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Measuring the benefits of local public goods: environmental quality in Gaston County, North Carolina

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Local governments across the United States have been confronted with a growing range of federal and state-mandated environmental protection programmes. It is found that an application of contingent valuation to a local environmental policy is internally valid by theoretically and empirically examining the economic determinants of responses to a hypothetical referendum. The resulting option price estimate is statistically reliable and has a reasonable order of magnitude. Results indicate that respondents are willing to pay for improvements in water quality, but not air quality. It is found that information from various external sources helps to explain risk perceptions, and these perceptions, in turn, influence willingness to pay. The aggregate benefits of an air and water pollution control programme to Gaston County are estimated to be \$13.07 million annually with a 90% confidence interval of \$11.07 million and \$16.12 million.

I. INTRODUCTION

In recent years, local governments across the United States have been confronted with a growing range of federal and state-mandated environmental protection programmes. Many of these involve substantial costs for which funding must be generated at the local level. For example, costs nationwide to comply with requirements of the Safe Drinking Water Act are estimated to be between \$12.5 and \$13 billion for construction of treatment facilities and \$117 million for monitoring and testing. Especially hard hit are the smaller cities because of the small number of customers over which programme costs must be spread. The city of Montreat, NC, with 600 customers, estimates that new requirements will increase their testing costs from \$2500 to \$30 000 per year. Nationally, water bills in some small systems are estimated to increase by as much as \$70 per month (O'Connor, 1993).

While citizens and local governmental entities may be supportive of increased environmental protection, funding these programmes often becomes controversial because the primary source of funds at the local level is property taxes. Since local citizen support is critical for the successful development and implementation of these programmes, it is essential that: (1) citizens have reliable and easily accessible information about local environmental issues, problems and policy options, and (2) policy makers are able to assess the extent of constituency support for environmental policies that will inevitably impose direct costs on local taxpayers.

The focus of this paper is an air and water quality improvement project in Gaston County, North Carolina. Gaston County is located in the Piedmont Region of North Carolina, near Charlotte, and had a 1990 population of 65 347. To provide the information needs identified in (1) above, a two-year assessment of the county's natural resources was conducted, followed by development of citizen

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information and educational programmes. Local interaction and guidance was provided by the County's 50-member Quality of Natural Resources Committee and the local Cooperative Extension Service office. Information regarding point (2) was obtained from a survey of county residents that asked for their opinion on several environmental protection matters, including their willingness to pay for an air and water pollution control programme. This paper addresses the willingness to pay segment of the survey and analysis.

In this paper we examine the theoretical determinants of willingness to pay for local environmental improvements and then empirically estimate these relationships. In order to understand the views that citizens have about the nature and extent of local environmental problems, we analyse the determinants of perceptions about environmental risks for both air and water pollution. In order to supply policy makers with information about the extent of constituency support for future decisions, we estimate individual and aggregate willingness to pay estimates for changes in public health and environmental risk.

II. THEORETICAL MODEL

Suppose that households gain utility from environmental quality and all other goods. Solution of the utility maximization problem yields the indirect utility function

$$u = v(A, W, y) \tag{1}$$

where u is the reference utility level, $v(\cdot)$ is the indirect utility function, A is air quality, W is water quality and y is income. If indirect utility is additively separable in environmental quality and income the utility associated with 'good' air and water quality is

$$v(A=1, W=1, y) = \mu(1) + \phi(y) \tag{2}$$

and with 'poor' air and water quality the utility level is

$$v(A=0, W=0, y) = \mu(0) + \phi(y) \tag{3}$$

where $\mu > 0$ and $\phi > 0$ are sub-utility functions.

Suppose that without an air and water pollution control programme, Gaston County households face a p_2 risk of poor environmental quality and a p_1 probability of good environmental quality, such that $p_1 = 1 - p_2$.[1] With a pollution control programme the probability of good environmental quality is g_1, and the risk of poor environmental quality is $g_2 = 1 - g_1$. The pollution control programme is assumed to increase the probability of good environmental quality from p_1 to g_1. Expected indirect utility without the programme is

$$E(v_p) = \phi(y) + \mu(0) + p_1[\mu(1) - \mu(0)] \tag{4}$$

while expected indirect utility with the programme is

$$E(v_g) = \phi(y) + \mu(0) + g_1[\mu(1) - \mu(0)] \tag{5}$$

Suppose that payments from households will fund the pollution control programme which increases the probability of good environmental quality. The value of the pollution control programme under uncertainty about the environmental quality is the option price. It is denoted OP and satisfies the equality

$$\phi(y) + \mu(0) + p_1[\mu(1) - \mu(0)] = \phi(y - OP) + \mu(0) + g_1[\mu(1) - \mu(0)] \tag{6}$$

The option price is the maximum willingness to pay for the pollution control programme under uncertainty about environmental quality.

A voter referendum on funding the pollution control programme would present households with the question: "Would you pay \$$\delta$ for a change in probability of good environmental quality from p_1 to g_1?" where \$$\delta$ is a payment amount, presented in terms of a payment vehicle such as additional taxes or utility bills. This creates the choice problem

$$\phi(y) + \mu(0) + p_1[\mu(1) - \mu(0)] \gtreqless \phi(y - \delta) + \mu(0) + g_1[\mu(1) - \mu(0)] E(v_p) \gtreqless E(v_g[\delta]) \tag{7}$$

If $OP \geqslant (<)\, \delta$ then the respondent will answer "yes" ("no"). Let $\Delta v = E(v_g[\delta]) - E(v_p)$. Simplification yields

$$\Delta v = \phi(y - \delta) - \phi(y) + (g_1 - p_1)[\mu(1) - \mu(0)] \tag{8}$$

where Δv is the change in utility function. If $\Delta v \geqslant (<)$ 0 then the respondent will vote "yes" ("no") in the referendum.

Air (A) and water (W) quality may themselves be additively separable in the utility function. If so, it can be shown that the change in utility function will be

$$\Delta v = \phi(y - \delta) - \phi(y) + (g_1^W - p_1^W)[\mu^W(1) - \mu^W(0)] + (g_1^A - p_1^A)[\mu^A(1) - \mu^A(0)] \tag{9}$$

where the utility change from air and water quality improvements are not equal. The appropriate specification for the change in utility function, Equation 8 or 9, is testable if independent measures of the change in probabilities for air and water are available.

Using either specification, the change in the utility function has the following properties. As the level of the payment changes

$$\frac{\partial \Delta v}{\partial \delta} = \frac{\partial \phi(y - \delta)}{\partial \delta} < 0 \tag{10}$$

[1] For simplicity, we have defined utility and risk directly in terms of environmental quality, although it should be understood that it is the outcomes of environmental quality (i.e. health status) which are at issue and thus the subject of uncertainty.

since the marginal utility of income is positive. With respect to income

$$\frac{\partial \Delta v}{\partial y} = \frac{\partial \phi(y-\delta)}{\partial y} - \frac{\partial \phi(y)}{\partial y} > 0 \tag{11}$$

if the marginal utility of income is diminishing with additional income. If air and water quality are separable, as the probability of good water and air quality changes

$$\frac{\partial \Delta v}{\partial (g_1^W - p_1^W)} = \mu^W(1) - \mu^W(0) > 0 \tag{12}$$

$$\frac{\partial \Delta v}{\partial (g_1^A - p_1^A)} = \mu^A(1) - \mu^A(0) > 0 \tag{13}$$

since the utility of improved environmental quality is positive. If air and water are not separable, the effect of a change in the probability of good environmental quality $(g_1 - p_1)$ would equal the change in utility of air and water quality changes, $\mu(1) - \mu(0)$, and would be positive.

Assuming a linear functional form for the change in indirect utility function yields

$$\Delta v = \alpha_0 + \alpha_1 \delta + \alpha_2 y + \alpha_3 (g_1^W - p_1^W) + \alpha_4 (g_1^A - p_1^A) \tag{14}$$

where α_i, $i = 0, \ldots, 4$ are coefficients to be estimated. The individual coefficients are estimates of the partial effects of independent variables on the change in utility

$$\alpha_1 = \frac{\partial \phi(y-\delta)}{\partial \delta}$$

$$\alpha_2 = \frac{\partial \phi(y-\delta)}{\partial y} - \frac{\partial \phi(y)}{\partial y}$$

$$\alpha_3 = \mu^W(1) - \mu^W(0)$$

and

$$\alpha_4 = \mu^A(1) - \mu^A(0)$$

The internal validity of contingent market responses to the referendum can be assessed by examining the size and sign of these coefficients.

III. CONTINGENT MARKET DESIGN

Contingent valuation is a method developed to estimate the value (OP) of nonmarket goods, such as environmental quality (Mitchell and Carson, 1989). The wording of the contingent market in the 1990 Gaston County, North Carolina survey is in the form of a political market which presents survey respondents with a hypothetical referendum vote. Policy referendum, or dichotomous choice, questions are thought to be easier to answer by survey respondents. This may be especially true in telephone or personal interviews where the pressure to formulate a response and answer quickly is higher than in self-administered mail questionnaires.

Respondents are presented with the policy referendum question: 'Would you and your family be willing to pay $\$\delta$ per month to improve and protect air and water quality in Gaston County?' where $\$\delta$ is a randomly chosen policy price which takes the form of additional taxes and utility bills. The complete text of the valuation question is found in the appendix. Our goal was to present respondents with a political market question that would closely resemble an actual environmental quality referendum and then measure the willingness to pay for the pollution control inputs. The air and water quality change that is being valued is respondents' perceptions of the resulting output of 'cleaner air and water'.

Respondents will answer yes to the referendum valuation question if the individual benefit of the policy (OP) is greater than the individual cost of the policy (δ). The probability of a yes response is specified to depend on the change in utility with random error

$$\pi(\text{yes}) = \pi[\Delta v + \varepsilon \geqslant 0] \tag{16}$$

where π is the probability and ε is a mean zero error term. The referendum data is analysed using logistic regression (Amemiya, 1981)

$$\pi(\text{YES}) = (1 + e^{-\Delta v})^{-1} \tag{17}$$

The option price estimate is then found by solving for $\Delta v = 0$

$$OP = \frac{-[\alpha_0 + \alpha_2 y + \alpha_3 (g_1^W - p_1^W) + \alpha_4 (g_1^A - p_1^A)]}{\alpha_1} \tag{18}$$

which is positive since $\alpha_1 < 0$. The option price increases with income and with the probabilities of improvements in air and water quality with the pollution control program. Confidence intervals for the option price are calculated using the Krinsky and Robb (1986) technique which has been developed by Loomis *et al.* (1991) for dichotomous choice contingent valuation.

IV. DATA COLLECTION METHODS

The telephone survey instrument was designed based on information from pretest interviews and a review of other studies. Extensive telephone pretests were conducted to validate the survey instrument. Telephone numbers were randomly generated by a professional sampling firm using a random digit dialing technique which ensured that all residents of Gaston County with telephones had an equal probability of being included in the sample.

During the summer of 1990, telephone interviews lasting about 20 minutes were completed with 514 residents of Gaston County who were 18 years of age and older. A total

Table 1. *Data summary*

Variable	Mean	Standard deviation	Minimum	Maximum
YES	0.60	0.49	0	1
δ	\$11.01	5.80	2.5	20
Income	\$31 087	21 616	2500	250 000
Water risk	0.74	0.12	0.20	0.80
Air risk	0.70	0.14	0.20	0.80
Sex	0.52	0.50	0	1
Race	0.09	0.29	0	1
Age	45.83	16.32	18	87
Education	12.24	2.49	8	18
Tenure	29.64	19.15	0	81
Urban	0.36	0.48	0	1
Use of information	20.97	4.46	13	39
Pollution control	14.57	3.09	11	27
Other problems	10.24	1.90	7	14

of 710 contacts were made with eligible respondents. Of these eligible contacts, 164 refused to be interviewed and 32 people terminated the interview before it was finished. We discard 144 additional cases due to item nonresponse and protest response on the WTP and income variables. The usable response rate is 52%. Survey respondents appear to reflect the county population in general within a margin of error of about plus or minus 3.5% (Table 1, see Hoban, 1991 for complete details).

V. RISK PERCEPTION

Research into the psychology of risk has shown a systematic divergence between experts' assessments of risks from various hazards and the lay public's assessments of these risks. Although many individuals may have difficulty conceptualizing the mathematical probabilities of adverse outcomes, it is clear, nonetheless, that individuals do form heuristic notions about risk. These are based on the perceived severity, controllability, and other characteristics of the hazards in question. Therefore, although individuals' risk perceptions may not be correct, they do exist, and it is not unreasonable to represent them as probabilities.

In our analysis we use probabilities as a proxy for risk perceptions. These perceptions are derived from Likert scale responses to questions that ask individuals to rate their level of concern about risks to public health and the environment from various forms of air and water pollution. The mean values of the water risk and air risk probabilities are not statistically different from each other (Table 1).

In order to better understand formation of these probabilities and assess which factors explain risk perceptions, we examine the influence of demographic characteristics that are frequently cited as determinants of risk perceptions. Our risk perception model also proposes that three other factors could influence *OP* through their influence on risk perceptions: use of information sources, assessment of pollution control efforts, and perception of environmental problems. Construction of these variables is described in the appendix.

Certain demographic variables have been shown to have an important influence on environmental attitudes (Hoban, 1991). Level of formal education has been found to be positively related to concern over pollution. Age is also related, with younger people tending to be more concerned about environmental issues. Sex differences in environmental perceptions have also been found, but the results are not conclusive. Race may be a factor, but this has not been adequately investigated.

Where an individual lives can also have an important influence on environmental attitudes. Residence-related research has mainly focused on rural and urban differences in risk perceptions. Although debate remains, most research indicates that urban residents hold stronger environmental attitudes. A final residence-related characteristic may involve the length of time a person has lived in the area. For example, long-time Gaston County residents could hold different attitudes from those who have recently moved to Gaston County.

The other three variables that we investigate reflect specific attitudes or knowledge about environmental issues. The first factor represents the level of awareness and information that people have about these issues. People obtain information from a number of sources, including the mass media, interpersonal relationships (i.e. friends and family), and their own experience. We analyse the frequency of use and importance of different sources of information that the public has used relating to environmental issues in general. We expect that those most interested and more likely to gather

Table 2. *Determinants of risk perceptions*

Variable	Water risk		Air risk	
	Coefficient	t-statistic[a]	Coefficient	t-statistic
Constant	0.60***	9.18	0.67***	9.21
Sex	0.0022	0.18	0.012	0.90
Race	0.039*	1.79	0.077***	3.19
Age	0.00017	0.35	0.00046	0.86
Education	− 0.0030	1.16	− 0.0049*	1.72
Tenure	0.00060	1.47	− 0.000016	0.04
Urban	− 0.0095	0.73	− 0.0097	0.67
Use of information	0.0039***	2.73	0.0048***	3.04
Pollution control	− 0.0079***	3.93	− 0.012***	5.20
Other problems	0.017***	5.29	0.012***	3.25
F-statistic	7.50***		7.75***	
Adj R^2	0.14		0.14	

[a]Absolute value of the t-statistic.
***Significant at $p = 0.01$.
**Significant at $p = 0.05$.
*Significant at $p = 0.10$.

information about environmental problems are those most likely to have high risk perceptions. We also analyse the perceived level of current air and water pollution control. Respondents report whether they feel government is doing too much or too little to control pollution. We expect that risk perceptions will increase for respondents who feel that government is doing too little to control pollution. The third factor indicates the relative importance of environmental problems. Pollution severity is then compared to several other perceived societal problems. Perceptions of environmental risk are expected to increase as its subjective ranking relative to other problems increases.

Our findings indicate that, for the most part, demographic factors do not play a major role in determining risk perceptions; however, attitudes and information do (Table 2). These results are remarkably consistent for air and water risk perceptions; however, enough differences emerge to suggest that air and water quality are separable in utility. The level of education has an unexpected negative influence on risk perceptions in both cases, but only in the case of air risk does it approach statistical significance. There is some correlation between the level of education and the information variable (Pearson correlation coefficient = 0.23), and when the latter variable is excluded from the regression, education becomes insignificant in both equations. Race, on the other hand, is a significant variable for explaining air risk perceptions, and is marginally significant for water risk. Our results suggest that white individuals rate environmental risks higher than do individuals in other racial groups. This race-related difference is not only more significant but also of larger magnitude for air pollution than for water pollution.

The last three variables in the regression involve individual attitudes and the use of information. They are all strongly significant and of the expected sign. First, as the amount of information that individuals gather or are exposed to regarding environmental quality increases (from sources ranging from news media to environmental and government groups), so do perceptions of risk. Second, attitudes towards government indicate that those who feel government is doing too little to control air or water pollution from various sources also have higher perceptions of risk from air and water pollution. Third, as individuals rank air and water pollution higher relative to other societal problems, their perceptions of the associated risks also increase significantly.

VI. CONTINGENT MARKET RESULTS

We conclude that the probability variables developed from Likert scales for air and water risk are valid measures of the perceived probability of good environmental quality without the pollution control program. The probabilities are converted into change in probability variables ($g_1 - p_1$) and included as independent variables in the logistic regression. Our measure of the probability change assumes that only the 'baseline' risk perception, p_1, will vary across individuals.[2]

[2]We recognize that this approach may lead to some mis-measurement and that it is not an ideal technique for measuring risk change. However, our telephone survey method does not allow us to use more appropriate measurement techniques such as those described by duVair and Loomis (1993).

Table 3. *Logistic regression results*

Variable	Coefficient	t-statistic[a]
Constant	− 0.820	1.40
δ	− 0.089***	4.41
Income	0.000034***	4.52
Water risk change	2.96**	2.36
Air risk change	− 0.696	0.62
Chi-square	53.30	
McFadden's R^2	0.11	
% correct	73.70	

[a]Absolute value of the t-statistic.
***Significant at $p = 0.01$.
**Significant at $p = 0.05$.
*Significant at $p = 0.10$.

Table 4. *90% confidence intervals of option price estimates*

WTP	Monthly	Annual
Lower bound	\$14.12	\$169.44
Mean	\$16.68	\$200.16
Upper bound	\$20.56	\$246.77

We estimate the coefficients of the change in utility function by specifying the yes response to depend on the policy price (additional taxes and utility bill, δ), income, and the changes in probabilities for air and water quality (Table 3). Overall, the logistic regression model performs well lending validity to the local environmental policy survey design and referendum responses. The model chi-square statistic is significant rejecting the null hypothesis that all regression coefficients are equal to zero. The McFadden's R^2 in this model is similar in magnitude to those found in many dichotomous choice contingent valuation data sets. This model correctly predicts about three-fourths of the responses.

The coefficient on the additional tax and utility bill variable (δ) is negative and significantly different from zero. As the monthly tax and utility bill offered increases (decreases) the chance of a yes response decreases (increases). This result indicates that survey respondents are rationally responsive to cost and that the marginal utility of income is positive. Income is positively related to the yes response indicating that the marginal utility of income is diminishing. The size of this coefficient is consistent with its theoretical interpretation. That is, the coefficient measures a change in the marginal utility of income and is small relative to the estimate of the marginal utility of income (the absolute value of the coefficient on δ).

The coefficient on the water quality probability change is positive and significantly different from zero. This result indicates that the marginal utility of a water quality improvement is positive and that respondents are willing to pay for an improvement. The marginal utility of an air quality improvement is not statistically different from zero. This result is robust whether the air quality change is entered with the water quality change variable or by itself. Theoretically, this result suggests that the utility gained from air quality improvements is negligible. This result is striking since respondents perceived the risk to public health and the environment to be similar for water and air pollution problems. In our sample, respondents are willing to pay only for improvements in water quality which strongly supports the indirect utility specification with separable air and water quality arguments.

The average option price is about \$17 per month which sums up to an increase in annual taxes and utility bills of \$200 (\$1990) per household (Table 4). The 90% confidence interval is relatively tight with a range of \$6 per month and \$77 per year. We can be fairly certain that survey respondents would be willing to pay at least \$169 in higher taxes and utility bills but no more than \$247 annually for cleaner air and water.

These option price results, for local environmental policy, are comparable to two valuation studies of US environmental policy. Randall and Kriesel (1989) estimated the national benefits of a 25% reduction in air and water pollution loads to be \$893 (\$1990) per household. Although these two studies use very different descriptions of the environmental quality change, survey methods, etc., the relative values are as expected. Carson and Mitchell (1993) estimated that the benefits of an improvement in national water quality to a swimmable level are \$318 (\$1990) per household. Again the relative values are in the expected direction although the two studies are very different. These rough comparisons lend some external validity to our estimates of the value of local environmental policy.

VII. CONCLUSIONS AND POLICY IMPLICATIONS

In this paper we present a contingent valuation application to local environmental policy. We find that this application of contingent valuation is internally valid by examining the economic determinants of responses to a hypothetical referendum. Responses are related, in the expected direction, to variables that measure cost, income, and risk perceptions. The resulting option price estimate is statistically reliable and has a reasonable order of magnitude.

One of our goals in this study is to generate information so that policy makers may have an indication of the sources and extent of constituency support they can expect when making environmental policy decisions that involve increasing costs for local taxpayers. The aggregate benefits of an air and water pollution control programme to Gaston County would be \$13.07 million annually with a 90% confidence interval of $11.07 million and $16.12 million. Again, this is for a county with 65 347 households and an average household income of $31 087. These numbers could be compared to the cost of an air and water pollution control programme to determine the net benefits and economic efficiency of the programme.

Our results also indicate that respondents are willing to pay for improvements in water quality, but not air quality. The Gaston County area has been designated as a non-attainment area which carries with it requirements to implement programmes for improving ambient air quality; therefore, local governments may have limited discretion for shifting funds from air pollution programmes to water programmes. If funding for environmental programmes is to be increased, however, there is evidence that net benefits are most likely to accrue if they are allocated to water pollution control programmes.

Concern over environmental problems appears fairly high and cuts across a number of different demographic groups. Our results suggest that informational programs could serve as a complement to development and implementation of a pollution control programme. We have found that information from various external sources does help to explain risk perceptions, and these perceptions, in turn, influence willingness to pay.

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REFERENCES

Amemiya, T. (1981) Qualitative response models: a survey, *Journal of Economic Literature*, **19**, 1483–536.

Carson, R. T. and Mitchell, R. C. (1993) The value of clean water: the public's willingness to pay for boatable, fishable, and swimmable quality water, *Water Resources Research*, **29**, 2445–54.

duVair, P. and Loomis, J. (1993) Household's valuation of alternative levels of hazardous waste risk reductions: an application of the referendum format contingent valuation method, *Journal of Environmental Management*, **39**, 143–55.

Hoban, T. J. (1991) Public attitudes toward air and water quality in Gaston county. Final Report Submitted to The Gaston County Quality of Natural Resources Committee, N.C. Cooperative Extension Service, Raleigh, NC.

Krinsky, I. and Robb, A. (1986) Approximating the statistical properties of elasticities, *Review of Economics and Statistics*, **68**, 715–19.

Loomis, J., Creel, M. and Park, T. (1991) Comparing benefit estimates from travel cost and contingent valuation using confidence intervals for Hicksian welfare measures, *Applied Economics*, **23**, 1725–31.

Mitchell, R. C. and Carson, R. T. (1989) *Using Surveys to Value Public Goods: The Contingent Valuation Method*, Resources for the Future, Washington, DC.

O'Connor, D. B. (1993) Testing requirements of Safe Drinking Water Act making water as costly as wine, *Southern City*, North Carolina League of Municipalities, Raleigh, NC.

Randall, A. and Kriesel, W. (1989) Evaluating national policy proposals by contingent valuation, in *Economic Valuation of Natural Resources: Issues, Theory, and Application*, R. L. Johnson and G. V. Johnson (eds), Westminster Press.

APPENDIX: VARIABLE DESCRIPTIONS

YES Response to the question: Many people feel that additional funding will be needed to have cleaner air and water in Gaston County. This additional funding would be used by county government for construction of such things as new water treatment systems, pollution monitoring, enforcing water and air quality regulations, and educational programs. Would you and your family be willing to pay $\$\delta$ to improve and protect air and water quality in Gaston County? This would be in addition to what you already pay through your taxes and utility bills. (YES = 1, NO = 0)

$\$\delta$ Randomly assigned additional taxes and utility bills in willingness to pay question: δ = \$2.50, \$5.00, \$7.50, \$10.00, \$12.50, \$15.00, \$17.50 or \$20.00.

Income Response to the question: Which of the following categories best represents your family's 1989 total income before taxes? Please include all income sources such as wages, salaries, pension dividends, net farm income, and government payments. Income categories ranged from less than $5000 to more than $200 000. Income is coded on an 11-point scale.

Water risk This involved adding two responses to the question: Tell me if you are very concerned, somewhat concerned, or not concerned about risks to public health and the environment from each of the following: pollution of lakes and streams? pollution of underground water?

Air risk This involved adding two responses to the question: Tell me if you are very concerned, somewhat concerned, or not concerned about risks to public health and the environment from each of the following: Air pollution? Garbage or waste incineration?

Sex Female = 1, Male = 0.

Race White = 1, Non-white = 0.

Age 1990 minus the answer to the question: In what year were you born?

Education Response to the question: What is the highest grade of school you have completed? Education categories ranged from 8 or less to graduate level degree. Education is coded in years as the midpoint of the interval.

Tenure Response to the question: How many years have you lived in Gaston County?

Urban Gastonia (population 55000) resident = 1, Other = 0.

Use of information How much information on air and water quality have you obtained from (each of the following)? Have you obtained a lot (3), some (2), or no information (1)? Twelve information sources were added to form an index: Newspapers; Books; Magazines; Television; Radio; Conversations with your friends; Government agencies; Government publications; Environmental groups; Elected officials; Schools; Churches; Museums.

Pollution control This involved adding the responses to two questions: (a) In your opinion, is government doing too much (3), too little (1), or the right amount (2) to control *water* pollution from (READ ITEM) ? Six sources of pollution were added to form an index; Municipal sewage; Industry; Household septic tanks; Agriculture; Underground storage tanks; Construction sites. (b) In your opinion, is government doing too much (3), too little (1), or the right amount (2) to control *air* pollution from (READ ITEM)? Five air pollution sources of pollution were added to form an index: Auto exhaust; Truck exhaust; Industry; Fireplaces or wood-stoves; Waste incineration.

Other problems I'm going to read you a list of some issues that are not environmental concerns. For each one, please tell me if you are more concerned with the issue that I mention (1) or with air and water pollution (2)? Seven other problems were added to form an index: Crime; Unemployment; Drugs; Taxes; Education; Traffic; Health Care.