*Environment and Development Economics* 9: 757–780 © 2004 Cambridge University Press
DOI: 10.1017/S1355770X0400169X Printed in the United Kingdom

# International support for environmental protection

DEBRA K. ISRAEL
*Department of Economics, Indiana State University, Terre Haute, IN 47809, USA. Tel: (812) 237-2165. Fax: (812) 237-4349.*
*E-mail: ecisrael@isugw.indstate.edu*

ABSTRACT. This paper uses household-level survey data from a 1989 Harris poll conducted in 12 developing and three developed countries to examine the empirical relationship between the support for paying higher taxes for environmental protection and per capita national income. Results from ordered probit estimation suggest that as per capita real gross domestic product rises, controlling for other household characteristics, the strength of the support for somewhat higher taxes for environmental protection is falling for low-income countries and rising for high-income countries. The evidence also suggests that environmental protection may be important to people in developing countries during the process of economic growth. The high level of support for environmental protection found among the lower-income African countries included in this study is one result that warrants additional research. Higher economic growth rates are also found to be associated with greater support for environmental protection.

## 1. Introduction

The willingness to pay for environmental protection in developing countries is often assumed to be lower than in developed ones. For example, in the 1990s, in an internal World Bank memo that was leaked to the press, Larry Summers created a stir by suggesting that waste and pollution would be better off in developing countries, speaking from an economic efficiency standpoint (McNamee, 1992). Increasing demand for environmental protection, as per capita national income increases, has also been proposed as an explanation for the empirical relationship of an inverted U between some types of pollution and per capita national income, which has been dubbed the 'environmental Kuznets curve' (Grossman and Krueger, 1995; Hilton and Levinson, 1998; Holtz-Eakin and Selden, 1995; Panayotou, 1997;

I would like to acknowledge the Department of Economics at the University of Wisconsin-Madison, the Mellon Foundation (through Prof. Brad Barham), and the Resources for the Future Joseph L. Fisher Dissertation Award for financial support of this research. I am also grateful to Prof. Arik Levinson, Prof. Brad Barham, Prof. Robert Haveman, Prof. Andy Reschovsky, Prof. Karl Scholz, seminar participants at the Midwest Economics Association Conference, Eastern Economic Association Conference, Eastern Illinois University, and Indiana State University, and two anonymous referees for their helpful comments on earlier versions of this work.

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

Selden and Song, 1994; Shafik and Bandyopadhyay, 1992; Torras and Boyce, 1998).[1] The relationship between the demand for environmental protection and economic growth has important implications for economic development policies: Should environmental protection begin only after a country achieves a certain level of income, or is it an important priority earlier in the development process? For pollutants that have both domestic and global effects, the choices that developing countries make may be of worldwide concern.

However, empirical research using data from developing and developed countries to either support or refute the claim that the underlying demand for environmental quality increases with national income is scarce. While a large literature on the measurement of demand for environmental quality in developed countries exists and in the past decade this research has also expanded to developing countries, direct comparisons of results between developed and developing countries from separate studies are difficult since methods differ from study to study.[2] In the environmental Kuznets curve literature, since pollution is affected by both supply of pollution and demand for pollution reduction, examining the relationship between actual pollution outcomes and national income does not provide direct evidence on the relationship between the demand for environmental protection and national income.[3] Even if the supply of pollution is held constant, a gap may exist between the realized amount of environmental protection in a country and the underlying demand for environmental protection. The demand for environmental protection will also reflect the institutional framework in a country and the mechanisms which allow this demand to be expressed. This highlights the need for empirical research looking directly at the willingness to pay for environmental protection in order to understand the relationship between demand for environmental protection and economic growth.

My study begins to fill this gap by examining the qualitative responses to the question 'How willing would you be to pay somewhat higher taxes to the government if you knew the money would be spent to protect the environment and prevent land, water and air pollution?' which was asked in 12 developing and three developed countries in a 1989 Harris survey (Harris, Louis and Associates, 1989). Specifically, the relationship between per capita national income and qualitative willingness to pay for environmental protection is explored, holding constant other household

[1] The original Kuznets curve describes the inverted U-shaped relationship between growth and income inequality (Kuznets, 1955). While many studies have found evidence of an inverted U-shape, Harbaugh, Levinson, and Wilson (2002) show that this estimated empirical relationship may not be as robust as once thought.

[2] See Whittington (1998) or Georgiou *et al.* (1997) for the current status of contingent valuation research in developing countries and Portney (1994) for a discussion of the state of the debate on using contingent valuation versus other methods to measure environmental quality demand.

[3] An exception to this is a paper by Hilton and Levinson (1998) which shows that for lead pollution the inverted U-shape stems from the decreasing lead content in fuel (which presumably reflects demand for reduced pollution) as fuel use continues to rise with income.

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

characteristics. Ideally, it would be preferable to have data from a carefully constructed multi-country contingent valuation study to allow a quantitative comparison of willingness to pay for environmental protection across countries. Given the unavailability of such data, the Harris survey results allow a comparison across countries using a qualitative measure of willingness to pay for environmental protection. However, this question has drawbacks relative to a carefully worded contingent valuation question since the size of the tax increase is not specified, the environmental good being valued is very general, the responses are qualitative rather than quantitative in nature, and it is not a referendum-style question.[4] For example, the question is worded generally to include land, water, and air pollution, but these environmental problems may vary by region, by the country's level of development, or country-specific geographic or institutional characteristics, so not all respondents will have the same types of environmental protection in mind.

Three different public opinion surveys, including the 1989 Harris survey that is used in this research, a Gallup poll conducted in 1992, and the World Values Surveys (from the 1990s) allow a comparison of environmental concern and qualitative responses on the willingness to pay for environmental protection in both developing and developed countries. All three ask qualitative questions on the willingness to pay for environmental protection. In comparison to the other two surveys, the Harris survey includes fewer countries, particularly among industrialized and transitional economies, but has the advantage of including more African nations. Compared with the World Values Surveys, the Harris data include a broad range of questions on types of environmental concern which allow an exploration of the basis for the qualitative willingness to pay for environmental protection (see appendices A and B). Although the Harris data utilized in this study are from more than a decade ago now, they still are some of the best currently available data to compare the demand for environmental protection in both developing and industrialized countries. In addition, examining this available evidence may provide insights to guide the further collection of more recent data for cross-country comparisons. It might also be argued that if in 1989 developing countries were demonstrating willingness to pay for environmental protection, over time, given increasing information and awareness about health risks and in some cases increasing contamination levels, one might expect the levels of concern to increase.

Previous research based on these three surveys suggest that support for environmental protection in developing countries may be stronger than is often assumed (Dunlap *et al.*, 1993a; Dunlap *et al.*, 1993b; Harris, Louis and Associates, 1989; Inglehart, 1995). Studies examining environmental

[4] Portney (1994) outlines the desirable characteristics of contingent valuation questions that were proposed by a panel of experts, chaired by Kenneth Arrow and Robert Solow, convened to provide advice to the National Oceanic and Atmospheric Administration (NOAA) in the wake of the Exxon- Valdez oil spill in 1989 when estimating the value of environmental goods through contingent valuation surveys came under careful scrutiny.

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

attitudes from the Gallup survey of 12 developing and 12 industrialized countries, at the aggregate national level, find more or equal concern about the environment in developing and industrialized countries, but less willingness to pay higher prices to protect the environment or to choose environmental protection at the expense of economic growth (Bloom, 1995; Brechin and Kempton, 1994; Dunlap and Mertig, 1996). Analyzing Harris survey data, also at the aggregate level, Brechin and Kempton (1994) find a small, statistically insignificant, positive correlation between per capita gross national product (GNP) and the willingness to pay higher taxes for environmental protection, while the willingness to volunteer time for environmental improvement is negatively correlated with per capita GNP.[5] Similarly, using household data for 33 countries from the World Values Survey from the mid 1990s, Israel and Levinson (2004) find little evidence of a consistent pattern between the qualitative willingness to pay for environmental protection and national income. With World Values Survey data from the early 1990s, Inglehart (1995) examines responses on qualitative willingness to pay and environmental concern by country and points out that some of the countries expressing the highest concern are developing countries, where pollution levels are quite high.[6]

In this paper, unlike in the previous research using the Harris data, household as well as national characteristics are used in analyzing support for environmental protection. This is particularly important in examining the relationship between the support for environmental protection and national income in order to control for variation in sampling methods across countries. An ordered probit model is estimated to investigate the empirical relationship between the qualitative willingness to pay for environmental protection and national income, while controlling for household and respondent characteristics.

## 2. Data description and econometric methods

### *2.1. Data description*

The Harris survey data used in this paper include 6,360 households from 15 developing and industrialized countries.[7] Four of the countries are in Latin America and the Caribbean, four are in Africa, four are in Asia and

[5] However, the difference between these results appears to be that in the correlation between the qualitative willingness to pay higher taxes and per capita GNP, the United States is included, whereas in the correlation between the willingness to volunteer and per capita GNP no information was available for the United States. When I re-do their results, using percentages from table 6 of their article, the willingness to pay higher taxes has a negative and statistically significant correlation coefficient when the United States is omitted.

[6] The focus of his multivariate analysis is examining the impact of post-materialist values on an index of environmental concern.

[7] The survey was conducted from February 1988 to June 1989 (Harris, Louis and Associates 1989). The data were obtained from the Institute for Research in Social Science (IRSS) at the University of North Carolina–Chapel Hill. The total sample size is 7,072, where the difference is mainly due to the omission of households that responded 'not sure' to the pertinent questions.

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

Table 1. *Variable means and standard errors*

| *Variable name* | *Mean (s.e.)* | *Variable Name* | *Mean (s.e.)* |
|---|---|---|---|
| Qualitative willingness to pay* | 2.9635 | 16–20 years | 0.1116 |
| | (0.0123) | | (0.0039) |
| Above-average household income | 0.1390 | 21–29 years | 0.2591 |
| | (0.0043) | | (0.0055) |
| Average household income | 0.4808 | 30–39 years | 0.2307 |
| | (0.0063) | | (0.0053) |
| Below-average household income | 0.3802 | 40–49 years | 0.1686 |
| | (0.0061) | | (0.0047) |
| No education | 0.0472 | 50–64 years | 0.1618 |
| | (0.0027) | | (0.0046) |
| Grades 1–4 | 0.0627 | 65 and over | 0.0682 |
| | (0.0030) | | (0.0032) |
| Grades 5–8 | 0.2296 | City | 0.5002 |
| | (0.0053) | | (0.0063) |
| 9th grade or more | 0.3462 | Suburb | 0.1586 |
| | (0.0060) | | (0.0046) |
| Some higher education | 0.1882 | Small town | 0.1489 |
| | (0.0049) | | (0.0045) |
| University graduate | 0.1261 | Rural | 0.1923 |
| | (0.0042) | | (0.0045) |
| Female | 0.4640 | | |
| | (0.0063) | | |

*Note*: * 4 is very willing to pay and 1 is not at all willing to pay.
*Source*: Author's calculations from Harris 1989 Environmental Survey in Four Continents; $N = 6{,}360$.

the Middle East, and three are in Europe. While it would be impossible to describe any combination of 15 countries as globally representative, this selection of countries does include the most populous country of the region in three of the four regions (Africa, Asia, and Latin America). The survey instrument was carefully translated to have the same meaning in each country. However, the sampling methodology varied somewhat, for example, some of the countries only surveyed urban areas.[8] Overall, 50 per cent of respondents are from cities (table 1). The percentage of respondents in cities by country can be seen in table 2.[9] Table 1 shows the means and standard errors for the household and respondent characteristics included

[8] More details on sampling methods by country are available from the author or see Israel (1999). Saudi Arabia had an unusual sample in two respects: no females are included and the interviews were conducted at the place of work or recreation, rather than in respondents' homes. Only portions of the Harris survey were conducted in the United States, so it is not included in this study.

[9] The respondent's location was categorized as rural, small town, suburb, or city (these were defined subjectively by the respondent or the interviewer). However, in Saudi Arabia the respondent's home location was not known but the interviews took place in urban areas. Therefore, for the purposes of this analysis, Saudi Arabian respondents are coded with the city location.

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press



Table 2. *Selected variables by country*

| *Country* | *Average perceived pollution** | *Average TSP level*** | *Per capita RGDP* | *Qualitative willingness to pay**** | *Above-average household income* (%) | *Average household income* (%) | *Below-average household income* (%) | *City location* (%) | *Sample size*****|
|---|---|---|---|---|---|---|---|---|---|
| Argentina | 2.81 | 140.8 | 5,349 | 2.35 | 7 | 40.7 | 52.3 | 32.6 | 371 |
| Brazil | 3.09 | 154.4 | 4,271 | 2.78 | 21 | 8 | 71.1 | 20.7 | 439 |
| China | 3.18 | 300.6 | 1,326 | 2.94 | 12.3 | 61.4 | 26.3 | 100 | 464 |
| W. Germany | 3.17 | 38.9 | 13,456 | 2.77 | 13.5 | 68.6 | 17.8 | 33.9 | 443 |
| Hungary | 3.35 | | 5,562 | 2.73 | 9.7 | 64.5 | 25.8 | 37.5 | 445 |
| India | 3.15 | 439.4 | 1,204 | 3.09 | 10.4 | 47.5 | 42.1 | 92.5 | 520 |
| Jamaica | 2.95 | | 2,443 | 2.77 | 13.9 | 57.1 | 29 | 26 | 231 |
| Japan | 3.08 | 54.8 | 13,156 | 2.65 | 11.2 | 55.6 | 33 | 39.8 | 500 |
| Kenya | 2.42 | 54.1 | 902 | 3.75 | 2.6 | 42.6 | 54.9 | 13.8 | 275 |
| Mexico | 3.34 | | 5,349 | 3.1 | 7.8 | 44 | 48.2 | 29.3 | 386 |
| Nigeria | 2.93 | | 940 | 3.22 | 16.7 | 42.9 | 40.4 | 90.4 | 562 |
| Norway | 2.65 | | 14,674 | 3.13 | 21.1 | 51.5 | 27.4 | 37.7 | 871 |
| Saudi Arabia | 2.14 | | 7,075 | 2.92 | 17.8 | 50.6 | 31.6 | 100 | 342 |
| Senegal | 3.16 | | 1,172 | 3.26 | 10.2 | 59.3 | 30.5 | 48.7 | 226 |
| Zimbabwe | 2.6 | | 1,087 | 2.99 | 21.1 | 19.3 | 59.7 | 3.2 | 285 |

*Notes*: * 4 = poor, 3 = only fair, 2 = pretty good, and 1 = excellent.
**micrograms per cubic meter.
***4 is very willing to pay and 1 is not at all willing to pay.
****Sample size is somewhat larger for average perceived pollution and WTP as all observations with responses to this question were utilized.
*Sources*: Harris (1989) Environmental Survey in Four Continents, author's calculations; Average TSP from GEMS AIRS Executive data base. US EPA, author's calculations; Per Capita RGDP from Penn World Tables Mark 5.6.

in the analysis. Means of selected national and household-level variables are shown by country in table 2.

The national income measure used in this paper is per capita real gross domestic product (RGDP) in constant dollars using the Chain index, based on 1985 international prices taken from the Penn World Tables Mark 5.6. This measure corrects for price variation across countries to allow for more accurate cross-country comparisons of income (see Summers and Heston, 1991 for a more complete description of Penn World Tables data).

Average perceived pollution is from responses to the question: 'How would you rate the environment in this country – excellent, pretty good, only fair, or poor?' The responses range from excellent = 1 to poor = 4. While controlling for actual pollution levels may be preferable to a perceived pollution measure, comparable pollution data for all 15 of the countries were not available. In addition, since the qualitative WTP question relates to environmental protection in general, the ideal pollution indicator would be an index of all types of environmental quality, which would be complicated to construct. However, for a subset of seven of the 15 countries, air pollution data on total suspended particulates (TSP) are available from the Global Environmental Monitoring System (GEMS), allowing a comparison with the perceived pollution measure.[10]

Both the perceived pollution indicator and the TSP values are presented by country in table 2. Differences in the relative ranking of countries using these two measures would be expected since household locations do not necessarily correspond to the locations of the measured air pollution, and since perceived pollution is a rating of the environment in general, not specifically air pollution. For example, while West Germany has a high perceived pollution rating but low actual air pollution, this difference may reflect either the geographical limitation of the air pollution data (one city) or the restriction to one type of pollution. However, both measures rank China and India with relatively high pollution and Kenya and Japan with relatively low pollution.

As seen in table 1, on average the qualitative willingness to pay (WTP) is close to 3, corresponding to 'somewhat willing.' Combining the two categories of 'very willing' and 'somewhat willing' to pay shows that about 74 per cent of respondents would support somewhat higher taxes for environmental protection. By comparing the qualitative WTP with other measures of support for environmental protection, the consistency of responses may be examined. As one would expect, of those respondents who are more likely to be willing to pay for environmental protection, a larger percentage also support environmental protection as measured by

[10] The GEMS air pollution data are from the AIRS Executive data base maintained by the US Environmental Protection Agency. The GEMS/AIR program is sponsored by the World Health Organization. Annual means are available by monitoring site. Some countries have monitoring sites in several cities and/or several monitoring sites in a city. The country-level environmental indicator constructed from these data is the average of all measurements for the country for 1988, or the average of available years if no data existed for 1988 (specifics by country are available from the author).

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

these other questions (see appendix A). In addition, insight into the basis of the environmental concerns is gained by comparing qualitative WTP with which environmental problems are considered to be 'very serious' in their country (appendix B). For those respondents who responded 'very willing to pay,' the pollution problem most important to the largest percentage was water pollution of lakes and rivers (65.7 per cent see as a very serious problem). Most of the problems listed were considered very serious by more than 50 per cent of those who are very willing to pay, and they are more likely to view these problems as very serious than those respondents who are less willing to pay or not at all willing to pay, again demonstrating a consistency in the responses to the various environmental concern questions.

*2.2. Ordered probit model estimation*

Since the dependent variable (WTP) has four ascending categories, an ordered probit model is estimated to examine the relationship between national income and qualitative WTP for environmental protection, while controlling for other characteristics (see Greene, 1993 for details on ordered probit estimation).[11] The dependent variable can be interpreted as indicating how a respondent might vote in a referendum on increasing taxes for environmental protection, where both 'somewhat willing' and 'very willing' responses would be seen as 'yes' votes. This is likely to be viewed by the respondents as additional taxes, for additional environmental protection.[12] The explanatory variables include the household and respondent characteristics of above-average and average household income, highest obtained education level, female, age, and city, suburban or rural location.[13] The national characteristics included are per capita RGDP and average perceived pollution. Since country indicator variables cannot be included at the same time as national characteristics, regional indicators are included. The regional categories are Asia and the Middle East (China, India, Japan, and Saudi Arabia), Latin America and the Caribbean (Argentina, Brazil, Jamaica, and Mexico), Africa (Kenya, Nigeria, Senegal, and Zimbabwe), and Europe (West Germany, Hungary, and Norway).[14]

[11] The responses were 'not at all willing', 'not very willing', 'somewhat willing', and 'very willing', coded from one to four, therefore higher numbers reflect a stronger qualitative WTP. Note that throughout this paper 'more willing to pay' or 'stronger WTP' refer to stronger support for paying somewhat higher taxes; it does not mean willing to pay more, which would imply willingness to pay an increased amount, which is not known from the qualitative nature of the WTP responses.

[12] The argument that this type of question reflects the *marginal* willingness to pay is further developed in Israel and Levinson (2004).

[13] The omitted categories for these 'dummy' variables are, respectively, below-average income, less than a 5th grade education, males, 16–20 year olds, and small town location.

[14] While these groupings are not ideal, for example, Saudi Arabia may have little in common with the Asian countries, Hungary may be quite different from W. Germany and Norway, and a Caribbean island nation like Jamaica is distinct from other Latin American countries, they are designed to at least broadly capture regional cultural differences.

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

In addition, heteroskedasticity may be expected by country, therefore the standard errors are adjusted for clustering by country.

Actual household income is not available, however, responses to the following question: 'Would you say that your household income, compared to others in the country, is above average, average, or below average?' are utilized as a measure of relative household income. Overall, average income is the largest response category, while above-average income is the smallest response category (table 1). This pattern reflects skewed income distributions. Mean income is generally higher than median income, due to fewer high-income households. The response to this question could also be interpreted more subjectively as reflecting perceived income class based partly on cultural considerations, e.g. average would be middle class.

Given the relative nature of the household income categories, they are also interacted with per capita RGDP to make a more absolute measure of household income. Ideally the impact of per capita RGDP on the qualitative WTP would be examined while also controlling for other national characteristics, such as type of tax system, government expenditures on the environment, and level of taxation.[15] However, even if reliable data were available for all of these characteristics, with only 15 countries in the sample it is unrealistic to attempt to distinguish among a large number of these country-level effects at the same time. In order to allow for additional flexibility in the relationship between national income and qualitative WTP, a quadratic for per capita RGDP is included in one specification of the model, and in another, the relationship is allowed to vary for low-, middle-, and high-income countries.

One of the explanatory variables included in the ordered probit estimation is average perceived pollution. As pollution increases, all else equal, the strength of support for taxes for environmental protection is expected to increase. However, if a country is more polluted partially because of a lower WTP for environmental protection, the estimated parameter may actually be reflecting the endogeneity of the relationship, where countries with a lower WTP are more polluted. See appendix C for a possible mathematical interpretation of this endogeneity.

## 3. Results

### *3.1. Per capita RGDP and qualitative WTP*

Figure 1 illustrates graphically the somewhat U-shaped relationship between average qualitative WTP for environmental protection and per capita RGDP by country (the underlying figures are in table 2). The lowest-income countries have a stronger qualitative WTP than the middle-income range, and the qualitative WTP rises again slightly at the high-income end.[16]

[15] To my knowledge, government expenditures on the environment are not readily available for most of the non-OECD countries in this study.

[16] In this paper I group the countries by region and by per capita RGDP level for purposes of comparing qualitative WTP, however, other similarities among countries could be examined. For example, one might be interested in asking if respondents from oil-exporting countries have a different WTP for environmental

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

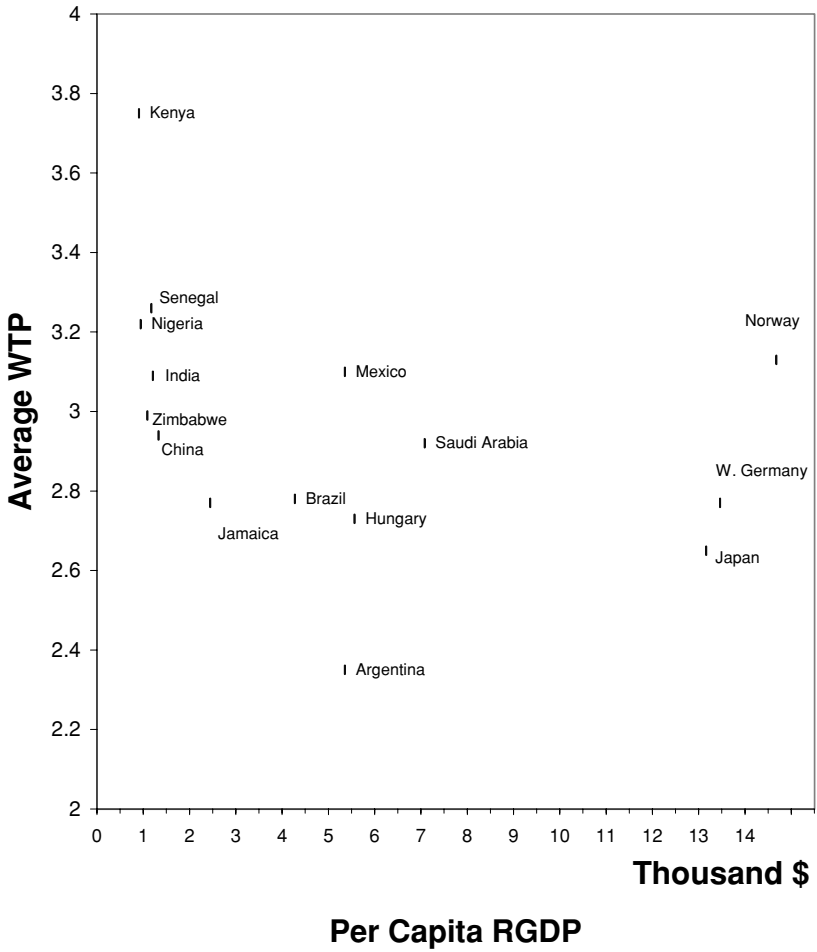



Figure 1. *Average qualitative willingness to pay for environmental protection by per capita RGDP*

It is interesting to note that the four African countries are in the top six when ranked by the average of the qualitative willingness to pay, while these same countries have the lowest per capita RGDP of the countries in the sample.[17] Also, two of the countries with the highest per capita RGDP (Japan and

protection than other countries. While a detailed analysis of this would be beyond the scope of this paper, one could look at table 2 and note that of the oil-producing countries included, Mexico, Nigeria, and Norway have an average qualitative WTP of slightly higher than the overall average of 2.96, while Saudi Arabia is close to average.

[17] Also, at least according to the average perceived pollution measure, the African countries are less polluted than other countries (table 2).

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

Table 3. *Sample percentages of willingness to pay somewhat higher taxes to protect the environment and prevent land, water and air pollution by income category*

| | *Not at all willing to pay* | *Not very willing to pay* | *Somewhat willing to pay* | *Very willing to pay* | *Sample Size* |
|---|---|---|---|---|---|
| Low-income countries | 13.86 | 12.21 | 35.61 | 38.32 | $N = 4{,}546$ |
| High-income countries | 8.32 | 16.76 | 50.28 | 24.64 | $N = 1{,}814$ |
| All households | 12.28 | 13.51 | 39.80 | 34.42 | $N = 6{,}360$ |
| Difference high–low | − 5.54 | 4.55 | 14.67 | − 13.68 | |

*Notes*: Low-income countries: Argentina, Brazil, China, Hungary, India, Jamaica, Japan, Kenya, Mexico, Nigeria, Saudi Arabia, Senegal, and Zimbabwe.
High-income countries: Japan, Norway, and W. Germany.
*Source*: Harris (1989) Environmental Survey in Four Continents, author's calculations.

West Germany) rank in the bottom five for average qualitative WTP. Of the Latin American and Caribbean countries, Mexico has a fairly high average qualitative WTP, while Argentina, Brazil, and Jamaica are among the bottom five.

In table 3, the qualitative WTP responses are compared by splitting the sample into low- and high-income countries. While any such division is somewhat arbitrary, one motivation for splitting the sample is to detect differences between countries that may be on the upward-sloping portion of the environmental Kuznets curve compared with those on the downward-sloping portion.[18] The low-income countries have a higher percentage of 'very willing' responses, while high-income countries have a higher percentage of 'somewhat willing' responses. This difference in qualitative WTP may reflect higher levels of current environmental protection in the high-income countries, resulting in less willingness to pay additional taxes for additional environmental protection. At the other end of the spectrum, low-income countries have a higher percentage of 'not at all willing' responses than high-income countries. Combining 'somewhat willing' and 'very willing' responses, 73.9 per cent in low-income countries are at least 'somewhat willing to pay' compared to 74.9 per cent in high-income countries, similar and both quite high percentages.

[18] When a regression of average perceived pollution on per capita RGDP (with linear and quadratic terms) is estimated for the countries in this sample, the inverted-U relationship of an Environmental Kuznets curve is found with a turning point of $7,133, although the parameter estimates on per capita RGDP are not statistically different from zero. In this sample of countries, this turning point is slightly above the per capita RGDP of Saudi Arabia, and if used to split the sample groups the three highest-income countries together, all with per capita RGDP greater than $13,000.

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

Table 4. *Model 1: ordered probit estimation results for the qualitative willingness to pay for environmental protection*

| *Variables* | *Coefficients* | *Standard errors* |
|---|---|---|
| Above-average household income | 0.0283 | 0.1418 |
| Average household income | 0.0940** | 0.0483 |
| Per capita (PC) RGDP (thousand $) | −0.0224* | 0.0130 |
| PC RGDP (thousand $) interacted with above-average household income | 0.0208 | 0.0165 |
| PC RGDP (thousand $) interacted with average household income | 0.0027 | 0.0052 |
| Perceived pollution | −0.2721 | 0.1741 |
| Grades 5–8 | 0.0694 | 0.0505 |
| Grades 9–12 | 0.0950* | 0.0579 |
| Some higher education | 0.1576*** | 0.0582 |
| University graduate | 0.1739** | 0.0766 |
| Female | −0.0030 | 0.0385 |
| 21–29 years | −0.1217* | 0.0668 |
| 30–39 years | −0.1151* | 0.0604 |
| 40–49 years | −0.2015*** | 0.0700 |
| 50–64 years | −0.1675** | 0.0702 |
| 65 and over | −0.2648*** | 0.0990 |
| City | −0.0600 | 0.0658 |
| Suburb | −0.4860*** | 0.1217 |
| Rural | 0.0556 | 0.0811 |
| Africa | 0.3674** | 0.1880 |
| Latin America and Caribbean (LAC) | −0.1916 | 0.1887 |
| Asia and Middle East | −0.1147 | 0.1259 |
| Cut point A | −2.2097 | 0.5954 |
| Cut point B | −1.681 | 0.5737 |
| Cut point C | −0.5774 | 0.5391 |

*Notes*: Sample Size: $N = 6{,}360$; Log likelihood: −7761.45.
Per Capita RGDP from Penn World Tables Mark 5.6 (measured in thousand dollars).
Standard errors adjusted for clustering by country.
***Significantly different from zero at 0.01 significance level.
**Significantly different from zero at 0.05 significance level.
*Significantly different from zero at 0.10 significance level.

### *3.2. Ordered probit estimation results*

In the ordered probit estimation, this relationship between per capita RGDP and qualitative WTP is examined while controlling for other factors. Looking at the parameter estimates on per capita RGDP in model 1 (table 4), as per capita RGDP increases the strength of the qualitative WTP declines.[19] However, while the parameter estimate on per capita RGDP for households with below-average income is statistically significant at the

[19] Note that the parameter estimates cannot directly be interpreted as the marginal effects of a change in a variable on the probability. Also, for the first and last categories, in this case 'very willing' or 'not at all willing', the sign of the parameter

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

Table 5. *Predicted qualitative willingness to pay with changes in per capita national income*

| *Qualitative WTP category* | *Share (1)* | *Marginal increase in per capita RGDP ($1,000) (2)* |
|---|---|---|
| **Below-average household income** | | |
| Not at all willing | 12.23% | 0.42% |
| Not very willing | 14.05% | 0.28% |
| Somewhat willing | 41.76% | 0.13% |
| Very willing | 31.95% | − 0.83% |
| **Average household income** | | |
| Not at all willing | 10.18% | 0.37% |
| Not very willing | 12.70% | 0.25% |
| Somewhat willing | 41.21% | 0.11% |
| Very willing | 35.91% | − 0.73% |
| **Above-average household income** | | |
| Not at all willing | 9.68% | 0.03% |
| Not very willing | 12.35% | 0.02% |
| Somewhat willing | 40.99% | 0.01% |
| Very willing | 36.98% | − 0.06% |

*Note*: Predicted Probabilities from table 4, model 1, evaluated at sample means for all other variables.

10 per cent significance level, for average-income and above-average income households the effect of per capita RGDP is not statistically different from zero.[20]

The magnitude of the impact on qualitative WTP of changes in per capita RGDP is presented in table 5. Column (1) shows the predicted shares of qualitative WTP categories by relative household income category evaluated at the means for all other variables, while column (2) shows the effect on qualitative WTP of a marginal change in per capita RGDP (measured in thousands). In general, the marginal change is very small for all relative household income categories, less than one percentage point for a thousand dollar change in per capita RGDP. For households with above-average income, the impact of per capita RGDP on qualitative WTP is very close to zero in all three cases. This table also illustrates that as per capita RGDP increases, while households are less likely to respond 'very willing to pay', they are more likely to respond 'somewhat willing to pay'.

Looking at the parameter estimates for relative household income in table 4, households reporting above-average and average income are more likely to be willing to pay for environmental protection than those reporting below-average income and this gap widens with increasing per capita

estimate gives an unambiguous indication of the direction of the effect, however, the same is not the case for the middle categories.

[20] Appendix D contains the covariances between the parameter estimates for per capita RGDP, relative household income, and the interaction terms in model 1, which are needed to test for statistical significance when interaction terms are involved.

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

RGDP.[21] Above-average income households are also more likely to be willing to pay than average income households in countries with per capita RGDP greater than $3,630, however this difference is not statistically significant for most of the countries in the sample (it is statistically significant at the 10 per cent level for the three highest income countries).

When comparing the magnitude of this combined effect of relative household income and per capita RGDP on the qualitative WTP at the two extremes for both variables, respondents with above-average income in high-income countries are 2.79 percentage points more likely to be 'very willing to pay' than those with below-average income in low-income countries, consistent with environmental protection being a normal good.[22]

In general, more education is associated with a stronger qualitative WTP for environmental protection. The parameter estimates on both perceived pollution and female are negative, but not statistically different from zero. Respondents in the African region are the most likely to be willing to pay for environmental protection, followed by Europe, Asia, and the Middle East, with those from Latin America and the Caribbean the least likely to be willing to pay. However, only the parameter estimate for Africa is statistically significant, consistent with the differences in average qualitative WTP among countries and regions examined previously in table 2.

All older age groups are less likely to be willing to pay for environmental protection than the youngest age group (16–20 year olds), with the oldest age group (65 and over) the least likely to be willing to pay. These results imply that if age cohorts keep their same likelihood of WTP for environmental protection as they grow older, that over time the demand for environmental protection may increase. However, if these belief differences are purely associated with age (that is, change as people grow older), the opposite will occur as a population ages. It is not possible to distinguish between these different implications with these cross-sectional data.

Suburban residents are less likely to be willing to pay for environmental quality than residents of small towns, which may suggest that small town residents have more pressing environmental problems. The qualitative WTP of those in city and rural locations are not statistically different from that in small towns, or from each other.[23] While this may seem surprising, as city residents might be expected to have greater concern about environmental problems, since these indicator variables are also serving as controls for different sampling schemes across countries (in particular, some

[21] The difference between average and below-average income is statistically significant at all levels of per capita RGDP, but the difference between above-average and below-average income is only statistically significant at high levels of per capita RGDP.

[22] The probabilities are evaluated at mean per capita RGDP for either low- or high-income countries.

[23] As mentioned in the data description section, all Saudi Arabian households are coded as city dwellers since the interviews all took place in an urban location. However, the ordered probit models were also estimated omitting the Saudi Arabian observations with similar results.

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

countries only sampled urban areas), strong conclusions on rural–urban differences or lack thereof, cannot be drawn.

*3.3. Sensitivity analysis*

Overall, the results from model 1 suggest only a weak relationship between per capita RGDP and qualitative WTP. However, one limitation of the specification in model 1 is that within the relative household income categories the relationship between qualitative WTP and per capita RGDP is restricted to be linear. Therefore, in model 2, a quadratic term is included for per capita RGDP, while in model 3, the relationship between qualitative WTP and per capita RGDP is allowed to vary for low-income, middle-income, and high-income countries (table 6).[24]

When including the quadratic term for per capita RGDP (model 2), qualitative WTP decreases with per capita RGDP, but at a decreasing rate, due to the positive parameter estimate on the quadratic term, and the turning point suggests that for the three highest-income countries in the sample, as per capita RGDP rises, the qualitative WTP also rises.[25] A similar pattern is found when the relationship between per capita RGDP and qualitative WTP is allowed to vary for low-, middle-, and high-income countries in model 3. For the high-income countries qualitative WTP increases as per capita RGDP increases (parameter estimate is $-0.5193 + 0.7396 = 0.2203$), for the middle-income countries the relationship is negative but close to zero (parameter estimate is $-0.5193 + 0.5079 = -0.0114$), and for the low-income countries the relationship is $-0.5193$.[26] Therefore, the alternate specifications estimated in models 2 and 3 imply that an increase in per capita RGDP will have a different impact on qualitative WTP for environmental protection, depending on the country's initial per capita RGDP. While falling over the low-income range, an increase in per capita RGDP has less of an effect in the middle-income range, and is increasing over the high-income range.

One difficulty in interpreting the sign on per capita RGDP is that the parameter estimates may also reflect other unobserved differences among countries that are both related to WTP and are correlated with the included country-level variables.[27] Therefore, in model 4 (table 6), a growth measure, the ratio of 1988 per capita RGDP over 1980 per capita RGDP, is included

[24] The specification in model 1 was also estimated using the natural logarithm of per capita RGDP, also finding a negative relationship between per capita RGDP and qualitative WTP.

[25] The estimated turning points vary by relative household income: $8,320 per capita RGDP for households with above-average income, $9,669 for households with average income, and $9,821 for households with below-average income.

[26] Note that these parameter estimates are actually for below-average income residents because of the interaction terms between per capita RGDP and relative household income, but the sign only changes in the case of above-average residents in middle-income countries, where the effect is positive and very close to zero.

[27] Differences among countries may also reflect the different sampling methods. However, the inclusion in the models of sex, age, and location should control for sampling differences.

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

Table 6. *Ordered probits for the qualitative willingness to pay for environmental protection, parameter estimates with standard errors in parentheses*

| *Variables* | *Model 2* | *Model 3* | *Model 4* |
|---|---|---|---|
| Above-average household income | 0.0401 | 0.0651 | 0.0453 |
| | (0.1412) | (0.1449) | (0.1427) |
| Average household income | 0.1025** | 0.0929* | 0.1065** |
| | (0.0521) | (0.0546) | (0.0506) |
| Per capita (PC) RGDP | −0.1181*** | −0.5193*** | −0.0232** |
| | (0.0407) | (0.1282) | (0.0109) |
| PC RGDP squared | 0.0060*** | | |
| | (0.0022) | | |
| PC RGDP interacted with above-average household income | 0.0180 | 0.0160 | 0.0173 |
| | (0.0165) | (0.0167) | (0.0163) |
| PC RGDP interacted with average household income | 0.0018 | 0.0040 | 0.0019 |
| | (0.0054) | (0.0059) | (0.0053) |
| Perceived pollution | −0.2907** | −0.2387 | −0.4695** |
| | (0.1464) | (0.2251) | (0.2086) |
| Grades 5–8 | 0.0781 | 0.0826 | 0.0636 |
| | (0.0535) | (0.0563) | (0.0570) |
| Grades 9–12 | 0.0939 | 0.1013* | 0.0732 |
| | (0.0626) | (0.0573) | (0.0689) |
| Some higher education | 0.1476** | 0.1901*** | 0.1510** |
| | (0.0639) | (0.0488) | (0.0681) |
| University graduate | 0.1774** | 0.1954*** | 0.1821** |
| | (0.0743) | (0.0725) | (0.0746) |
| Medium-income countries indicator (per capita RGDP 4,000–7,500) | | −1.0321*** | |
| | | (0.3820) | |
| Medium-income countries indicator interacted with per capita RGDP | | 0.5079*** | |
| | | (0.1333) | |
| High-income countries indicator (per capita RGDP above 7,500) | | −4.1834*** | |
| | | (1.0673) | |
| High-income countries indicator interacted with per capita RGDP | | 0.7396*** | |
| | | (0.1307) | |
| Female | −0.0209 | −0.0156 | −0.0280 |
| | (0.0380) | (0.0398) | (0.0358) |
| 21–29 years | −0.1154* | −0.1051 | −0.1088 |
| | (0.0698) | (0.0703) | (0.0725) |
| 30–39 years | −0.1047 | −0.0934 | −0.1048 |
| | (0.0652) | (0.0654) | (0.0666) |
| 40–49 years | −0.1877** | −0.1794** | −0.1811** |
| | (0.0778) | (0.0800) | (0.0812) |
| 50–64 years | −0.1648** | −0.1642** | −0.1606** |
| | (0.0725) | (0.0810) | (0.0770) |
| 65 and over | −0.2705*** | −0.2781*** | −0.2742*** |
| | (0.0970) | (0.1017) | (0.0988) |
| City | −0.0601 | −0.1334* | −0.0258 |
| | (0.0632) | (0.0793) | (0.0537) |
| Suburb | −0.4735*** | −0.4411*** | −0.5004*** |
| | (0.1234) | (0.1403) | (0.1178) |
| Rural | 0.0561 | 0.0728 | 0.0393 |
| | (0.0812) | (0.0891) | (0.0716) |

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

Table 6. *Continued*

| *Variables* | *Model 2* | *Model 3* | *Model 4* |
|---|---|---|---|
| Africa | 0.2478 | | 0.4974*** |
| | (0.1782) | | (0.1330) |
| Latin America and | − 0.0875 | | − 0.0459 |
| Caribbean (LAC) | (0.1472) | | (0.1594) |
| Asia and Middle East | − 0.1281* | | − 0.1742* |
| | (0.0778) | | (0.1050) |
| Ratio of 1988 PC RGDP | | | 0.5694** |
| over 1980 PC RGDP | | | (0.0881) |
| Cut point 1 | − 2.4695 | − 2.8979 | − 2.1592 |
| | (0.5525) | (0.7502) | (0.5180) |
| Cut point 2 | − 1.9372 | − 2.3636 | − 1.627 |
| | (0.5344) | (0.7397) | (0.4890) |
| Cut point 3 | − 0.8303 | − 1.2551 | − .5197 |
| | (0.5191) | (0.7343) | (0.4707) |
| Log Likelihood | − 7745.97 | − 7747.71 | − 7740.56 |

*Notes*: Sample size: $N = 6{,}360$; per capita RGDP from Penn World Tables Mark 5.6 (in thousand dollars).
Standard errors adjusted for clustering by country.
*** Significantly different from zero at 0.01 significance level;
** significantly different from zero at 0.05 significance level;
* significantly different from zero at 0.10 significance level.

(underlying figures in appendix E). The estimated relationship between this growth measure and qualitative WTP is positive and statistically significant. This relationship may be interpreted directly as an increased qualitative willingness to pay because of improving economic conditions or indirectly as a result of increasing pollution accompanying the growth. This result suggests that changing macroeconomic conditions may affect qualitative WTP. However, the rest of the parameter estimates, including that on per capita RGDP, remain substantively unchanged.

Another possible difference among countries that might be correlated with both per capita RGDP and qualitative WTP is the amount that is currently being spent on environmental protection. If households are less willing to pay more in taxes in countries where they are already paying taxes for environmental protection, this could help explain the negative estimated parameter on per capita RGDP. Similarly, this could be an explanation for the negative estimated relationship between perceived pollution and qualitative WTP (only statistically different from zero in models 2 and 4), if in countries with high pollution a large amount of spending is already going towards environmental protection and therefore households are not interested in paying more on the margin. Or the opposite scenario could be imagined where in a country with a more pristine environment, although the pollution level is low, households are more likely to be willing to pay to keep it that way than households in a more polluted environment where a small reduction in pollution might not be perceived of as making a difference (note that this is opposite from the more commonly assumed

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

decreasing marginal benefits to pollution abatement).[28] Differences in tax structure across countries could also affect the perceived magnitude of 'somewhat higher taxes' and could affect the results.

One might also speculate that corruption could be negatively associated both with willingness to pay taxes and with per capita RGDP. In this case, it would be unlikely to explain the negative relationship found between per capita RGDP and the qualitative WTP. However, this is examined empirically with the 2000 Corruption Perceptions Index, where the correlation with per capita RGDP is 0.937, which means that a higher per capita RGDP is associated with less corruption (underlying figures are in appendix E). When model 1 is estimated including this Corruption Perceptions Index, the parameter estimate is not statistically significant, but the negative relationship between per capita RGDP and qualitative WTP is essentially unaffected.

## 4. Conclusions

As per capita RGDP rises, controlling for other household characteristics, the strength of support for somewhat higher taxes for environmental protection is found to be falling for low-income countries and rising for high-income countries. For the per capita RGDP range of most countries in the sample, as per capita RGDP increases, the strength of support for somewhat higher taxes for environmental protection is falling, but the magnitude of the effect is small. An interpretation of this result is that on the margin WTP may fall as per capita RGDP rises even if total WTP is rising, especially if either tax revenues in general or environmental expenditures in particular are already high. Another possibility is that 'somewhat higher taxes' may be interpreted as a relatively larger amount in higher-income

[28] When Model 1 is estimated including a quadratic term for the perceived pollution variable, the coefficient on the quadratic is positive, but with the turning point at a perceived pollution level of 3.72, so the relationship is negative within the sample range of perceived pollution (highest value 3.35.) The negative relationship between pollution and the qualitative WTP does disappear when a different subset of countries is used. Since an actual measure of particulate air pollution is available for seven of the 15 countries, model 1 is estimated for these seven countries, with either the particulate air pollution measure in place of average perceived pollution, or the exact same specification as model 1 with average perceived pollution. In both cases an increase in pollution is associated with a stronger qualitative WTP for environmental protection. Recalling the earlier discussion of interpreting the parameter estimate on per capita RGDP in the presence of endogeneity, when the perceived pollution indicator is omitted from the estimation, the parameter estimate on per capita RGDP remains negative, which according to the discussion of endogeneity in appendix C might suggest that the underlying relationship is also negative. However, since the parameter estimate is not statistically significant no conclusions may be drawn. To check for sensitivity to omitting 'not sure' responses, an ordered probit model was estimated including 'not sure' responses as a middle or borderline response falling between the 'not very willing' and 'somewhat willing' to pay categories. The results were similar to those in model 1, although the estimated relationship between per capita RGDP and qualitative WTP for above-average income households is positive but close to zero in magnitude.

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

countries, thus generating less support. The results may also be viewed as indicating more support for at least a slight increase in taxes to pay for environmental protection in developing countries than is commonly thought. Households reporting a higher relative income as well as those with more education are more likely to show strong support for somewhat higher taxes for environmental protection. This follows the pattern that would be expected assuming that environmental protection is a normal good. In addition, growth of per capita RGDP is found to be positively associated with qualitative WTP, suggesting that macroeconomic effects other than the level of per capita RGDP may be important.

A tension exists between the limited number of data points for national characteristics and the desire to control for differences among countries. Idiosyncratic differences among countries that cannot be controlled for also may be driving the negative relationship between per capita RGDP and qualitative WTP, particularly among the lower-income countries. Possible differences that are not accounted for include the fiscal crises experienced in Latin America during this time period, so, although these countries had higher per capita RGDP than the African countries, WTP higher taxes is lower. For example, Argentina has a low average qualitative WTP and had an annual inflation rate of 343 per cent in 1988 (Little *et al.*, 1993). Also the types of environmental problems vary in the different countries. If environmental protection is tied to private economic benefits, this may lead to a stronger WTP (e.g. ecotourism in Kenya).

In conclusion, a large percentage of respondents in developing as well as industrialized countries responded that they are at least somewhat willing to pay somewhat higher taxes for environmental protection. Due to difficulties with the survey design and the limited number of countries, strong conclusions cannot be drawn. However, if support for higher taxes for environmental protection is indeed stronger in lower-income countries it may suggest a gap between this underlying support for environmental protection and the current level of environmental protection that exists. The evidence from this study suggests that environmental protection, even when accompanied by somewhat higher taxes, may already be important to people in developing countries during the process of economic growth, rather than after a certain level of per capita income has been achieved. Interesting regional differences may also exist, which warrant additional research, such as the apparent strong support for environmental protection among the lower-income African countries included in this study.

## References

Bloom, D.E. (1995), 'International public opinion on the environment', *Science* **269**: 354–358.

Brechin, S.R. and W. Kempton (1994), 'Global environmentalism: a challenge to the postmaterialism thesis?', *Social Science Quarterly* **75**: 245–269.

Dunlap, R.E., G.H. Gallup, Jr. and A.M. Gallup (1993a), *Health of the Planet: Results of a 1992 International Environmental Opinion Survey of Citizens in 24 Nations*, Princeton, NJ: The George H. Gallup International Institute.

Dunlap, R.E., G.H. Gallup, Jr. and A.M. Gallup (1993b), 'Of global concern: results of the health of the planet survey', *Environment* **35**: 7–17, 33–39.

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

Dunlap, R.E. and A.G. Mertig (1996), 'Global environmental concern: a challenge to the postmaterialism thesis', in P. Ester and W. Schluchter (eds), *Social Dimensions of Contemporary Environmental Issues: International Perspectives*, Tilburg: Tilburg University Press, pp. 133–164.
Georgiou, S., D. Whittington, D. Pearce, and D. Moran (1997), *Economic Values and the Environment in the Developing World*, Cheltenham, UK: Edward Elgar.
Greene, W.H. (1993), *Econometric Analysis*, 2nd Edition, New York: Macmillan.
Grossman, G.M. and A.B. Krueger (1995), 'Economic growth and the environment,' *Quarterly Journal of Economics* **110**: 353–377.
Harbaugh, W.T., A. Levinson, and D.M. Wilson (2002), 'Reexamining the empirical evidence for an environmental Kuznets curve', *Review of Economics and Statistics* **84**: 541–551.
Harris, Louis & Associates, Inc. (1989), *Public and Leadership Attitudes to the Environment in Four Continents: A Report of a Survey in 16 Countries*, New York: Louis Harris & Associates, Inc.
Hilton, F.G.H. and A. Levinson (1998), 'Factoring the environmental Kuznets curve: evidence from automotive lead emissions', *Journal of Environmental Economics and Management* **35**: 126–141.
Holtz-Eakin, D. and T.M. Selden (1995), 'Stoking the fires? $CO_2$ emissions and economic growth', *Journal of Public Economics* **57**: 85–101.
Inglehart, R. (1995), 'Public support for environmental protection: objective problems and subjective values in 43 societies', *PS: Political Science and Politics* **28**: 57–72.
Israel, D.K. (1999), 'Essays on energy, equity, and the environment in developing countries', Ph.D. Thesis, University of Wisconsin-Madison, Madison, WI.
Israel, D. and A. Levinson (2004), 'Willingness to pay for environmental quality: testable empirical implications of the growth and environment literature', Contributions to Economic Analysis and Policy, bepress.com Vol 3.
Kuznets, S. (1955), 'Economic growth and income inequality', *American Economic Review* **45**: 1–28.
Little, I.M.D., R.N. Cooper, W.M. Corden, and S. Rajapatirana (1993), *Boom, Crisis, and Adjustment: The Macroeconomic Experience of Developing Countries*, New York: Oxford University Press.
McNamee, M. (1992), 'The in-your-face economist at the world Bank', *Business Week*, II, May: p. 76.
Panayotou, T. (1997), 'Demystifying the environmental Kuznets curve: turning a black box into a policy Tool', *Environment and Development Economics* **2**: 465–484.
Portney, P.R. (1994), 'The contingent valuation debate: why economists should care', *Journal of Economic Perspectives* **8**: 3–17.
Selden, T.M. and Daqing Song (1994), 'Environmental quality and development: is there a Kuznets Curve for air pollution emissions?', *Journal of Environmental Economics and Management* **27**: 147–162.
Shafik, N. and S. Bandyopadhyay (1992), *Economic Growth and Environmental Quality: Time-Series and Cross-Country Evidence*, Washington, DC: The World Bank.
Summers, R. and A. Heston (1991), ' The Penn World Table (Mark 5): an expanded set of international comparisons, 1950–1988', *Quarterly Journal of Economics* **106**: 327–367.
Torras, M. and J.K. Boyce (1998), 'Income, inequality, and pollution: a reassessment of the environmental Kuznets curve', *Ecological Economics* **25**: 147–160.
Transparency International, 'The 2000 Corruption Perceptions Index', http://www.gwdg.de/~uwvw/ (2001).
Whittington, D. (1998), 'Administering contingent valuation surveys in developing countries', *World Development* **26**: 21–30.
World Values Survey, website: http://wvs.isr.umich.edu

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

Appendix A. *Other measures of support for the environment by WTP category*

| *Survey question and response* | *Very* | *Somewhat* | *Not very* | *Not at all* |
|---|---|---|---|---|
| Would you, yourself, be willing to work with other people in your community to improve the environment there – either by spending two hours a week working on environmental projects or by contributing money? | 95.4 | 82.8 | 62.9 | 58.1 |
| Response: "Yes" | | | | |
| Now, if you had to make a choice between having building and industrial development which might endanger the health of some people but would make jobs for people and a better standard of living, or living conditions where the air was good, the water was good, and the health of people was much better, which would you choose? | 82 | 79.1 | 69.1 | 71 |
| Response: "Less good standard of living but with much less health risk" | | | | |
| Do you favor or oppose stronger action by the government of this country to stop pollution and prevent the loss of land, clean air and water? | 96.4 | 96 | 91 | 92.7 |
| Response: "Favor" | | | | |
| Do you think that preserving the environment and protecting the land, oceans, rivers and the air for future generations should be a major priority for government, a minor priority or not a priority? | 93.1 | 86.7 | 74.4 | 77.5 |
| Response: "Major Priority" | | | | |
| Do you think this country should be doing more or less than it does now to protect the environment and curb pollution? | 93 | 90.3 | 84.6 | 85.1 |
| Response: "Doing more" | | | | |
| Do you think this country is spending too much money, not enough money or about the right amount of money to protect the environment and reduce pollution? | 61.3 | 65.4 | 55.2 | 50.2 |
| Response: "Not spending enough" | | | | |

*Source*: Harris (1989) Environmental Survey in Four Continents, author's calculations.

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

Appendix B. *Comparison of concern about specific environmental problems with the willingness to pay for environmental protection*

| *Description of Environmental Problem* | *Percent of WTP category that answered very serious danger from this type of pollution in their country in next five years* | | | |
|---|---|---|---|---|
| | *Very* | *Somewhat* | *Not very* | *Not at all* |
| The lakes and rivers become more polluted each year | 65.7 | 57.2 | 53.4 | 58.9 |
| Many trees are cut down and the dry land that is left will not grow good crops | 63.6 | 48.4 | 45 | 54.3 |
| The oceans and seas become more polluted each year | 62.6 | 50.4 | 48.8 | 53.3 |
| Air which is polluted and makes breathing more difficult | 59.3 | 48.7 | 44.9 | 50.4 |
| More land that is turning into desert | 54.7 | 39.2 | 34.4 | 42.5 |
| An environment where each year there are fewer birds, insects, wild animals and plants | 53.3 | 41.5 | 36.6 | 42.7 |
| Land which will not produce enough food to feed the people who live there | 53.2 | 37.9 | 36.6 | 43.9 |
| Drinking water that will make people sick | 52.5 | 42 | 37.1 | 48.7 |
| Land which is so dry and dusty that it will not yield good crops | 50.8 | 35.1 | 32.3 | 37.8 |
| Climates which are too hot or too cold | 28.4 | 20.7 | 21.3 | 24.9 |

*Source*: Harris (1989) Environmental Survey in Four Continents, author's calculations; Responses to question: Now I want to ask you about different kinds of environmental pollution. For each, I want to know how much of a danger you think that kind of pollution will be in your country in the next five years – very serious, somewhat serious, not very serious, or not serious at all?

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

Appendix C

The following equations would suggest one way to interpret the parameter estimate on income when the environmental indicator is not included as an explanatory variable

$$WTP = \beta_0 + \beta_1 X + \beta_2 Y + \beta_3 P + \epsilon_1 \tag{1}$$

$$P = \alpha_0 + \alpha_1 WTP + \alpha_2 Y + \epsilon_2 \tag{2}$$

$$WTP = \frac{\beta_0 + \beta_3\alpha_0}{1 - \beta_3\alpha_1} + \frac{\beta_1}{1 - \beta_3\alpha_1} X + \frac{\beta_2 + \beta_3\alpha_2}{1 - \beta_3\alpha_1} Y + \frac{\epsilon_1 + \beta_3\epsilon_2}{1 - \beta_3\alpha_1} \tag{3}$$

where

$X =$ *explanatory variable*

$Y =$ *income*

$P =$ *pollution level*

$WTP =$ *willingness to pay for environmental protection*

$\epsilon_1, \epsilon_2 =$ *random unobserved disturbances*

Equation (1) is a simplified representation of the underlying population relationship estimated in this study. However, if equation (2) also holds, then in the ordered probit estimation the parameter on income, $\beta_2$, is not being estimated. In this case, if the pollution indicator is omitted, the combined parameters on income in equation (3) are actually being estimated. If $\alpha_2 > 0$, $\alpha_1 < 0$, and $\beta_3 > 0$, as expected, then if the underlying $\beta_2 > 0$, this combined parameter would also be positive. However, if the combined parameter is negative, it implies that the underlying parameter $\beta_2$ is also negative and greater in magnitude than the product $\beta_3\ \alpha_2$. Note that a positive sign on the combined parameter is still possible even if the underlying $\beta_2$ is negative, if $\beta_2$ is smaller in magnitude than the product $\beta_3\ \alpha_2$. Therefore, under certain conditions, the results from an equation estimated without the pollution indicator may shed some light on the sign of the underlying parameter $\beta_2$.

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press

Appendix D. *Covariances between selected parameter estimates from model 1*

| *Variables* | *Average household income* | *Per capita (PC) RGDP (thousand $)* | *PC RGDP (thousand $) interacted with above-average household income* | *PC RGDP (thousand $) interacted with average household income* |
|---|---|---|---|---|
| Above-average household income | 0.0042 | 0.0008 | − 0.0019 | − 0.0005 |
| Average household income | | 0.0002 | − 0.0004 | − 0.0002 |
| Per capita (PC) RGDP (thousand $) | | | − 0.0001 | − 0.00002 |
| PC RGDP (thousand $) interacted with above-average household income | | | | 0.0001 |

Appendix E. *Additional national descriptive statistics by country ranked by PC RGDP*

| *Country* | *Per capita RGDP* | *2000 Corruption perceptions index* | *Ratio 1988 over 1980 PC RGDP* |
|---|---|---|---|
| Kenya | 902 | 2.1 | 0.99 |
| Nigeria | 940 | 1.2 | 0.65 |
| Zimbabwe | 1,087 | 3 | 0.90 |
| Senegal | 1,172 | 3.5 | 1.03 |
| India | 1,204 | 2.8 | 1.37 |
| China | 1,326 | 3.1 | 1.36 |
| Jamaica | 2,443 | NA | 1.03 |
| Brazil | 4,271 | 3.9 | 0.98 |
| Argentina | 5,349 | 3.5 | 0.82 |
| Mexico | 5,349 | 3.3 | 0.88 |
| Hungary | 5,562 | 5.2 | 1.11 |
| Saudi Arabia | 7,075 | NA | 0.51 |
| Japan | 13,156 | 6.4 | 1.31 |
| W. Germany | 13,456 | 7.6* | 1.13 |
| Norway | 14,674 | 9.1 | 1.21 |

* For Germany, not W. Germany

*Notes*: Corruption Perceptions Index from Transparency International [2001]: 10 = highly clean, 0 = highly corrupt.
PC RGDP ratio calculated from Penn World Tables Mark 5.6.

https://doi.org/10.1017/S1355770X0400169X Published online by Cambridge University Press