**What do happiness and health satisfaction data tell us about relative risk aversion?[[1]](#footnote-2)**

Néstor Gandelman Rubén Hernández-Murillo

Universidad ORT Uruguay Federal Reserve Bank of St. Louis

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*Abstract*

In this paper we provide estimates of the coefficient of relative risk aversion using information on self-reports of subjective personal well-being from three data sets: the Gallup World Poll, the European Social Survey, and the World Values Survey.

We additionally consider the implications of allowing for health state dependence in the utility function on estimates of risk aversion and examine how the marginal utility of income changes in bad health states.

Our estimates of relative risk aversion vary closely around 1, which corresponds to logarithmic utility, ranging between 0.79 and 1.44. We find that controlling for health dependence generally reduces these estimates. In contrast with other studies in the literature, our results also suggest that the marginal utility of income *increases* when health deteriorates, and this effect is robust across the various data sets we analyzed

**JEL codes**: D80, G00, I10, I31.

**Keywords**: relative risk aversion; marginal utility of income; happiness; health dependence.

1. **Introduction**

Attitudes towards risk are a central issue in almost every economic problem involving decision making. Surprisingly, there is not yet a commonly accepted estimate of the coefficient of relative risk aversion. Many economists think that the coefficient of relative risk aversion probably lies between 1 and 3, but there is a wide range of estimates in the literature, from as low as 0.2 going up to 10 or higher, particularly in the literature that uses inferences from behavioral choices to elicit risk aversion.

Among the studies based on behavioral choices, Friend and Blume (1975), studying the demand for risky assets, estimate that the coefficient of relative risk aversion generally exceeds 1. Weber (1975), using expenditure data, and Szpiro, (1986) using data on property insurance, estimate relative risk aversion to be in the range between 1.3 and 1.8. Using consumption data, Hansen and Singleton (1983) report lower estimates, between 0.68 and 0.97. Also using data on consumption, Mankiw (1985) finds much larger estimates in the range of 2.44 to 5.26.[[2]](#footnote-3)

In this paper we use data on subjective self-reports of personal well-being to estimate the coefficient of relative risk aversion. The literature on the application of happiness or subjective well-being data to address economic issues originated with Easterlin’s (1974) seminal paper, and since the late nineties the amount of research making use of happiness and satisfaction databases has increased considerably: Frey and Stutzer (2002) and Di Tella and MacCulloch (2006) are two examples of reviews of the use of these types of data in economics.

In our analysis, we build on Layard et al. (2008). They use happiness data to estimate how fast the marginal utility of income declines as income increases, an elasticity that corresponds to the parameter of relative risk aversion under a constant relative risk aversion utility function. The authors stress the importance of this interpretation of the parameter of interest for analyzing normative public economics issues, such as optimal taxation. Our paper extends their analysis by considering health-state dependence in the utility function, as in Finkelstein et al. (2008), and we stress the interpretation of the parameter of interest as a measure of risk aversion for analyzing financial problems such as determining the optimal amount of health insurance.

We use data from the Gallup World Poll, the European Social Survey, and the World Values Survey. The Gallup data set only recently became available for applied research and covers a larger set of people than most subjective well-being surveys: about 70,000 individuals in more than 140 countries; we use data covering 103 countries. The largest dataset used by Layard et al. (2008), for example, has only about 50 countries. We also use data from the European Social Survey covering 27 countries and from the World Values Survey covering 41 countries. From these surveys, in addition to demographic information on personal income, age, gender, marital status, and employment, we use information on self-reports of subjective well-being and satisfaction with personal health, which we use to study the implications of health status on relative risk aversion or the marginal utility of income.

We provide estimates of the coefficient of relative risk aversion for five groups of countries categorized by the World Bank in terms of income per capita. For each of the surveys we also provide overall estimates that use observations from all countries. In general, the estimates using the Gallup World Poll are slightly lower than 1, whereas the estimates with the European Social Survey and the World Values Survey were slightly larger than 1. Using the Gallup data, for example, we obtain an overall estimate or relative risk aversion of 0.79, and the estimate is significantly different from 1.0, which corresponds to log utility. The overall estimates with the European Social Survey and the World Values Survey are slightly higher at 1.44 and 1.16, respectively, and are also significant and different from 1. Using the Gallup data, the pooled estimates for the various income country classes were mostly smaller than 1, suggesting a lower degree of concavity than logarithmic utility. On the other hand, the estimates by income classes with the European Social Survey and the World Values Surveys were slightly larger than 1, suggesting more concavity than logarithm utility. The estimate for the United States using the Gallup data is 1.48, which is similar to the estimates of Layard et al. (2008); the estimate for the United States using the World Value survey is 0.9. However, using either the Gallup or the World Value Survey, we cannot reject the null of a relative risk aversion of 1 for the United Sates.

We also analyze the effect of controlling for health state dependence on the estimates of relative risk aversion. We find that generally, the estimated relative risk aversion coefficients for country groups decline when we control for the dependence of the utility function on health status. We also find, in contrast with Finkelstein et al. (2008), that the marginal utility of income *increases* when health deteriorates. This result holds across the three different data sets we analyzed.

In the next section we describe the data sets used in the analysis. In section 3 we present the methodology. We discuss the results in section 4, and we provide concluding comments in section 5.

1. **Data**

We use data from the 2006 Gallup World Poll, the 2002-2006 European Social Survey (ESS), and the 1981-2008 World Values Survey (WVS).The main variables of interest are self-reported happiness or satisfaction with life, assessment of personal health, and data on household income. We also use additional information on age, gender, marital status, employment status, and residence in urban areas.

**2.1 The Gallup World Poll**

The Gallup World Poll is probably the world's most comprehensive database of behavioral economic measures. It surveys individuals in more than 140 countries representing about 95 percent of the world's adult population. In our study we use data on about 55,000 individuals from 103 countries.

While the Gallup World Poll does not have a specific question on personal happiness (e.g., “*How happy are you?”*), it has a question on satisfaction with life which corresponds to a personal assessment of general well-being. The question in the survey reads “*Please imagine a ladder/mountain with steps numbered from zero at the bottom to ten at the top. Suppose we say that the top of the ladder/mountain represents the best possible life for you and the bottom of the ladder/mountain represents the worst possible life for you. If the top step is 10 and the bottom step is 0, on which step of the ladder/mountain do you feel you personally stand at the present time?”* We use the ordered responses to this question as our measure of reported well-being, and henceforth we do not distinguish it from happiness.

As an indicator of health status we use the question on satisfaction with personal health *“Are you satisfied or dissatisfied with your personal health?”* which has “yes” or “no” as possible answers.

Household income data are reported in twenty nine brackets. We use the midpoint of the bracket as the measure of income, and for the top bracket we use a value equal to double the previous midpoint value. Although the data are supposed to represent monthly gross income, some countries report annual income. Furthermore, income data are reported in local currency for most countries (Gasparini et al. 2008). Therefore, for individuals in each country, we express the income measure in deviations from the country’s average.[[3]](#footnote-4) We also eliminate outlier observations from the analysis as we describe in section 3.

* 1. **European Social Survey**

The first three rounds of the European Social Survey conducted from 2002 to 2006 contain data on 27 countries. In our study we use data on 32,951 individuals.

The European Social Survey asks respondents separate questions about their happiness and satisfaction with life. We use the happiness question that reads “*Taking all things together, how happy would you say you are?*” Respondents are asked to select a number from 0 (corresponding to *extremely unhappy*) to 10 (corresponding to *extremely happy*). We use the ordered responses to this question as our measure of reported well-being.

The health status indicator is derived from the European Social Survey question that reads “*How is your health in general? Would you say it is… ?*” Respondents are asked to select one of five responses: *very good, good, fair, bad, very bad*. We create an indicator that distinguishes *fair*, *bad* and *very bad* responses from *good* and *very good* responses.

Household total net income data are reported in twelve brackets. The survey provides bracket intervals in Euro and when necessary, inserts corresponding national currencies. We use the midpoint of the bracket as the measure of income. For the bottom and top bracket we use a value equal to two-thirds the bottom-code value and one and a half times the top-code value, respectively. Similar to the procedure used with the Gallup data the income measure is expressed in deviations from the country’s average and outlier observations are excluded from the analysis.

* 1. **World Values Survey**

The World Values Survey aggregated files contain data across five waves from 1981 to 2008 for 87 countries. In our study we use data on 38,500 individuals from 41 countries.[[4]](#footnote-5)

The World Values Survey asks respondents separate questions about their happiness and satisfaction with life. The responses to the satisfaction with life question are provided on an ordinal scale comparable to the measures of well-being used in the other surveys so we use this as our measure of reported well-being. The life satisfaction question reads “*All things considered, how satisfied are you with your life as a whole these days?*” Respondents are asked to select a number from 1 (corresponding to *dissatisfied*) to 10 (corresponding to *satisfied*).

The health status indicator is derived from the World Values Survey question that reads “*All in all, how would you describe your state of health these day? Would you say it is… ?*” Respondents are asked to select one of five responses: *very good, good, fair, bad, very bad*. We create an indicator that distinguishes *fair*, *bad* and *very bad* responses from *good* and *very good* responses.

Household gross income data are reported in ten brackets. Specific bracket intervals in national currencies are not provided for all country-wave combinations. Data is excluded from the analysis when the country-specific bracket values are not known. We use the midpoint of the bracket as the measure of income. For the bottom and top bracket we use a value equal to two-thirds the bottom-code value and one and a half times the top-code value, respectively. Similar to the procedure used with the Gallup data the income measure is expressed in deviations from the country’s average and outlier observations are excluded from the analysis.

* 1. **Summary Statistics**

The top panel in Table 1 reports summary statistics from the Gallup World Poll for the key variables in our estimations. In the baseline estimations we used data from 103 countries and 54,624 individual observations. The average individual has a reported happiness level of 5.5 in the 0-10 scale, with a standard deviation of 2.2. About 22% of individuals in Gallup reported dissatisfaction with personal health. The database is composed of adult individuals with an average age of 42.2 years and with a slightly larger presence of women (55%) than men (45%). About 70% of individuals in our sample are married, less than half live in an urban setting (44%), and 60% are employed.

The middle panel presents similar summary statistics computed among individuals in the European Social Survey. In the baseline estimations we used data from 27 countries and 32,951 individuals. The average reported happiness was 7.4 in the 0-10 scale, with a standard deviation of 1.8. About 23% of individuals in the ESS reported dissatisfaction with personal health. The average age is 42.1 years, with a smaller presence of women (48%) than in the Gallup data. About 66% of individuals in the sample are married, 68% live in an urban setting, and 92% are employed.

The bottom panel presents the corresponding statistics in the World Values Survey. This data set has information on 38,500 individuals in 41 countries. The average reported happiness was 6.8 in the 0-10 scale, with a standard deviation of 2.4. A larger proportion than in the Gallup and ESS report dissatisfaction with personal health (33%). The average age of 41.2 years is similar, as is the proportion of women (52%). However, the proportion of married individuals is somewhat higher (79%) while the proportion of employed individuals is smaller (68%).

In these tables the income variable is expressed in deviations from the country’s average, and because we trimmed outlier observations, the reported means in each data set may differ from 100%.

[Table 1 about here]

1. **Methodology**
   1. **Utility function**

In this paper we follow a common assumption in theoretical and applied work and assume a constant relative risk aversion utility function with respect to income (a proxy for consumption):

 (1)

where *y* represents income, and  corresponds to the Arrow-Pratt coefficient of relative risk aversion .

 (2)

* 1. **Estimation methodology: happiness and utility**

To make use of happiness data we need to hypothesize on the nature of the relation between reported happiness,  and the individual’s experienced utility, . For simplicity, Layard et al. (2008) assume that the relation  is linear. Instead, we allow for the relationship *f* between utility and happiness to be nonlinear, and assume only that it needs to be strictly monotonic. We postulate that

, (3)

where γ is a scalar parameter, *Xi* are individual characteristics such as age and gender that do not affect utility from income but affect happiness, and  is a vector of parameters. As in Layard et al. (2008) an important assumption in our methodology is that the relation *f* is common to all individuals. Therefore, we consider the following model,

 (4)

where  represents an error term that is independent of experienced utility *u*i.

Since reported happiness is an ordered discrete response, we can operationalize the above model by replacing observed happiness in equation (4) with a continuous latent variable  and assuming that  has a logistic distribution, allowing *f* to represent any monotonically increasing transformation.

Therefore individuals whose latent happiness is below a certain threshold will report their happiness level to be at the bottom of the ladder ().

 (5)

Since *f* is strictly increasing it has an inverse function and

 (6)

where we define .

Similarly, those individuals reporting to be in the first step of the happiness ladder, , are those whose latent happiness is above the first threshold  but below a second cut-off point. This implies:

 (7)

In summary we have:



, and (8)

The last problem that we have to deal with is how to separately estimate  and . We follow an iterative maximum likelihood procedure as in Layard et al. (2008). First we compute  for values of  between 0 and 5 in steps of 0.1. Second, for each of these computations we estimate  and the vector of parameters  with an ordered logit model and save the resulting log-likelihood of the estimation. In the vicinity of the maximum likelihood estimator we repeat this procedure in steps of 0.01.

In order to be sure that our results are not affected by outliers in the income reports we trim observations corresponding to the bottom 5 percent and the top 5 percent of the distribution of residuals of a regression of the log of relative income on individual controls, as in Layard et al. (2008).

* 1. **Health state dependence**

The previous estimation strategy can be easily extended to analyze the effect of health status on the utility function. We denote by *Si* (for sick) a dummy variable which takes the value of 1 if individuals provide an affirmative answer to the question on personal health problems and rewrite the equation for the utility function over income and health status as:

 (9)

The coefficient *η* reflects shifts in utility from dissatisfaction with personal health which do not modify the marginal utility income, while the coefficient *γ2*represents changes in the marginal utility of income from changes in health status. We use the same iterative procedure described before to estimate the modified model.

1. **Results**

We perform our estimations for five different sets of countries categorized in terms of income using the World Bank’s income classifications: High income OECD, high income non-OECD, upper middle income, lower middle income, and low income. We also estimate the models with all the pooled observations and for each country individually. Whenever we pool data from several countries we include country dummies in the estimation.

The top panel of Table 2 reports the estimates of the relative risk aversion coefficient with and without health dependence in the Gallup data set. The reported coefficients are for the 5 income country classifications, the United States, and the overall pooled estimation. The table also reports likelihood ratio tests for the null hypothesis of log utility (=1), and the bold coefficients indicate statistical significance at the 10% confidence level.

The estimates of the relative risk aversion coefficient in the Gallup data for the various income groups and the overall estimate without controlling for health dependence are in the range 0.63 to 0.89 and we do not observe a monotonic relation between income groups and the estimated relative risk aversion coefficient. The estimate with all countries, the estimate for high-income OECD countries, and for low income countries are statistically different from one (which corresponds to log utility), while the coefficients for high-income non-OECD and lower- and upper-middle income countries are not statistically different from one at a 10% confidence level. The estimate for the United States without health dependence is quite higher than the group estimates at 1.48, but it is not statistically different from one. Adding health status in the utility function tends to reduce the estimates of the relative risk aversion coefficients across all groups and the United States.

The middle panel reports the estimates of relative risk aversion in the European Social Survey. In this data set, most countries fall in the either the upper-middle-income or high-income-OECD classifications. The overall estimate without health dependence is 1.44, and it is significantly different from 1. Similarly, the estimate for high-income-OECD countries is 1.41 and it is significantly different from 1. The estimate for upper-middle-income countries is 1.06 and it is not significantly different from 1. Adding health dependence in the utility function reduces the point estimates for the overall estimates and for high-income-OECD countries, but they remain significantly different from 1.

The estimates with the World Values Survey, reported in bottom panel, present a similar picture as that portrayed with the ESS estimates. The overall estimate (1.16) and those for high-income-OECD (1.45), as well as for upper-middle-income (1.35) are greater than 1 in magnitude and statistically significantly different from 1. The estimates for high-income-non-OECD (0.71) and for low-income countries (1.35) are not significantly different from 1. The estimates also generally decline when controlling for health dependence.

[Table 2 about here]

The estimate of relative risk aversion using the Gallup data are lower than those of Layard (2008) and lower than the estimates with the ESS and WVS, especially for high-income-OECD countries. The estimates using the ESS and WVS are, in contrast, slightly larger than Layard’s reported range for the elasticity of the marginal utility with respect to income (1.19-1.34). A possible explanation for the disparities among our findings is the composition of countries in the different surveys that were used. The lower estimates with Gallup data are below previous estimations of relative risk aversion that use inferences based on behavioral choices (Friend and Blume 1975, Weber 1975, Szpiro 1986, Mankiw 1985). However, although the reliability of the income data in the Gallup Wolrd Poll may play a role in explaining the differences in the magnitude of the estimates, our estimates are closer to the results of Hansen and Singleton (1983), Cox and Oaxaca (1996), and Bartunek and Chowdhury (1997). The results with Gallup data are also in line with Gandelman and Porzecanski (2011) who also use Gallup data and find that the only way to reconcile happiness inequality with income inequality is with a relative risk aversion coefficient lower than one. Most studies using experimental data also find low levels of risk aversion.[[5]](#footnote-6)

Tables 3 through 5 report the estimated coefficients of the individual controls and the cut-off levels in the ordered logit model controlling for health dependence in the utility function. The reported estimations correspond to the maximum likelihood estimator of the coefficients of relative risk aversion reported in tables 1 and 2. The coefficients reported are odds ratios to facilitate their interpretation, as most individual controls are categorical variables. Hence, an odds ratio larger than 1 represents a positive effect on the likelihood of reporting higher happiness levels, while an odds ratio smaller than 1 represents a negative effect. Most individual regressors have the expected direction of effect across all data sets.

In Table 3, corresponding to the estimates using the Gallup World Poll, women are about 20% more likely than men to report higher levels of life satisfaction (Column All countries). Similarly, happiness responds positively to marriage: married individuals are 20% to 40% more likely to report higher levels of happiness than non-married individuals (147% more likely in the United States). Age has a negative effect on the likelihood of higher happiness reports, while its square has a positive effect. Residence in an urban setting has a statistically negative effect for the United States, high-income OECD countries, and low income countries and a positive effect in other cases. Individuals in the United States who live in urban areas, for example, are 30% less likely to report higher happiness levels than individuals in rural settings. The coefficient on the urban indicator is not statistically significant in the case with all countries or with low income countries. The effect of employment status is also positive whenever it is statistically significant, with employed individuals being 15% to 20% more likely to report higher levels of happiness than unemployed individuals. In terms of health dependence, individuals reporting health problems are less likely to report higher levels of happiness, and the effect is statistically significant for most specifications. The odds ratio varies from 0.488 to 0.640. The interaction of health status with the utility of income, *u(y)*, has a positive effect (odds ratio greater than 1) and is statistically significant in the specifications for all countries (1.14), high income OECD countries (1.27), low income countries (1.16) and upper-middle income countries (1.15), and suggests that the marginal utility of income increases for sick individuals. In the overall estimate, for example, an odds ratio of 1.14 indicates that the effect of income on reported happiness is about 14.0% higher for individuals who report dissatisfaction with personal health.[[6]](#footnote-7) These results are in contrast with those of Finkelstein et al. (2008). Our findings indicates that controlling for health dependence would suggest that the optimal amount of health insurance or the optimal amount of life-cycle savings is *higher* than when not controlling for health dependence.

[Table 3 about here]

Table 4 presents similar coefficient estimates for the European Social Survey. All the individual controls are statistically significant for the estimation with all countries and for high-income-OCED countries, but some coefficients are not statistically significant in the case of upper-middle-income countries. Women and married individuals are more likely to report higher happiness levels in all three specifications (although the female coefficient is not statistically significant in the case of upper-middle-income countries). Residence in an urban setting and employment status also have a positive effect on reported happiness. In contrast, the direct effect of age is negative (but age square has a positive effect). Similarly, the variable indicating health problems (*Sick*) has a negative effect. Sick individuals are 50-55% less likely to report higher levels of happiness (in the case of odds ratio smaller than one, the effect is computed subtracting the coefficient from 1). The interaction of the *Sick* dummy with the utility of income, *u(y)*, has a positive effect also has a positive effect (odds ration greater than 1) when it is statistically significant, suggesting that individuals dissatisfied with personal health have a effect from income on reported happiness that is about 9% higher than individuals who are satisfied with their personal health.

[Table 4 about here]

Finally, table 5 presents the estimations using the World Value Survey. Again, the magnitude and direction of the effects of the various controls is similar to those reported in tables 7 and 8. Similarly, the results regarding health dependence are robust. In the case of the overall estimate, for example, the *Sick* dummy has a negative effect and suggests that individuals dissatisfied with personal health are 41-67% less likely to report higher levels of happiness than healthier individuals. The interaction of the health status indicator with the utility of income is also positive and suggests that individuals dissatisfied with personal health have larger effect from income on reported happiness by about 7% in the all counties estimation, and much higher for high-income countries.

[Table 5 about here]

1. **Conclusion**

A significant volume of literature on the implications of behavioral choices for attitudes toward risk yields varying estimates of the coefficient of relative risk aversion, ranging from nearly linear utility on income (a relative risk aversion coefficient of zero) to estimates implying vastly more concavity than log utility (corresponding to a relative risk aversion coefficient of one).

In this paper we use data from three large surveys that include information on self-reports of subjective well-being, dissatisfaction with personal health, and household income to estimate the coefficient of relative risk aversion and the effect of health state dependence on the utility function. Happiness data, although extensively used in recent years to analyze the effects of inflation and unemployment, among other economic issues, has only begun to be used to study risk aversion or the links with personal health. Our paper, along with those of Layard et al. (2008) and Finkelstein et al. (2008) is among the first studies in this area.

In contrast with Layard et al. (2008), who report estimates of relative risk aversion that exceed a value of one, we obtain estimates that are smaller than one in some cases. While the authors do not study the implications of health status, we find that controlling for health dependence tends to reduce the estimates of relative risk aversion, even in the cases for which we obtain coefficients of relative risk aversion that are greater than one.

Controlling for health state dependence in the specification of the utility function indicates that individuals who are dissatisfied with personal health are more likely to report lower levels of subjective well-being. Our findings also suggest that the marginal utility of income is higher for individuals who are dissatisfied with their health. This result is robust across all three data surveys and is in contrast with that of Finkelstein et al. (2008), who find the opposite. This result may prove important for future analysis of the implications of risk attitudes and health status on the optimal amount of health insurance benefits.

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2. More recent studies continue to show a great disparity of estimates. Using a consumption-based capital asset pricing model with state dependent risk aversion, Gordon and Amour (2004) find estimates in the range of 0 to 10. García et al. (2003) using a generalization of a Black-Scholes option pricing model to S&P 500 call option prices report estimates of relative risk aversion in the range of 0.83 to 3.28. Chetty (2006), studying the links between labor supply, risk aversion and the curvature of the utility over consumption, finds a mean estimate of relative risk aversion of 0.71 with a range of 0.15 to 1.78. Campo et al. (2011) estimate a first-price auction model semiparametrically and report an estimate of relative risk aversion of 0.61. [↑](#footnote-ref-3)
3. This normalization also addresses the issue of making the measures comparable across countries, as there is no clear indication of which countries report in local currency. [↑](#footnote-ref-4)
4. The number of observations used in our study is substantially limited by the lack of country-specific values for the income variable. [↑](#footnote-ref-5)
5. Holt and Laury (2002) report relative risk aversion between 0.3 and 0.5 and Andersen et al. (2008) report an estimate of relative risk aversion of 0.74. [↑](#footnote-ref-6)
6. Buis (2010) shows that interpreting the odds ratio representation of the ordered logit coefficients as the multiplicative effect of the interaction term is a straightforward alternative to the interpretation of interaction effects in terms of marginal effects, which requires the computation of a cross-partial derivative as in Ai and Norton (2003) and Norton et al. (2004). [↑](#footnote-ref-7)