# Risk aversion at the country level[1]

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**Abstract**

In this paper we provide estimates of relative risk aversion for 80 countries using data on self-reports of personal well-being from the Gallup World Poll. For most countries we cannot reject the null hypothesis that the coefficient of relative risk aversion equals 1. This result supports the use of the log utility function in numerical simulations.

**JEL codes**: D80, D31, I31.
**Keywords**: relative risk aversion; happiness; personal well-being.

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## 1. Introduction

At the individual level, risk attitudes are at the cornerstone of most economic decisions. Examples of these decisions are the choices on the optimal amount of retirement or precautionary savings, investments in human capital, public or private sector employment, and entrepreneurship attitudes, among others. In the aggregate, these micro-level decisions can have a large impact on a country's growth and development outcomes.

Although there is a vast literature on measuring risk aversion, there is not yet a commonly accepted estimate. Probably the most commonly accepted measures of the coefficient of relative risk aversion lie between 1 and 3, but there is a wide range of estimates in the literature—from as low as 0.2, to 10, and higher.[1] In estimating this parameter, the literature has focused almost exclusively on developed countries.[2] Moreover, with the exception of Szpiro and Outreville (1988), to the best of our knowledge, no additional study has yet applied a homogenous methodology for estimating risk aversion to a large set of countries comprising both high- and low-income countries.[3][4] In this note, we fill this gap by eliciting risk aversion measures for 80 countries from self-reports of personal well-being. This is important for several reasons. First, the replication of the same methodology for different countries is useful to assess the robustness of the estimates. Second, it is a starting point for the study of cross-country differences in risk aversion and how this correlates with multiple variables of interest. Third, calibration of the utility function is a part of most dynamic stochastic general equilibrium models; however, in most cases, the calibration is based on estimates for developed countries and there are no measures of the relevant parameters for developing countries.

We use the methodology first outlined in Layard et al. (2008). The authors use happiness data to estimate how fast the marginal utility of income declines as income

[1] See Chetty (2006), Campo et al. (2011), Friend and Blume (1975), Gandelman and Hernández-Murillo (2013), García et al. (2003), Gordon and St-Amour (2004), Hansen and Singleton (1983), Kapteyn and Teppa (2011), Layard, et al (2008), Mankiw (1985), Szpiro, (1986), and Weber (1975).

[2] For an exception see Gandelman and Hernández-Murillo (2013) that estimates measures of risk aversion for groups of countries classified by income level and Gandelman and Porzecanski (2013) that calibrates utility inequality for a similar country classification.

[3] The study by Szpiro (1986) initially used property/liability insurance data to estimate relative risk aversion for 15 developed countries. Szpiro and Outreville (1988) augmented the analysis to 31 countries, including 11 developing countries.

[4] On a slightly different approach Gandelman and Porzecanski (2013) use different assumption of relative risk aversion to calibrate how much happiness inequality is due to income inequality using a sample of 117 developing and developed countries from the Gallup World Poll

increases. Under a constant relative risk aversion utility function this elasticity corresponds to the parameter of relative risk aversion. This methodology was also used in Gandelman and Hernández-Murillo (2013) to provide aggregate estimates for the coefficient of relative risk aversion using pooled data from the 2006 Gallup World Poll and various other cross-sectional and panel data sets. In this study we discuss estimates for 80 individual countries, including 55 developing countries, using the Gallup World Poll.

Our estimates show that individual country estimates vary between 0 (implying a near-linear utility function) and 3 (implying a more concave utility function than the log utility function). In only 5 of the 25 developed countries considered in the sample, we reject the null hypothesis that the coefficient of relative risk aversion equals 1. Similarly, in only 9 of the 55 developing countries, we reject the null hypothesis. We conclude that this result supports the use of the log utility function in numerical simulations.

## 2. Data

The main variables of interest in the 2006 Gallup World Poll are self-reported happiness or satisfaction with life and data on household income. We also use data on additional individual controls such as age, gender, marital status, employment status, and residence in urban areas.

The relevant question in the Gallup World Poll 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?*" The ordered responses to this question are our measure of reported well-being, and henceforth we do not distinguish it from happiness.

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 twice the previous midpoint value. In order to avoid some measurement problems reported in Gasparini and Glüzmann (2012), we express the income measure in deviations from the country's average.

Table 1 reports summary statistics for the key variables in our estimations. We used data from 80 countries and 42,726 individual observations. We split the sample into developing and developed countries, following the World Bank criterion of gross national income (GNI) per capita. A country is defined as developing if GNI per capita is less than $12,000 (in 2010 U.S. dollars). According to this definition, the sample includes 55 developing countries and 25 developed countries.

The table reports statistics of country averages for the overall sample and for each country classification. For example, the mean of individual country averages of reported happiness is 5.5 in the 0-10 scale for the overall sample, 6.7 for developed countries, and 4.9 for developing countries. The overall sample includes countries with adult individuals with an average age of 42 years, a slightly larger presence of women (55%) than men (45%), about 70% of individuals who are married, less than half who live in an urban setting (44%), and about 60% who are employed. Comparing developing and developed countries, sampled individuals in developed countries tend to include older people (aged 44 years compared with 41), a slightly larger percentage of women (58% compared with 54%), and a higher percentage of employed individuals (71% compared with 54%). The samples for developed and developing countries include about the same percentages of married individuals (69%) and people who live in an urban setting (45%).[5]

## 2 Estimation

We follow the literature and explicitly assume that happiness scores are cardinally comparable so that we can estimate a constant relative risk aversion utility function using linear least squares regressions. We interpret the estimated coefficient as relative risk aversion.

### 2.1 Utility function

As in Layard et al. (2008) and Gandelman and Hernández-Murillo (2013), we assume a constant relative risk aversion utility function with respect to income:

$$u(y) = \begin{cases} \dfrac{y^{1-\rho}-1}{1-\rho} & \text{if} \quad \rho \neq 1 \\ \log(\mathrm{y}) & \text{if} \quad \rho = 1 \end{cases} , \tag{1}$$

[5] In these tables, the income variable is expressed in deviations from the country's average; and, because we trimmed outlier observations, the reported means differ from 100%.

where $y$ represents income and $\rho$ corresponds to the Arrow-Pratt coefficient of relative risk aversion $r_R$.

$$r_R = -y\frac{u''(y)}{u'(y)} = \rho. \tag{2}$$

According to this specification, income enters the utility function as a proxy for consumption. In other words, this specification assumes that the effect of income on reported happiness corresponds to the causal effects of consumption on utility. While we are following previous studies in making this assumption, we recognize that it is not trivial and we acknowledge its potential limitations.[6]

### 2.2 Estimation: happiness and utility

To use the happiness data in regression analysis, we need to assume that reported happiness, $h_i$, and an individual's experienced utility, $u_i = u(y_i)$, are related by a function $h_i = f_i(u_i)$. For simplicity, as in Layard et al. (2008) and Gandelman and Hernández-Murillo (2013), we assume that the relation $f_i = f$ is linear and common to all individuals in each country. The linearity assumption is equivalent to assuming a cardinality interpretation of the happiness scores and justifies the estimation with ordinary least squares.[7]

The estimated equation is therefore

$$h_i = \gamma u_i + X_i\beta + v_i, \tag{3}$$

where $v_i$ represents an error term that is independent of experienced utility.

One final issue to be addressed is how to separately estimate $\gamma$ and $\rho$. We follow an iterative maximum likelihood procedure. First, we compute $u_i = u(y_i)$ for values of $\rho$ between 0 and 5 in steps of 0.1. Second, for each of these computations we estimate $\gamma$ and the vector of parameters $\beta$ with ordinary least squares and save the

[6] Further discussion on this topic can be found in Clark, Frijters, and Shields (2008) and the references therein.

[7] The results do not vary significantly if we estimate the model with ordered logit instead of ordinary least squares. Ferrer-i-Carbonell and Frijters (2004) argue that one can practically assume that happiness scores are both cardinally and ordinally interpersonally comparable. The authors note that it makes little practical difference to estimate similar regressions with ordinary least squares or ordered logit when using cross-sectional data. The results may differ when using panel data, however, if time-invariant effects are important.

resulting log-likelihood of the estimation. In the vicinity of the maximum likelihood estimator we repeat this procedure in increments 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 and 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).

## 3. Results

Table 2 reports the estimates of the relative risk aversion coefficient for the 80 countries in our sample.[8] The estimates range from 0.03 to 3.02. The median and simple averages of the country estimates are both equal to 0.97. The average coefficient among developing countries is 1.01, while the average coefficient among developed countries is 0.88. For each country we report a likelihood ratio test of the null hypothesis that the coefficient of relative risk aversion equals 1. The null hypothesis is rejected at the 10% level in 5 developed countries and 10 developing countries and fails to be rejected in the remaining 65 countries. At the 5% significance level the null is rejected in 3 developed countries and 8 developing countries.

## 4. Conclusions

The literature has made a significant effort in finding adequate measures of risk aversion, but in general it has focused only on a limited set of mostly developed countries. Szpiro (1986) provided estimates of the coefficient of relative risk aversion for 15 developed countries. Szpiro and Outreville (1988) later augmented the sample to 31 countries, including 11 developing countries. Their methodology uses insurance data and primarily tests the hypothesis of constant relative risk aversion, which cannot be rejected for the majority of countries considered in their sample. In this paper, we apply the methodology of Layard et al. (2008) and Gandelman and Hernández-Murillo (2013) to estimate the coefficient of relative risk aversion for 80 countries, including 55 developing countries, using subjective well-being data.

Our individual country estimates range from 0 to 3, with an average of 0.97. However, for the vast majority of countries we cannot reject the null hypothesis that the

[8] We eliminated from the sample various developed and developing countries for which the iterative procedure (described in section 2) did not find a value for $\rho$ in the interior of the interval considered.

coefficient of relative risk aversion is equal to one. The individual country estimates in Szpiro and Outreville (1988) vary between 1 and 5, with an average of 2.89. Our estimates are close to the results of Layard et al. (2008) and Gandelman and Hernández-Murillo (2013).

Many models, including dynamic general stochastic equilibrium models, often do not have closed-form solutions and have to be numerically solved after calibrating the key parameters of the model. Our findings support, on the one hand, the use of the log form for the utility function in these exercises; and, on the other hand, our findings also provide a point estimate for a key parameter of the utility function at the country level. The importance of our results becomes apparent in cases in which it is important to allow for different parameterizations for high- and low-income countries.

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| Table 1. Summary Statistics | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All countries | | | | | Developed countries | | | | | Developing countries | | | | |
| variable | No. of countries | mean | sd | min | max | No. of countries | mean | sd | min | max | No. of countries | mean | sd | min | max |
| No. obs. | 80 | 534 | 155 | 248 | 1201 | 25 | 575 | 97 | 406 | 916 | 55 | 515 | 172 | 248 | 1201 |
| Happiness | 80 | 5.5 | 1.2 | 3.3 | 7.8 | 25 | 6.7 | 0.8 | 5.1 | 7.8 | 55 | 4.9 | 0.9 | 3.3 | 7.3 |
| Income | 80 | 90.3% | 10.7% | 54.7% | 114.1% | 25 | 98.1% | 5.3% | 85.4% | 109.4% | 55 | 86.7% | 10.7% | 54.7% | 114.1% |
| Age | 80 | 42.3 | 2.8 | 36.4 | 47.7 | 25 | 44.6 | 1.7 | 40.5 | 47.7 | 55 | 41.2 | 2.6 | 36.4 | 47.0 |
| Female | 80 | 55.4% | 6.9% | 40.9% | 73.4% | 25 | 57.7% | 6.3% | 46.3% | 73.4% | 55 | 54.3% | 7.0% | 40.9% | 71.2% |
| Married | 80 | 69.1% | 10.1% | 32.2% | 89.7% | 25 | 68.7% | 6.9% | 56.1% | 83.2% | 55 | 69.3% | 11.4% | 32.2% | 89.7% |
| Urban | 80 | 44.6% | 20.1% | 5.5% | 100.0% | 25 | 44.6% | 18.4% | 24.7% | 100.0% | 55 | 44.6% | 21.0% | 5.5% | 87.6% |
| Employed | 80 | 59.4% | 14.3% | 24.8% | 87.6% | 25 | 71.0% | 8.7% | 54.8% | 86.8% | 55 | 54.1% | 13.2% | 24.8% | 87.6% |

Notes

1) Developed countries are countries with Gross National Income (GNI) per capita greater than $12,000 USD in 2010.

2) Statistics are for the country averages of the variable.

3) Income is expressed relative to the country average. The mean does not equal 100% because outlier observations were trimmed.

Table 2. Relative Risk Aversion by Country

| | Developed countries | | | | | | Developing countries | | | | | | Developing coutries (contd) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Country | Rho | Chi-squared | No. Obs. | R-squared | | Country | Rho | Chi-squared | No. Obs. | R-squared | | Country | Rho | Chi-squared | No. Obs. | R-squared |
| 1 | Australia | 1.20 | 0.57 | 594 | 13.7 | 1 | Albania | 0.13 | **10.23*** | 453 | 18.6 | 29 | Macedonia | 1.27 | 0.37 | 563 | 17.6 |
| 2 | Austria | 1.25 | 0.14 | 465 | 12.0 | 2 | Argentina | 1.14 | 0.08 | 410 | 10.5 | 30 | Madagascar | 0.73 | 0.22 | 618 | 4.6 |
| 3 | Belgium | 1.72 | **2.78*** | 533 | 13.7 | 3 | Armenia | 0.53 | 1.54 | 520 | 11.0 | 31 | Malaysia | 1.88 | 0.54 | 497 | 1.6 |
| 4 | Canada | 0.83 | 0.37 | 867 | 14.2 | 4 | Azerbaijan | 1.86 | **4.44*** | 565 | 13.5 | 32 | Mexico | 0.79 | 0.09 | 469 | 3.1 |
| 5 | Croatia | 0.52 | 0.90 | 489 | 6.9 | 5 | Bangladesh | 1.17 | 0.18 | 661 | 13.1 | 33 | Moldova | 1.20 | 0.34 | 545 | 5.7 |
| 6 | Estonia | 0.54 | 1.52 | 488 | 15.0 | 6 | Belarus | 0.24 | 0.81 | 528 | 5.5 | 34 | Montenegro | 2.05 | 2.19 | 322 | 11.5 |
| 7 | Finland | 0.49 | 2.02 | 433 | 10.4 | 7 | Benin | 0.39 | 0.79 | 467 | 4.1 | 35 | Mozambique | 1.05 | 0.05 | 486 | 15.3 |
| 8 | France | 1.59 | 0.36 | 490 | 12.3 | 8 | Bolivia | 0.15 | **5.24*** | 450 | 11.0 | 36 | Myanmar | 1.01 | 0.00 | 749 | 12.9 |
| 9 | Germany | 0.66 | 1.36 | 630 | 14.3 | 9 | Bosnia & Herzegovina | 0.58 | **3.96*** | 889 | 13.6 | 37 | Niger | 0.14 | 0.38 | 489 | 6.3 |
| 10 | Greece | 1.12 | 0.10 | 555 | 13.7 | 10 | Botswana | 0.98 | 0.01 | 453 | 16.1 | 38 | Panama | 0.22 | **3.90*** | 476 | 15.1 |
| 11 | Ireland | 0.41 | 0.72 | 443 | 8.8 | 11 | Brazil | 0.75 | 0.01 | 612 | 5.0 | 39 | Paraguay | 0.50 | 0.52 | 480 | 7.1 |
| 12 | Japan | 0.37 | **2.87*** | 550 | 7.8 | 12 | Bulgaria | 1.06 | 0.04 | 466 | 20.6 | 40 | Peru | 1.39 | 0.40 | 359 | 10.3 |
| 13 | Korea | 0.24 | **6.24*** | 604 | 17.2 | 13 | Burundi | 2.19 | 1.97 | 451 | 9.6 | 41 | Russia | 0.56 | **2.75*** | 1000 | 12.5 |
| 14 | Netherlands | 0.45 | 0.67 | 531 | 14.1 | 14 | Cameroon | 0.94 | 0.03 | 504 | 13.7 | 42 | Senegal | 1.81 | 1.40 | 407 | 16.7 |
| 15 | New Zealand | 1.08 | 0.06 | 565 | 11.1 | 15 | Chile | 1.18 | 0.47 | 481 | 16.7 | 43 | Serbia | 0.26 | 2.48 | 815 | 13.0 |
| 16 | Norway | 0.98 | 0.00 | 647 | 14.2 | 16 | Colombia | 1.91 | 0.17 | 415 | 6.2 | 44 | South Africa | 1.34 | 2.44 | 458 | 21.7 |
| 17 | Poland | 0.39 | 1.58 | 513 | 16.3 | 17 | Dominican Republic | 0.30 | **5.71*** | 332 | 16.8 | 45 | Sri Lanka | 0.64 | 0.94 | 692 | 10.1 |
| 18 | Portugal | 1.05 | 0.03 | 418 | 15.4 | 18 | Ecuador | 1.35 | 0.48 | 548 | 7.3 | 46 | Tajikistan | 1.40 | 0.48 | 523 | 7.2 |
| 19 | Singapore | 0.35 | 2.65 | 605 | 7.1 | 19 | El Salvador | 0.42 | 1.67 | 387 | 11.0 | 47 | Tanzania | 1.23 | 0.20 | 395 | 4.1 |
| 20 | Slovak Republic | 0.17 | **4.08*** | 531 | 18.1 | 20 | Georgia | 1.11 | 0.08 | 541 | 7.8 | 48 | Togo | 1.04 | 0.00 | 504 | 5.8 |
| 21 | Slovenia | 0.82 | 0.30 | 527 | 24.0 | 21 | Ghana | 0.63 | 2.21 | 379 | 15.8 | 49 | Uganda | 0.80 | 0.52 | 497 | 12.5 |
| 22 | Switzerland | 0.97 | 0.00 | 528 | 9.8 | 22 | Honduras | 0.82 | 0.18 | 230 | 15.0 | 50 | Ukraine | 0.38 | 1.20 | 564 | 6.5 |
| 23 | Taiwan | 2.51 | **4.46*** | 566 | 7.0 | 23 | India | 0.90 | 0.01 | 1241 | 7.1 | 51 | Uruguay | 1.07 | 0.04 | 485 | 16.5 |
| 24 | United Kingdom | 0.96 | 0.04 | 640 | 11.2 | 24 | Indonesia | 1.34 | 0.54 | 758 | 4.5 | 52 | Uzbekistan | 3.02 | **9.21*** | 551 | 7.7 |
| 25 | United States | 1.37 | 1.32 | 610 | 17.4 | 25 | Kosovo | 1.04 | 0.01 | 521 | 14.6 | 53 | Venezuela | 2.03 | **6.57*** | 452 | 10.9 |
| | | | | | | 26 | Kyrgyz Republic | 1.83 | 2.53 | 564 | 6.6 | 54 | Vietnam | 0.95 | 0.04 | 558 | 13.0 |
| | | | | | | 27 | Lao People's Dem. Rep | 0.30 | 1.96 | 627 | 6.1 | 55 | Zimbabwe | 0.03 | 1.26 | 518 | 1.2 |
| | | | | | | 28 | Lithuania | 1.44 | 1.43 | 452 | 17.6 | | | | | | |

Notes
1) Developed countries are countries with Gross National Income (GNI) per capita greater than $12,000 USD in 2010.
2) The chi-squared statistic corresponds to the likelihood ratio test for the null hypothesis that Rho=1, which implies log utility.
3) The bold typeface and the asterisk indicate statistical significance at the 10% level.
4) The R-squared statistic corresponds to the regression for equation (3) evaluated at the likelihood-maximizing value for rho.