Estonia	0	966	0	0	0	966
Hungary	1,464	999	0	0	0	2,463
Iran, Islamic Rep.	0	0	0	0	2,656	2,656
Korea, Rep.	0	1,251	0	0	0	1,251
Lithuania	0	956	0	0	0	956
Mexico	1,837	0	2,313	0	0	4,150
Poland	0	0	1,153	1,095	0	2,248
Slovak Republic	0	1,135	0	0	0	1,135
Total	3,301	5,307	4,662	4,578	3,658	21,506

Table 9: **Country/Wave in the 9th Quantile**

	wave					
	1981-1984	1989-1993	1994-1999	1999-2004	2005-2007	Total
Chile	0	0	0	0	1,000	1,000
Czech Republic	0	2,109	0	0	0	2,109
Hungary	0	0	650	1,000	0	1,650
Ireland	1,217	0	0	0	0	1,217
Malaysia	0	0	0	0	1,068	1,068
Malta	0	383	0	0	0	383
Mexico	0	0	0	1,535	1,560	3,095
Poland	0	0	0	0	1,000	1,000
Russian Federation	0	1,961	0	0	1,935	3,896
Slovak Republic	0	466	1,095	1,331	0	2,892
Slovenia	0	1,017	0	0	0	1,017
Spain	2,302	0	0	0	0	2,302
Turkey	0	0	0	0	1,346	1,346
Total	3,519	5,936	1,745	3,866	7,909	22,975

Table 10: **Country/Wave in the 10th Quantile**

	wave				
	1981-1984	1989-1993	1994-1999	1999-2004	Total
Czech Republic	0	924	1,147	1,907	3,978
Finland	1,003	0	0	0	1,003
Ireland	0	1,000	0	0	1,000
Italy	1,345	0	0	0	1,345
Japan	1,204	0	0	0	1,204
Korea, Rep.	0	0	1,247	1,200	2,447
Malta	0	0	0	1,000	1,000
Portugal	0	1,185	0	1,000	2,185
Slovenia	0	0	1,007	1,006	2,013
Spain	0	4,147	0	0	4,147
United Kingdom	1,167	0	0	0	1,167
Total	4,719	7,256	3,401	6,113	21,489

Table 11: **Country/Wave in the 11th Quantile**

	wave				
	1981-1984	1994-1999	1999-2004	2005-2007	Total
Australia	1,157	0	0	0	1,157
Belgium	1,138	0	0	0	1,138
Canada	1,254	0	0	0	1,254
Denmark	1,182	0	0	0	1,182
Finland	0	981	0	0	981
France	1,198	0	0	0	1,198
Germany	1,303	0	0	0	1,303
Greece	0	0	1,142	0	1,142
Iceland	927	0	0	0	927
Israel	0	0	1,199	0	1,199
Korea, Rep.	0	0	0	1,200	1,200
Netherlands	1,221	0	0	0	1,221
New Zealand	0	1,201	0	0	1,201
Saudi Arabia	0	0	1,427	0	1,427
Spain	0	1,211	0	0	1,211
Sweden	954	0	0	0	954
Trinidad and Tobago	0	0	0	1,002	1,002
Total	10,334	3,393	3,768	2,202	19,697

Table 12: **Country/Wave in the 12th Quantile**

	wave					
	1981-1984	1989-1993	1994-1999	1999-2004	2005-2007	Total
Austria	0	1,460	0	0	0	1,460
Belgium	0	2,790	0	0	0	2,790
Cyprus	0	0	0	0	1,049	1,049
Denmark	0	1,030	0	0	0	1,030
Finland	0	588	0	0	0	588
France	0	1,002	0	0	0	1,002
Iceland	0	702	0	0	0	702
Italy	0	2,018	0	0	0	2,018
New Zealand	0	0	0	0	954	954
Slovenia	0	0	0	0	1,037	1,037
Spain	0	0	0	2,409	0	2,409
Sweden	0	1,047	1,009	0	0	2,056
United Kingdom	0	1,484	0	0	0	1,484
United States	2,325	0	0	0	0	2,325
Total	2,325	12,121	1,009	2,409	3,040	20,904

Table 13: **Country/Wave in the 13th Quantile**

	wave					
	1981-1984	1989-1993	1994-1999	1999-2004	2005-2007	Total
Australia	0	0	1,945	0	0	1,945
Canada	0	1,730	0	0	0	1,730
Finland	0	0	0	1,036	0	1,036
France	0	0	0	1,615	0	1,615
Germany	0	3,437	2,026	0	0	5,463
Italy	0	0	0	2,000	1,012	3,012
Japan	0	1,011	1,054	0	0	2,065
Netherlands	0	1,017	0	0	0	1,017
Norway	1,031	0	0	0	0	1,031
Sweden	0	0	0	1,015	0	1,015
United Kingdom	0	0	1,051	0	0	1,051
Total	1,031	7,195	6,076	5,666	1,012	20,980

Table 14: **Country/Wave in the 14th Quantile**

	wave				
	1989-1993	1994-1999	1999-2004	2005-2007	Total
Austria	0	0	1,522	0	1,522
Belgium	0	0	1,906	0	1,906
Denmark	0	0	1,023	0	1,023
Finland	0	0	0	1,013	1,013
France	0	0	0	1,001	1,001
Germany	0	0	2,036	2,064	4,100
Iceland	0	0	968	0	968
Ireland	0	0	1,012	0	1,012
Japan	0	0	1,362	1,096	2,458
Norway	1,239	0	0	0	1,239
Spain	0	0	0	1,200	1,200
Switzerland	0	1,212	0	0	1,212
United Kingdom	0	0	998	0	998
United States	1,838	0	0	0	1,838
Total	3,077	1,212	10,827	6,374	21,490

Table 15: **Country/Wave in the 15th Quantile**

	wave				
	1989-1993	1994-1999	1999-2004	2005-2007	Total
Australia	0	0	0	1,421	1,421
Canada	0	0	1,931	2,148	4,079
Luxembourg	0	0	1,161	0	1,161
Netherlands	0	0	1,003	1,002	2,005
Norway	0	1,127	0	1,025	2,152
Singapore	0	0	1,300	0	1,300
Sweden	0	0	0	1,003	1,003
Switzerland	1,400	0	0	1,241	2,641
United Kingdom	0	0	0	1,011	1,011
United States	0	1,542	1,200	1,249	3,991
Total	1,400	2,669	6,595	10,100	20,764

A.2 Regions' 5 Quantiles Partition

Table 16: **Region/Wave in the 1st Quantile**

	wave			
	1994-1999	1999-2004	2005-2007	Total
Aitoloakarnania	0	20	0	20
Alentejo	0	55	0	55
Andalucia	214	432	0	646
Argolida	0	5	0	5
Asturias	34	0	0	34
Brandenburg	173	170	0	343
Calabria	0	66	25	91
Campania	0	185	102	287
Cantabria	51	0	0	51
Castilla-la Mancha	77	103	0	180
Centro (PT)	0	185	0	185
Chios	0	10	0	10
Etel-Karjala	58	0	0	58
Etel-Pohjanmaa	0	54	0	54
Etel-Savo	35	33	0	68
Evvoia	0	36	0	36
Extremadura	33	64	27	124
Galicia	86	170	0	256

Table 17: **Region/Wave in the 1st Quantile cont'd**

	wave			
	1994-1999	1999-2004	2005-2007	Total
Kainuu	0	21	0	21
Kanta-Hme	141	0	0	141
Karditsa	0	26	0	26
Kerkyra	0	15	0	15
Keski-Suomi	48	0	0	48
Lakonia	0	12	0	12
Lappi	49	0	0	49
Larisa	0	5	0	5
Luxembourg (Grand-Duch)	0	1,161	0	1,161
Magnisia	0	27	0	27
Messinia	0	2	0	2
Murcia	33	0	0	33
Norte	0	355	0	355
Northern Ireland	64	0	0	64
Pohjois-Karjala	36	45	0	81
Pohjois-Pohjanmaa	100	0	0	100
Pohjois-Savo	54	0	0	54
Puglia	0	136	71	207
Sachsen	296	290	0	586
Sachsen-Anhalt	169	175	0	344
Sicilia	0	168	88	256
Thessalia	0	1	0	1
Thringen	162	155	0	317
Trikala	0	40	0	40
Wales	43	0	0	43
Total	1,956	4,222	313	6,491

Table 18: **Region/Wave in the 2nd Quantile**

	wave			
	1994-1999	1999-2004	2005-2007	Total
Abruzzo	0	0	16	16
Algarve	0	40	0	40
Andalucia	0	0	209	209
Arkadia	0	4	0	4
Asturias	0	68	33	101
Basilicata	0	21	11	32
Berlin	123	0	0	123
Brandenburg	0	0	200	200
Burgenland (A)	0	65	0	65
Canarias (ES)	191	97	51	339
Cantabria	0	32	0	32
Castilla y Len	16	151	0	167
Castilla-la Mancha	0	0	49	49
Chania	0	7	0	7
Comunidad Valenciana	122	244	124	490
East Midlands (ENGLAND)	74	0	0	74
Eastern	40	0	0	40
Etel-Pohjanmaa	0	0	64	64
Etel-Savo	0	0	36	36
Flevoland	0	17	0	17
Fthiotida	0	5	0	5
Galicia	0	0	84	84
Kainuu	0	0	11	11
Kanta-Hme	0	68	40	108
Keski-Pohjanmaa	0	11	0	11
Keski-Suomi	0	62	0	62
Kriti	0	15	0	15
La Rioja	8	0	0	8
Lappi	0	22	0	22
Molise	0	29	13	42
Murcia	0	66	35	101
Mditerrane	0	235	0	235
Niedersachsen	104	0	0	104
Nord	0	84	0	84
North East (ENGLAND)	0	56	0	56
North West (ENGLAND)	108	0	0	108

Table 19: **Region/Wave in the 2nd Quantile Cont'd**

	wave			
Ouest	0	201	0	201
Pohjanmaa	55	0	0	55
Pohjois-Karjala	0	0	32	32
Pohjois-Pohjanmaa	0	79	0	79
Pohjois-Savo	0	55	58	113
Prov. Hainaut	0	265	0	265
Prov. Lige	0	177	0	177
Prov. Luxembourg (B)	0	44	0	44
Prov. Namur	0	61	0	61
Pijt-Hme	0	33	37	70
Rheinland-Pfalz	60	0	0	60
Saarland	18	0	0	18
Sachsen	0	0	315	315
Sachsen-Anhalt	0	0	176	176
Sardegna	0	57	30	87
Satakunta	0	61	0	61
Schleswig-Holstein	41	0	0	41
Scotland	111	0	0	111
Sjlland	0	164	0	164
South East	203	0	0	203
South West (ENGLAND)	100	0	0	100
Sud-Ouest	0	163	0	163
Thringen	0	0	179	179
Varsinais-Suomi	174	0	0	174
Wales	0	59	50	109
West Midlands (ENGLAND)	105	0	0	105
Yorkshire and The Humber	92	0	0	92
Zaragoza	37	0	0	37
Total	1,782	2,818	1,853	6,453

Table 20: **Region/Wave in the 3rd Quantile**

	wave			
	1994-1999	1999-2004	2005-2007	Total
Abruzzo	0	29	0	29
Attiki	0	868	0	868
Baden-Wrttemberg	160	0	0	160
Bassin Parisien	0	324	0	324
Bayern	173	0	0	173
Berlin	0	135	101	236
Cantabria	0	0	16	16
Castilla y Len	0	0	75	75
Catalua	46	0	0	46
Centre-Est	0	209	0	209
Dodekanisos	0	17	0	17
Drenthe	0	31	29	60
East Midlands (ENGLAND)	0	61	76	137
Eastern	0	45	0	45
Est	0	100	88	188
Etel-Karjala	0	29	16	45
Flevoland	0	0	17	17
Friesland (NL)	0	32	40	72
Gvleborgs ln	0	0	25	25
Hallands ln	0	0	33	33
Illes Balears	23	0	0	23
Kalmar ln	0	0	17	17
Keski-Suomi	0	0	56	56
Kyklades	0	4	0	4
Kymenlaakso	0	38	0	38
Krnten	0	108	0	108
Lappi	0	0	40	40
Mditerrane	0	0	121	121
Navarra	16	0	0	16
Niedersachsen	0	126	137	263
Niedersterreich	0	315	0	315
Nord	0	0	68	68
Nordrhein-Westfalen	293	0	0	293
North West (ENGLAND)	0	138	68	206

Table 21: **Region/Wave in the 3rd Quantile cont'd**

	wave			
	1994-1999	1999-2004	2005-2007	Total
Northern Ireland	0	0	90	90
Ouest	0	0	136	136
Pais Vasco	64	0	0	64
Pirkanmaa	0	67	0	67
Pohjanmaa	0	10	0	10
Pohjois-Pohjanmaa	0	0	64	64
Prov. Limburg (B)	0	101	0	101
Prov. Oost-Vlaanderen	0	208	0	208
Rheinland-Pfalz	0	54	70	124
Saarland	0	16	0	16
Satakunta	0	0	56	56
Schleswig-Holstein	0	23	40	63
Scotland	0	83	0	83
South West (ENGLAND)	0	79	0	79
Steiermark	0	221	0	221
Sud-Ouest	0	0	109	109
Sdermanlands ln	0	0	24	24
Umbria	0	0	15	15
Varsinais-Suomi	0	97	0	97
Vrmlands ln	0	0	12	12
Vstmanlands ln	0	0	5	5
West Midlands (ENGLAND)	0	99	110	209
Yorkshire and The Humber	0	60	84	144
Zaragoza	0	74	0	74
stergtlands ln	0	0	7	7
Total	775	3,801	1,845	6,421

Table 22: **Region/Wave in the 4th Quantile**

	wave			
	1994-1999	1999-2004	2005-2007	Total
Baden-Wrttemberg	0	160	0	160
Bayern	0	181	0	181
Catalua	0	376	192	568
Dalarnas ln	0	0	19	19
Eastern	0	0	43	43
Friuli-Venezia Giulia	0	43	22	65
Gelderland	0	145	107	252
Grande Lisboa	0	365	0	365
Hessen	89	0	0	89
Illes Balears	0	47	25	72
Jmtlands ln	0	0	2	2
Jnkpings ln	0	0	77	77
Korinthia	0	19	0	19
Kronobergs ln	0	0	22	22
Kymenlaakso	0	0	38	38
La Rioja	0	16	8	24
Lazio	0	0	97	97
Liguria	0	61	28	89
Limburg (NL)	0	34	74	108
Madrid	160	0	0	160
Marche	0	47	17	64
Midtjylland	0	235	0	235
Navarra	0	33	15	48
Nordjylland	0	109	0	109
Nordrhein-Westfalen	0	289	252	541
Norrbottens ln	0	0	11	11
Obersterreich	0	271	0	271
Overijssel	0	76	71	147
Pais Vasco	0	130	0	130
Piemonte	0	147	70	217
Pirkanmaa	0	0	103	103
Pohjanmaa	0	0	16	16
Prov. Brabant Wallon	0	45	0	45
Prov. Vlaams Brabant	0	104	0	104
Prov. West-Vlaanderen	0	164	0	164

Table 23: **Region/Wave in the 4th Quantile cont'd**

	wave			
	1994-1999	1999-2004	2005-2007	Total
Saarland	0	0	9	9
Scotland	0	0	113	113
Skne ln	0	0	135	135
South East	0	187	0	187
South West (ENGLAND)	0	0	108	108
Syddanmark	0	243	0	243
Tirol	0	80	0	80
Toscana	0	133	65	198
Umbria	0	30	0	30
Uppsala ln	0	0	57	57
Uusimaa	231	0	0	231
Valle d'Aosta/Valle d'Aoste	0	0	12	12
Varsinais-Suomi	0	0	88	88
Vorarlberg	0	55	0	55
Vsterbottens ln	0	0	40	40
Vsternorrlands ln	0	0	40	40
Vstra Gtalands ln	0	0	217	217
Zaragoza	0	0	32	32
Zeeland	0	23	22	45
rebro ln	0	0	3	3
Total	480	3,848	2,250	6,578

Table 24: **Region/Wave in the 5th Quantile**

	wave			
	1994-1999	1999-2004	2005-2007	Total
Baden-Wrttemberg	0	0	149	149
Bayern	0	0	185	185
Emilia-Romagna	0	145	74	219
Groningen	0	37	35	72
Hamburg	30	20	23	73
Hessen	0	103	70	173
Hovedstaden	0	272	0	272
Lazio	0	181	0	181
Lombardia	0	320	154	474
London	111	90	68	269
Madrid	0	306	158	464
Noord-Brabant	0	151	149	300
Noord-Holland	0	206	164	370
Pais Vasco	0	0	67	67
Paris	0	0	361	361
Prov. Antwerpen	0	242	0	242
Rgion de Bruxelles-Capitale	0	495	0	495
Salzburg	0	98	0	98
South East	0	0	201	201
Stockholms ln	0	0	257	257
Trentino Alto Adige	0	33	18	51
Utrecht	0	34	69	103
Uusimaa	0	251	258	509
Valle d'Aosta/Valle d'Aoste	0	10	0	10
Voiotia	0	1	0	1
Zuid-Holland	0	212	225	437
le de France	0	299	0	299
Total	141	3,506	2,685	6,332

B Personality Traits

B.1 Factor Analysis to Determine the Personality Traits

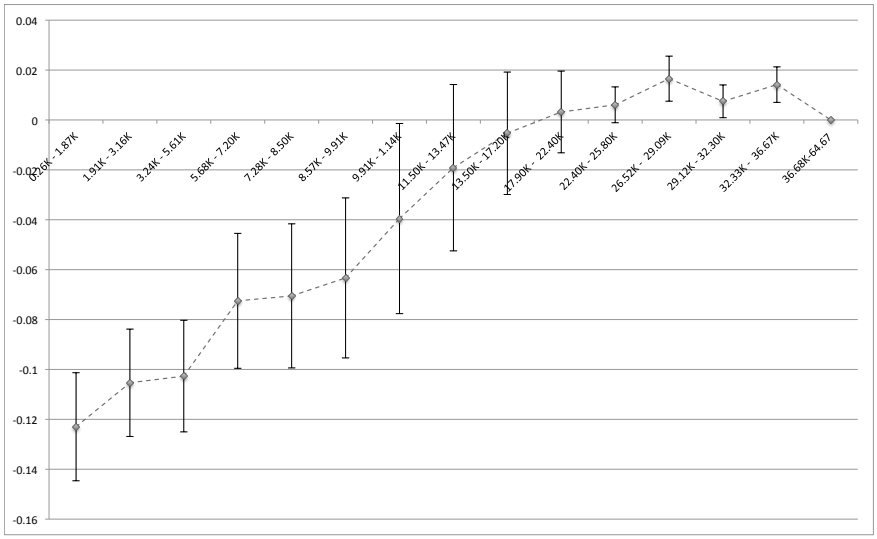
Determination of traits from the score in each question was necessary because no existing imputation to traits on the sample of questions in the data exists.

Trait determination was realized with exploratory factor analysis (statistical software Stata, release 11). We retained factors with eigenvalue larger than a threshold value of 1 as suggested by different sources. We selected all the personality questions in the WVS dataset, such questions were available only for the wave 1989-93. For completeness, we included also the variable e065 answering to the residual question 'none of the above'. In figure 4 we present the list of the questions and some descriptive statistics. In figure 5 we present the Stata log showing the eigenvalues of all factors and the factor loadings.

We plot the factors' loadings with eigenvalues larger than 1 in figure 6, where we note that variables are clustered in two main groups. An high score in the group of variable with high loading on factor 1 represents high excitement and assertiveness, high seeking of stimulation and other people company, pronounced engagement with the external world. We therefore defined factor 1 as Extraversion. An high score in the group of variables with high loading on factor 2 represents negative emotions like depression, loneliness, boredom, anxiousness, anger. We defined factor 2 as Neuroticism.

To complete the analysis we also present the rotated matrix in figure 7 and the Kaiser-Meyer-Olkin measure of sampling adequacy in figure 8. This test generate values between 0 and 1 for each single variable included, with small values meaning overall the variables have too little in common to warrant a factor analysis. All our variables show adequacy levels well above 0.7, generally considered the acceptable threshold.

Figure 1: **Marginal effects of the GDP quantiles on life satisfaction, in the 15-quantile partition of all WVS data** *Upper Panel:* Each point indicates the elasticity of the quantile dummy variables to the probability that satisfaction = 10, the maximum level (with the 95 % confidence intervals). *Lower Panel:* Each point indicates the elasticity of the quantile dummy variables estimated using a linear model (OLS with country specific effect). The base level is the last quantile, grouping the countries with per capita GDP larger than 36.81K. The coefficients are derived from the estimation of the baseline specification of model (1). Errors clustered at country and wave levels. GDP in 10K, 2005 UDS, PPP adjusted



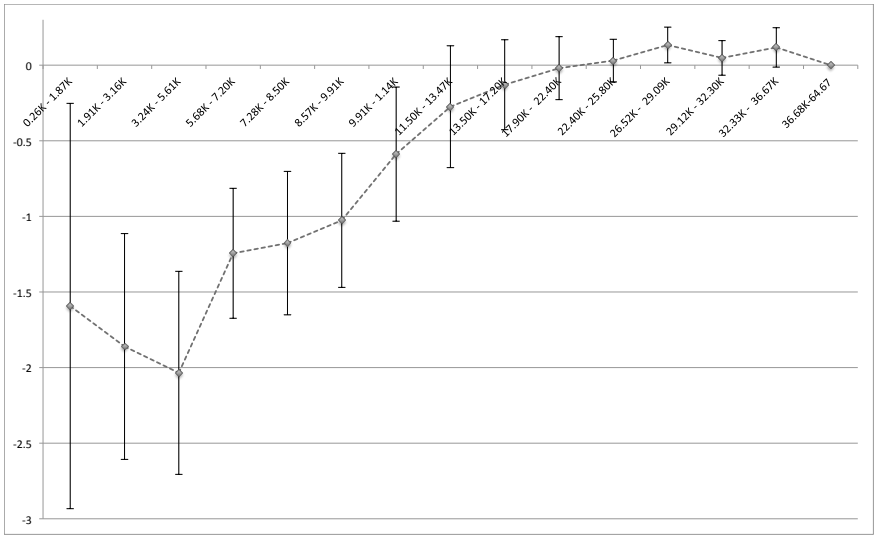


Figure 2: **Effect of GDP quantiles on life satisfaction in the 30-quantile partition of all WVS data.** Coefficients of the dummies indicating the different 30 quantiles– with the 95 % confidence intervals and errors clustered at country and wave levels– derived from the basic ordered probit regression. The Base level is the 30^{th} quantiles. GDP in 10K, 2005 UDS, PPP adjusted

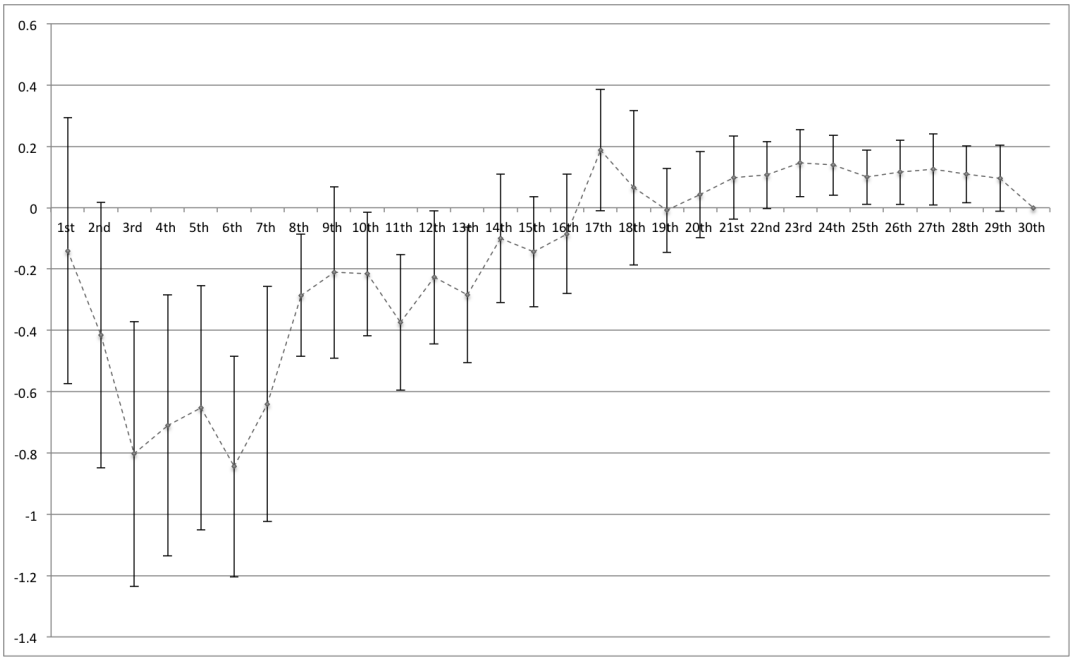
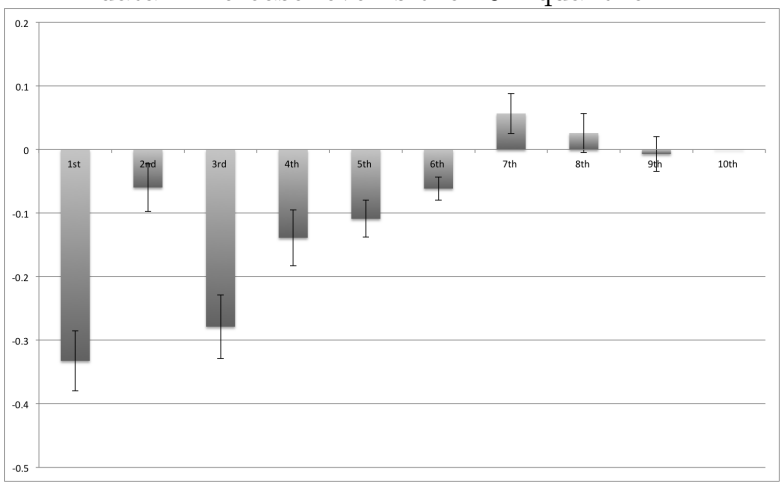


Figure 3: **Effect of regional GDP quantiles on life satisfaction in the 10-quantile partition of EU14 data.** Coefficients of the dummies indicating the different 10 quantiles–with the 95 % confidence intervals and errors clustered at quantile level– derived from the basic ordered probit regression. GDP in 10K, 2005 UDS, PPP adjusted

A: All data: The base level is the 10^{th} quantile.



B: Without 10th quantile: The base level is the 9^{th} quantile.

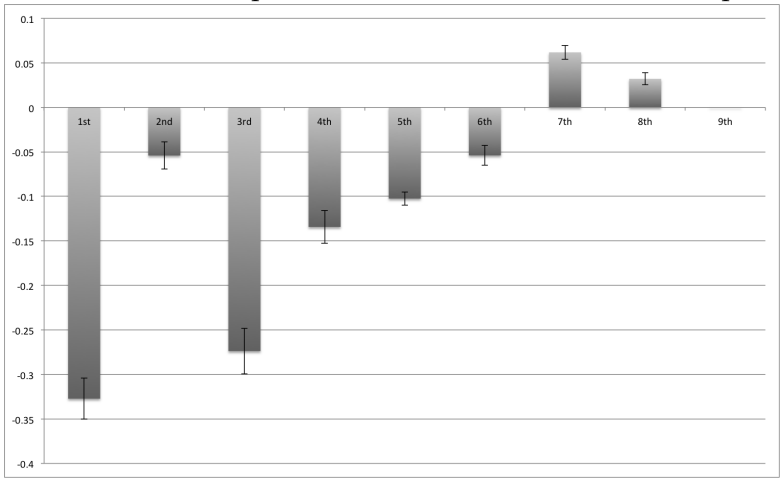


Figure 4: **Questions used for the determination of personality traits**

Variable	Obs	Unique	Mean	Min	Max	Label
a010	21116	2	.5107028	0	1	ever felt very excited or interested
a011	21103	2	.3086765	0	1	ever felt restless
a012	21093	2	.463092	0	1	ever felt proud because someone complimented you
a013	21076	2	.1897419	0	1	ever felt very lonely or remote from other people
a014	21074	2	.7216475	0	1	ever felt pleased about having accomplished something
a015	21087	2	.2185233	0	1	ever felt bored
a016	21026	2	.3521355	0	1	ever felt on top of the world
a017	21060	2	.2213675	0	1	ever felt depressed or very unhappy
a018	21017	2	.4764238	0	1	ever felt that things were going your way
a019	21056	2	.1745821	0	1	ever felt upset because somebody criticized you
e047	20404	10	.5806558	.1	1	personal characteristics: changes, worry or welcome possibility
e048	21113	2	.4707053	0	1	personal characteristics: i usually count on being successful in everything I do
e049	21134	2	.2725466	0	1	personal characteristics: i enjoy convincing others of my opinion
e050	21070	2	.1612245	0	1	personal characteristics: i serve as a model for others
e051	21096	2	.3396378	0	1	personal characteristics: i am good at getting what i want
e052	21088	2	.1323976	0	1	personal characteristics: i own many things others envy me for
e053	21146	2	.5175447	0	1	personal characteristics: i like to assume responsibility
e054	21132	2	.3680201	0	1	personal characteristics: i am rarely unsure about how i should behave
e055	21146	2	.4250449	0	1	personal characteristics: i often give others advice
e056	21205	2	.1211035	0	1	personal characteristics: none of the above

Figure 5: **Factor Analysis**

```
      name:  <unnamed>
       log:  /Users/proto/Dropbox/sharing/PNAS/SI/traits-FactorAnalisys1.smcl
  log type:  smcl
 opened on:   7 Oct 2011, 15:54:00

. factor  a010 a011 a012 a013 a014 a015 a016 a017 a018 a019 e047 e048 e049 e050 e051 e052 e053 e054 e055
(obs=19694)

Factor analysis/correlation                       Number of obs    =     19694
    Method: principal factors                     Retained factors =         2
    Rotation: (unrotated)                         Number of params =        39
```

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	2.31880	0.98316	0.7000	0.7000
Factor2	1.33564	0.67889	0.4032	1.1032
Factor3	0.65675	0.43986	0.1983	1.3014
Factor4	0.21689	0.07117	0.0655	1.3669
Factor5	0.14572	0.06469	0.0440	1.4109
Factor6	0.08103	0.03675	0.0245	1.4354
Factor7	0.04428	0.05078	0.0134	1.4487
Factor8	-0.00651	0.01437	-0.0020	1.4468
Factor9	-0.02088	0.01448	-0.0063	1.4405
Factor10	-0.03536	0.02370	-0.0107	1.4298
Factor11	-0.05906	0.02329	-0.0178	1.4120
Factor12	-0.08235	0.01896	-0.0249	1.3871
Factor13	-0.10131	0.01390	-0.0306	1.3565
Factor14	-0.11521	0.01518	-0.0348	1.3217
Factor15	-0.13039	0.01064	-0.0394	1.2824
Factor16	-0.14103	0.01303	-0.0426	1.2398
Factor17	-0.15406	0.02394	-0.0465	1.1933
Factor18	-0.17800	0.03131	-0.0537	1.1396
Factor19	-0.20931	0.04372	-0.0632	1.0764
Factor20	-0.25303	.	-0.0764	1.0000

LR test: independent vs. saturated: chi2(190) = 4.4e+04 Prob>chi2 = 0.0000

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Uniqueness
a010	0.4021	0.1101	0.8262
a011	0.2037	0.4096	0.7908
a012	0.4533	0.1133	0.7817
a013	0.0006	0.5681	0.6772
a014	0.4643	0.0023	0.7844
a015	-0.0663	0.4165	0.8221
a016	0.4051	-0.0188	0.8356
a017	0.0405	0.6166	0.6182
a018	0.3115	-0.2511	0.8399
a019	0.1156	0.3614	0.8560
e047	0.2304	-0.1206	0.9324
e048	0.3785	-0.0945	0.8478
e049	0.3516	0.0685	0.8717
e050	0.3449	0.0484	0.8787
e051	0.4160	-0.0785	0.8208
e052	0.2861	0.0687	0.9134
e053	0.4443	-0.0934	0.7939
e054	0.2830	-0.1099	0.9078
e055	0.3853	0.0545	0.8486
e056	-0.5425	0.0856	0.6984

```
. log close
      name:  <unnamed>
       log:  /Users/proto/Dropbox/sharing/PNAS/SI/traits-FactorAnalisys1.smcl
  log type:  smcl
 closed on:   7 Oct 2011, 15:54:03
```

Figure 6: **Factor Loadings of the Personality Factor Analysis**. Factor 1 has been defined Extraversion, Factor 2 has been defined Neuroticism, variable e065 is the residual questions 'none of the above'

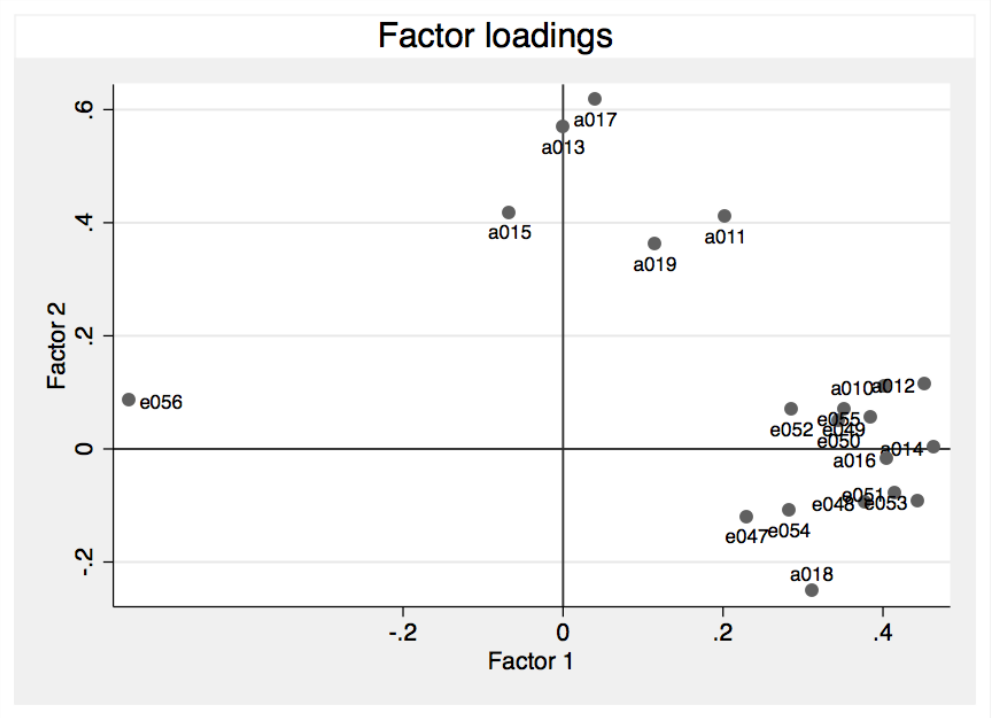


Figure 7: **Rotated Matrix of Correlation**

```
      name:  <unnamed>
       log:  /Users/proto/Dropbox/sharing/PNAS/SI/rotateFA.smcl
  log type:  smcl
 opened on:   7 Oct 2011, 15:59:27

. rotate

Factor analysis/correlation                       Number of obs    =     19694
    Method: principal factors                     Retained factors =         2
    Rotation: orthogonal varimax (Kaiser off)     Number of params =        39
```

Factor	Variance	Difference	Proportion	Cumulative
Factor1	2.31470	0.97495	0.6987	0.6987
Factor2	1.33975	.	0.4044	1.1032

LR test: independent vs. saturated: chi2(190) = 4.4e+04 Prob>chi2 = 0.0000

Rotated factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Uniqueness
a010	0.3942	0.1359	0.8262
a011	0.1768	0.4219	0.7908
a012	0.4450	0.1423	0.7817
a013	-0.0362	0.5670	0.6772
a014	0.4632	0.0323	0.7844
a015	-0.0931	0.4113	0.8221
a016	0.4054	0.0075	0.8356
a017	0.0006	0.6179	0.6182
a018	0.3271	-0.2304	0.8399
a019	0.0920	0.3681	0.8560
e047	0.2377	-0.1054	0.9324
e048	0.3838	-0.0699	0.8478
e049	0.3465	0.0911	0.8717
e050	0.3411	0.0706	0.8787
e051	0.4202	-0.0515	0.8208
e052	0.2810	0.0870	0.9134
e053	0.4494	-0.0645	0.7939
e054	0.2895	-0.0913	0.9078
e055	0.3810	0.0793	0.8486
e056	-0.5469	0.0503	0.6984

Factor rotation matrix

	Factor1	Factor2
Factor1	0.9979	0.0646
Factor2	-0.0646	0.9979

```
. log close
      name:  <unnamed>
```

Figure 8: **Kaiser-Meyer-Olkin measure of sampling adequacy.**

```
      name:  <unnamed>
       log:  /Users/proto/Dropbox/sharing/PNAS/SI/testFA.smcl
  log type:  smcl
 opened on:   7 Oct 2011, 15:54:03

. estat kmo

Kaiser-Meyer-Olkin measure of sampling adequacy
```

Variable	kmo
a010	**0.8417**
a011	**0.8015**
a012	**0.8102**
a013	**0.7172**
a014	**0.8197**
a015	**0.7763**
a016	**0.8030**
a017	**0.7057**
a018	**0.7816**
a019	**0.8085**
e047	**0.8338**
e048	**0.7807**
e049	**0.8639**
e050	**0.8152**
e051	**0.8599**
e052	**0.8325**
e053	**0.8231**
e054	**0.8131**
e055	**0.8053**
e056	**0.7599**
Overall	**0.7963**

```
. log close
      name:  <unnamed>
       log:  /Users/proto/Dropbox/sharing/PNAS/SI/testFA.smcl
  log type:  smcl
 closed on:   7 Oct 2011, 15:54:03
```