ESSAYS IN HEALTH AND ENVIRONMENTAL ECONOMICS: CHALLENGES IN THE EMPIRICAL ANALYSIS OF MICRO-LEVEL ECONOMIC SURVEY DATA

by

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Micro-level survey data are widely used in applied economic research. This dissertation, which consists of three empirical papers, demonstrates challenges in empirical research using micro-level survey data, as well as some methods to accommodate these problems.

Chapter II examines the effect of China's recent public health insurance reform on health utilization and health status. Chinese policy makers have been eager to identify how this reform, characterized by a substantial increase in out-of-pocket costs, has affected health care demand and health status. However, due to self-selection of individuals into the publicly insured group, the impact of the reform remains an unresolved issue. I employ a Heckman selection model in the context of difference-in-difference regression to accommodate the selection problem, and provide the first solid

empirical evidence that the recent public health insurance reforms in China adversely affected both health care access and health status for publicly insured individuals.

Chapter III examines the construct validity of a stated preference (SP) survey concerning climate change policy. Due to the fact that the SP survey method remains a controversial tool for benefit-cost analysis, every part of the survey deserves thorough examination to ensure the quality of the data. Using a random utility approach, I establish that there is a great deal of logical consistency between people's professed attitudes toward different payment vehicles and their subsequent choices among policies which vary in the incidence of their costs.

Chapter IV employs the same survey data used in Chapter III, but demonstrates the potential for order effects stemming from prior attitude-elicitation questions. In addition, it considers the potential impact of these order effects on Willingness to Pay (WTP) estimates for climate change mitigation. I find the orderings of prior elicitation questions may change people's opinions toward various attributes of the different policies, and thereby increase or decrease their WTP by a substantial amount. Thus, this chapter emphasizes the significance of order effects in prior elicitation questions, and supports a call for diligence in using randomly ordered prior elicitation questions in stated preference surveys, to minimize inadvertent effects from any single arbitrary ordering.

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CHAPTER I

INTRODUCTION

Micro-level survey data are widely used in applied economic research. Despite the many advantages of using such data, economists must often acknowledge that the quality of the data can leave something to be desired. Deficiencies in survey data can stem from poorly designed questionnaires, respondents' inattention when answering survey questions, or compositional changes in the sample when survey data that are collected repeatedly over a number of years. The results of research are only as good as the quality of the data. Thus, if it is not possible to get better data, we must develop models that can accommodate those deficiencies which may be present. This dissertation, which consists of three empirical papers, explores (a) the consequences of systematic selection in a survey of health insurance reform and health care utilization in China, (b) the systematic influence of respondents' attitudes in a stated-preference survey of policy preferences concerning climate change mitigation (especially with respect to the distribution of policy costs), and (c) the potential for seemingly innocuous researcher decisions (about presentation order for information in the preamble to preference-elicitation) to influence respondents' inferences about the degree of priority to attach to a policy problem like climate change mitigation.

To elaborate, Chapter II demonstrates some problems encountered in the China Health and Nutrition Survey (CHNS) that affect the researcher's ability to explore the

impact of public health insurance reform on health status and health utilization in China. The sample suffers from selectivity problems, which result from the complexity of the reform process. China's public health insurance reform between 1993 and 1997 did more than just reduce the generosity of the insurance program enjoyed by those who remained publicly insured. It also systematically reduced eligibility, so that the remaining membership contained a higher ratio of the educated, the elderly, employees in state-owned enterprises, etc. This systematic selection produces a potential for serious selectivity bias in any analysis over time.

China's policy-makers are desperate for rigorous assessments of empirically demonstrated consequences of their country's health policy reforms. They are particularly eager to know how these reforms affected health utilization and the health status of the Chinese populace. However, due to the complexity of these reforms, very little analysis of their consequences has appeared in either the Chinese or the international health economics literatures. The data available for the first chapter in this dissertation is the only data of its type. However, because of its selectivity problems, it is not suitable for use without some aggressive correction strategies. Some of the major remedial measures employed in this study include emphasis on a subsample that is less likely to be afflicted by selection bias, and the use of an improved "difference-in-differences" specification that is estimated using Heckman selectivity correction models to mitigate the systematic selection problems which pervade these data.

After correcting for sample selectivity (and other problems) to the extent possible with available estimators, I find that the health insurance reforms between

1993 and 1997 resulted in an approximately 23% decline in health care utilization and about a 41% increase in the propensity of individuals in the "publicly insured" group to report being "recently sick." These findings, while seemingly very simple, actually represent the first solid empirical evidence that public health insurance reform in China has had measurable effects on both health care utilization and health status. Both have been affected adversely, and to a significant extent. These main findings have important policy implications for China's public decision making, as well as for other low and middle income developing countries which may intend to adapt their public health services during the process of transition to a market economy.

Chapter III examines a common empirical issue in stated preference (SP) surveys designed to elicit the non-market value of a public environmental good. At issue is the question of whether systematic variation in stated policy preferences reflects respondents' attitudes and opinions. SP survey methods remain a controversial tool for benefit-cost analysis, but they are still sometimes the only source of any type of demand information about fundamentally non-market goods. Economists are skeptical about any type of demand information other than "revealed preferences." Thus it is important that every aspect of an SP survey should be subjected to thorough examination to ensure the quality of the data. "Construct validity" is often one criterion upon which SP data are judged. How well do the respondent's marginal utilities for different policy attributes (inferred from respondents' preferences across alternatives with different mixes of attributes) conform with the same respondent's attitudes about related issues?

Do the estimated marginal utilities vary systematically, in the expected direction, with the individual's opinions about related matters?

In Chapter III, we use an available online survey about preferences with respect to alternative climate change mitigation policies to examine construct validity with respect to results concerning the distribution of policy costs and the seriousness of the adverse consequences expected if a policy of business-as-usual is followed. Our findings suggest that the respondent's utility level increases with the cost shares borne via the respondent's more-preferred "payment vehicles" and decreases with the cost shares borne via less-preferred payment vehicles. Utility from avoided climate change impacts is also increasing with the individual's subjective level of worry about the vulnerability of specified climate "services" to the impacts of climate change (such as agriculture and water, or ecosystems). Other findings are also consistent with our theoretical prediction. Taken together, our results provide evidence of construct validity for this particular survey and simultaneously demonstrate an appropriate strategy that should probably be planned-for and executed for other, future stated preference surveys.

In the literature about stated preference surveys, earlier researchers have documented that a good's placement among a sequence of goods in a set of valuation questions can have a substantial impact on people's valuation of this particular good. However, the economic consequences of potential order effects stemming from questions prior to the valuation task have received surprisingly little attention. In Chapter IV, we take advantage of the fact that the online climate change survey used in Chapter III departs from conventional SP surveys in that the design of the questionnaire

incorporates an unusually wide array of dynamically generated randomized elicitation formats. In particular, virtually every time that information could be displayed in an arbitrary order, this order was randomized across respondents.

In Chapter IV, we focus on cues about importance that respondents may subliminally draw from the presentation of information in the preamble to the main policy choice question in a stated preference survey. Is it possible to manipulate, unintentionally, respondent's choices on the key policy-choice question in a stated preference survey? Can this manipulation stem from the presentation of information well before the actual choice scenario that is the focus of the research? Can the eventual willingness-to-pay measures derived from stated-preference choices be "steered" (either intentionally or unintentionally) by the researcher's seemingly innocuous decisions about how to present information in the "tutorial" portion of a survey?

Chapter IV identifies order effects created by prior attitude-elicitation questions, and assesses the potential impact of these order effects on willingness to pay (WTP) estimates for stylized climate change policies. I find that the orderings in prior elicitation questions may change people's opinions toward various attributes of the good, and thereby increase or decrease WTP by a substantial amount. Thus, it emphasizes the significance of order effects in prior elicitation questions, and supports a call for diligence in using randomly ordered prior elicitation questions in stated preference surveys to minimize inadvertent effects from any single arbitrary ordering.

The suite of papers that constitute this dissertation thus share a common thread in their concern for some distressingly common deficiencies in household-level micro

data gathered via surveys. Each paper concerns a pressing policy concern—the efficacy of health care reform in China in the case of Chapter II, and public preferences over climate change mitigation policies in the case of Chapters III and IV. In each application, it would be possible to analyze the available data naively, using packaged econometric software. In each case, however, it is demonstrated that deficiencies in the data mean that more effort is required to discern the implications of the available survey data for the policy questions at hand.

CHAPTER II

HOW DID CHINESE PUBLIC HEALTH INSURANCE REFORM BETWEEN 1993 AND 1997 INFLUENCE HELATH CARE DEMAND AND HEALTH STATUS?

Introduction

As China launched its economic reforms in the late 1970s, its health care system encountered severe cost-escalation and cost-effectiveness problems due to conflicts between the new market-based economy and the old command economy. To resolve these problems, the Chinese government implemented a series of reforms beginning in the mid-1980s, aimed at reducing the generosity of publicly supported insurance programs, and thereby containing health care costs.

Since the 1950s, the publicly supported insurance programs, including Government Insurance Schemes (GIS) and Labor Insurance Schemes (LIS), had protected virtually all urban dwellers and some rural people.[1] Not surprisingly, reform to these extensive public insurance schemes, which occurred in the mid-1980s, affected a huge proportion of the Chinese populace. The reform was highly decentralized and

[1] The Government Insurance Scheme (GIS) provided coverage for employees in government agencies and people working in the health and education sectors. The Labor Insurance Scheme (LIS) provided full benefits to employees in state or collective enterprises and partial coverage for their immediate family members. The "Rural Cooperative Medical System" (RCMS) provided low-cost basic health care for most rural residents at the commune level. By the late 1970s, these three health insurance schemes covered roughly 90% of the Chinese populace (including virtually all urban residents and 85% of those in rural areas) (World Bank, 1997).

nation-wide, associated with a change in the composition of participants and other reforms to Chinese infrastructure that were carried out simultaneously. These features make China's health care reform a unique laboratory for inferring the implications of reform in developing or lower income countries that intend to adapt their health care services to a market-oriented economy; on the other hand, these features make evaluating the reform extremely challenging (Langan, 1993; Bloom, 1998; Blumenthal et al., 2005).

The public insurance reform process began in the mid-1980s and ended in the late-1990s, with the introduction of a new type of insurance scheme involving a three-layer payment system, replacing the publicly supported insurance programs GIS and LIS.[2] The public insurance reform, at its beginning stage, had little effect on cost escalation (Grogan, 1995; Liu et al., 1995; Liu, 2002). It is well-known that reforms in the mid-1990s led to a decrease in the number of participants (Guo, 2003; Akin et al., 2004) and greater cost-sharing by the remaining patients (Wong et al.). Recent work has identified a 19% increase in out-of-pocket costs for the publicly insured over this period (Cai, 2007). Although Chinese policymakers were eager to determine how the generosity reduction affected health care demand, no studies have definitively answered this question.

[2] The three layers are: individual medical savings accounts (MSAs); out-of-pocket spending by beneficiaries in the form of deductibles; and social risk pooling. Enrollees are expected to pay for outpatient care through MSAs. After the MSAs are exhausted, enrollees need to pay a deductible and a copayment, and the rest of the cost should be covered by the social risk pooling funds. Some pilot cities, such as Zhenjiang and Jiujiang, were selected to carry out this stage of reforms as early as 1994 (Liu, 2002).

This study contributes to the literature in two important ways. First, it provides empirical evidence of how health care utilization and health status were affected when public insurance reform decreased program generosity. Previous studies use only summary statistics and suggest that there was no significant change in health conditions, but a 50% decline in inpatient health utilization (Gao et al., 2001). Using the Heckman selection correction model in the context of a difference-in-difference regression, the present study shows that health insurance reform decreased the health care utilization of publicly insured individuals by about 23%, and increased their likelihood of getting sick by 41%. Second, existing studies have identified a price elasticity of demand of 0.7 and an income elasticity of demand of "somewhat above unity" (Chow, 2006) based on provincial- and country-level data. The present study uses individual-level data and identifies a price elasticity of 1.65 and an insignificant income elasticity of health-care demand. The differences between the two studies may result from the different attributes of the data sets, as models based on individual data are capable of controlling for many individual characteristics that provincial-level data would fail to capture. Therefore, the estimated price elasticity using provincial- or country-level data may not as accurate as the one obtained in this study.

The rest of the chapter is organized as follows: Section II: Data Sources; Second III: Empirical Model; Section IV: Estimation Results; Second V: Health Status Deterioration; Section VI: Further Robustness Check; Section VII: Price Elasticity; Section VIII: Price Elasticity and Implications; and Section VIII: Conclusions.

Data

The data come from the "China Health and Nutrition Survey" (CHNS). This survey is a collaborative effort involving the National Institute of Nutrition and Food Safety (INFS), the Chinese Center for Disease Control and Prevention (CCDC), and the University of North Carolina at Chapel Hill (UNC-CH). It is a unique micro-level longitudinal survey which was conducted in the years 1989, 1991, 1993, 1997, 2000 and 2004 for nine provinces in China.[3] The choice of survey jurisdictions was based on a random selection process.[4]

The summary statistics for the years 1989 to 2000 are reported in Table 1, and variable definitions are provided in Table A.1. The available demographic information suggests roughly constant proportions male and urban over the years in question. The consistent increases in average age reflect the normal pattern of aging; the increasing trend in household incomes reflects China's recent high annual growth rates of GDP. The proportion employed increased from 77% to 89% between 1989 and 1993, then dropped to 69% in the late 1990s. This trend coincides with China's enterprise reform (in the late 1990s) that laid off large numbers of workers, especially in state-owned and collective enterprises. Not surprisingly, the proportion of people working in state-owned or collective enterprises declined in the late 1990s. The proportion of the population having health insurance dropped from 24% to 16% in 2000. This is most likely due to the fact that the two main health insurance schemes are mostly employment-based.

[3] Eight provinces, Liaoning, Jiangsu, Shandong, Henan, Hubei, Hunan, Guangxi, and Guizhou, were surveyed from 1989 to 1993. In the year 1997, the province of Liaoning was excluded, and the province of Heilongjiang was added to the survey. In the year 2000, all nine provinces were included in the survey.

[4] See the CHNS website: http://www.cpc.unc.edu/china

Workers lose their health insurance when they become unemployed. The proportion of publicly insured individuals (either GIS or LIS) decreased slightly from 1989 to 1993, while it dropped drastically after 1993. This corresponds with findings, in the previous literature, that reforms after 1993 largely reduced the number of publicly insured individuals. Commercial insurance, as a new type of insurance, has been included in the CHNS since the year 1997.[5] We also observe that people switch from the less-educated categories to more-educated categories, which reflects China's improvement in overall educational attainment. A roughly equal number of individuals were surveyed in each province.[6]

One major concern is the shrinking sample size of publicly insured individuals. The public insurance reform over the 1990s reduced the number of program participants. The size of the publicly insured sample (GIS or LIS insured) shrinks from 2920 persons in 1989 to 801 persons in 2000 (Table 2). The surviving group has higher proportions of males, urban residents, the rich, the elderly, the highly educated people, and professionals than does the aggregate sample. Most importantly, compositional variations over the years suggest that the eligibility criteria may have changed as the reform went along: First, the proportions of highly educated people (especially those

[5] The first Chinese insurance company which provided medical care services was established in 1996. Its predecessor organization, the People's Insurance Company of China (PICC), did not start to sell medical care insurance for young people until 1992. Not surprisingly, commercial insurance was not a popular form of insurance until the late 1990s (Xinhua News Agency, December 5, 1995; The Xinhua General Overseas News Service, January 29, 1993).

[6] The discussion suggests that social reforms and normal development, rather than simply attrition, may account for changes in sample composition. To assess this conjecture, I further investigate whether the "missing" or "replacement" individuals consistently exhibit particular characteristics over the years that might alter the sample's composition. These estimations support the randomness of the sample. The results are available from the author.

with a college degree or above) increase at a greater rate than in the full sample. Second, farmers, skilled workers, unskilled workers and service workers are less well-represented, while professionals, administrators and staff become better-represented in the publicly insured sample in later sample years. In addition, provinces differ considerably in the rates at which public insurance prevalence declines, which indicates a heterogeneous process of reform. Summary statistics for the publicly insured subsample indicate that the publicly insured group had been narrowed down to a group of individuals with specific attributes as health reforms proceeded during the 1990's. This brings up a potentially severe selection problem that I will discuss extensively in the following sections.

Empirical Model

One important issue is to measure health utilization change. In the CHNS data, respondents who had been "sick" over the last four weeks were asked to indicate how they treated their illness from the following alternatives: 1. went to see a doctor; 2. went to a countryside clinic; 3. did not pay any attention; 4. took care of it on their own. I created a variable "care" which equals one if the person chose alternative 1 or 2, and zero otherwise. Therefore, health care utilization is quantified as a dummy variable for the decision to seek professional (i.e hospital or clinic) care, conditional on being sick.

Using data for 1993 and 1997 to represent the periods before and after the policy change, respectively, I next employ the "difference-in-difference" (DD) method to examine how the policy change affected the health care utilization of the publicly

insured. With the DD method, the treatment group is defined as the group affected both by the policy of interest and economywide trends, while the control group is affected only by economywide trends. In my study, publicly insured individuals comprised the treatment group of interest, and the control group consisted of uninsured individuals who are not covered by any type of health insurance and thus should not be affected by any insurance-related policy change. Ideally, the control group should resemble the treatment group in all aspects except that they do not experience the health policy reform of interest. However, in our case, the publicly insured and uninsured groups differ not only in their insurance status, but also in their demographic information, education, working status, etc, due to the nature of the public insurance program (Henderson et al., 1995). As Tables 2 and 3 suggest, compared with the uninsured group, the publicly insured group is more urban, older, richer, and better educated.

Another approach to arguing for the validity of the control group is to demonstrate that it experiences similar compositional changes to those seen in the treatment group during the sample period. However, in our case, public health insurance reform over this period not only reduced program generosity, but also cut off those with specific attributes. Following Finkelstein (Finkelstein, 2002), I reported the means of the treatment and the control groups before and after the reform in Table 4. The column "difference-in-difference" compares the change in the means of the publicly insured group before and after the health reform to the change in the means of the uninsured group before and after the reform. An insignificant coefficient in this column suggests similar trends for the treatment and the control groups. Most of the differential changes

between the treatment and the control groups are indeed significant. Thus, the conventional DD method is not applicable unless we first address the selection problem. I next employ the Heckman selection correction model to compensate for the endogeneity of being publicly insured or uninsured.

The Heckman selection model is a very powerful technique for use in accommodating sample-selection problems. The recent literature describes its utility for addressing sample attrition problems (Hirano et al., 2001). Briefly, the idea behind Heckman's method can be described as follows. Let the equation which determines the "sample selection" be $z_i^* = w_i'\gamma_i + u_i$, and let the "outcome equation" be $y_i = x_i'\beta + \varepsilon_i$, the observation y_i is observed only if $z_i^* > 0$.[7]

It is preferable to have identifying exogenous variables in the selection equation which do not also appear in the outcome equation. Sometimes, however, the same set of variables serves as regressors for the "selection equation" as for the "outcome equation." Since unobserved heterogeneity may affect the selectivity equation and the outcome equation at the same time, examining the significance of the unobserved heterogeneity is an important step in the Heckman selectivity correction model.

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[7] Under the assumption that y and z follow a joint normal distribution with correlation ρ, we have

$$E[y_i \mid z_i^* > 0] = E[y_i \mid u_i > -w_i'\gamma_i] = x_i'\beta + E[\varepsilon_i \mid u_i > -w_i'\gamma_i] = x_i'\beta + \rho\sigma_\varepsilon\lambda_i(\alpha_u) = x_i'\beta + \beta_\lambda\lambda_i(\alpha_u)$$

Where $\alpha_u = -w_i'\gamma_i / \sigma_u$, and $\lambda(\alpha_u) = \phi(w_i'\gamma_i / \sigma_u) / \Phi(w_i'\gamma_i / \sigma_u)$

So $y_i \mid z_i^* > 0 = E[y_i \mid z_i^* > 0] + v_i = x_i'\beta + \beta_\lambda\lambda_i(\alpha_u) + v_i$

(Greene, 2003).

I next apply difference-in-difference (DD) method to the outcome equation to evaluate the effect of policy change on health utilization. The idea of the DD method is illustrated in Table 5. Conditional on being recently sick, compared with year 1993, 3.69% more uninsured sought professional care in year 1997, while 11.9% less publicly insured sought professional care. Note that the increased health care utilization of the uninsured group represents impacts on health care utilization from economywide changes. The change in health utilization of the publicly insured can be broken down into two parts: the impact of economywide changes and the impact of the reform. Under the DD assumption that the impact of economywide changes on health care utilization of the treatment group is identical to that of the control group, the reform itself resulted in about 15.6% fewer doctor visits for the publicly insured.

The Heckman selectivity correction model is identified by the following two-equation structure, where equation (1) is the selection equation and equation (2) is the outcome equation.

$$selection_{ipt} = \alpha_0 + \alpha_1 Z_i + \alpha_2 year1997_t + \alpha_3 sicklevel_i + \alpha_4 (Z_i \times year1997_t) + \gamma_p province_p + \mu_{ipt} \quad (1)$$

$$care_{ipt} = \beta_0 + \beta_1 Z_i + \beta_2 publicinsured_i + \beta_3 year1997_t + \beta_4 (public_i \times year1997_t) + \beta_5 sicklevel_i + \delta_p province_p + \varepsilon_{ipt} \quad (2)$$

Where

$care_{ipt}$ =1 if the person sought hospital or clinic care when he/she was sick; zero if otherwise;

Z_i is a vector of individual demographic characteristics such as age, gender, etc;

$publicinsured_i$ =1 if he/she is public insured; =0 otherwise;

$year1997_t$ =1 if year=1997; =0 if year=1993;

$province_p$ is a set of province dummy variables;

$sicklevel_i$ is a set of dummies of self-reported measure of sickness, including "not severe," "somewhat severe" and "very severe;"

$selection_{ipt}$ is a dummy variable; =1 if the observation belongs to either the publicly insured or the uninsured group; =0 if the person is otherwise insured.

The selection equation, equation(1) determines inclusion of the observation in the estimating sample for the outcome equation. If the individual is either publicly insured or uninsured, the observation is used in estimating the outcome model and the "selection" variable is set equal to one. The interaction term $Z_i \times year1997_t$ captures the differential selection, pre- and post-reform, into the two groups. Equation(2), the outcome equation, is estimated only if the dependent variable $selection_{ipt}$ in equation (1) equals one. The key coefficient β_4 in the outcome equation measures the change in health care utilization that can be imputed to the health care reform.

Estimation Results

Estimation results are reported in Table 6. The results for the Heckman selection model are presented in two columns. The first column is the outcome equation (equation2), which explains the variation in health care utilization. The outcome equation is estimated as a linear probability model. The second colum is the selection

equation (equation1), which is estimated as a probit model. In addition to the selection correction model, a linear probability model (LPM) with individual-specific fixed effects, and a simple LPM, are provided for comparison. Table 6 suggests that more-educated people are more likely to seek professional care than less-educated people. Publicly insured individuals have a higher propensity to seek health care than the uninsured.[8]

The estimated coefficient on household income is negative and never statistically significant in these models. This implies a low income elasticity of health care demand, in contrast to the income elasticity of "somewhat above unity" identified in Chow's work (2006). This disparity may be attributable to the different types of data used in the two studies. Models based on individual data permit the researcher to control for many personal characteristics, whereas models based on provincial-level data cannot.

Across all three different models, the coefficients on the variable "publicinsured × year1997" are all negative, with similar magnitudes, and are statistically significant. The estimated effect of health insurance reform on health care utilization, from the Heckman model, is larger than the estimate from the LPM. This indicates a downward bias in the simple LPM estimates. The P-value of the t-test for the estimated error correlation parameter ρ suggests insignificant unobserved-but-correlated heterogeneity. I conclude that the finding that health care reforms decreased the health care utilization of publicly insured individuals by about 18% is a fairly robust result.

[8] This finding is not robust in the model with individual fixed effects, possibly due to the limited size of the sample, which includes only those who are consistently publicly insured or consistently uninsured.

Effects on Health Status

Respondents were asked about their habits in seeking professional health care only if they had been sick over the last four weeks. This is a non-trivial conditioning problem. Suppose the health reforms between 1993 and 1997 substantially reduced the likelihood of being sick; then a decrease in health care utilization by publicly insured individuals could be attributed to an improvement in their health status. The task of this section is to determine whether health status changed pursuant to China's health care reforms.

As before, I employ a difference-in-difference technique with publicly insured and uninsured workers as the treatment and the control groups, respectively. Health status is measured as the propensity to have been sick within the last four weeks.[9] As Table 7 illustrates, while the publicly insured are four percent more likely to be sick in 1997 than in 1993, the uninsured were 0.4 percent more likely to be sick over the same period. Health policy changes appear to have resulted in a 3.5 percent relative increase in the propensity for individuals to have been sick during the most recent four weeks.

The estimating specification takes the following form:

$$selection_{ipt} = \alpha_0 + \alpha_1 Z_i + \alpha_2 year1997_t + \alpha_3 (Z_i \times year1997_t) + \gamma_p province_p + \mu_{ipt} \quad (3)$$

$$sick_{ipt} = \beta_0 + \beta_1 Z_i + \beta_2 publicinsured_i + \beta_3 year1997_t + \beta_4 (public_i \times year1997_t) + \delta_p province_p + \varepsilon_{ipt} \quad (4)$$

[9] The surveys were conducted in fall and winter each year, specifically, in September, October and November. Therefore, we expect to see little seasonal variation on the propensity of being sick within the previous four weeks.

Where

$sick_{ipt}$ = 1 if the person got sick over the last four weeks, zero otherwise;

Z_i is a vector of individual demographic characteristics such as age, gender, education etc;

$publicinsured_i$ =1 if the individual is publicly insured; =0 otherwise;

$year1997_t$ =1 if year=1997; =0 if year=1993;

$province_p$ is a set of province dummy variables;

$selection_{ipt}$ =1 if the observation belongs to either the treatment or the control group; =0 otherwise.

The selection equation (3) for this Heckman correction model controls for systematic selection of the observations into the publicly insured or the uninsured sample. The interaction term $Z_i \times year1997_t$ makes it possible to capture the differential selection into the sample used to estimate the outcome equation. β_4 is the key coefficient assessing the health status change of the publicly insured compared with the uninsured. Estimation results are presented in Table 8. The estimated coefficients on "household income," "age" and "education attainment" are statistically significant and bear the expected signs: higher-income, young and better-educated individuals have better health. Urban dwellers appear to be more likely to get sick than those living in rural areas. This may reflect the greater environmental pollution and higher population densities (and therefore contagion) in urban China. The individual fixed effects model suggests that publicly insured individuals have worse health than the uninsured. This

confirms earlier findings that the jobs of the publicly insured involve more high-stress office work and less outdoor physical activity, which may contribute to health problems (Ding, 1994). The key coefficients (on publicinsured × year1997) are statistically significant in all three models, and suggest an approximately 3% increase in the likelihood of getting sick for the publicly insured relative to the uninsured. Heckman's model slightly reduces the magnitude of the key coefficient compared to the simple LPM. This indicates that simple LPM estimates may be biased slightly upward. The P-value of t-test for the estimated error correlation ρ suggests insignificant unobserved-but-correlated heterogeneity.

Robustness

The findings in the last two sections imply that the health reforms in China between 1993 and 1997 decreased health care utilization and worsened the average health status of the publicly insured. The evidence thus far does not support the conjecture that lower health care utilization rates resulted primarily from improved health. Rather, the results suggest that health reforms decreased the health care utilization of publicly insured individuals. As is well established in the health economics literature, the less health care utilization is likely lead to a worse health condition, my estimations of the previous section indicates a decline in health status of the publicly insured group. As a robustness check, I improve upon equation (2) by

correcting for the potential selection into the sample of "being recently sick."[10] In this section, the sample being used consists of the publicly insured and the uninsured groups only.[11] The results of a Heckman selection model and simple LPM are reported in Table 9.

The selection equation in Table 9 (the second column) confirms the previous finding that the more-educated and those with higher incomes are less likely to become sick; the publicly insured, older people, and urban dwellers have worse health conditions than their counterparts. The key coefficient on (publicinsured*year1997) confirms previous findings in Table 6 that health care reforms between 1993 and 1997 reduced health care utilization by about 18% (after correcting for systematic selection into the sample of "being recently sick"). Some incidental results from previous sections—e.g. that the publicly insured and more-educated people are more likely to seek professional care—are less robust. Compared with the pre-reform stage, health utilization decreased by 18/76.98%~= 23%, and the percentage-increase in reported illness is: 3/7.23% ~=41%.[12]

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[10] I do not focus on the selection into the treatment and the control groups in this section for the following two reasons: 1. The estimates of simple LPM model appear to be biased downward compared with Heckman's selectivity correction model (Table 6). Ignoring this selection could only understate my result. 2. Since the Heckman selection model cannot control for two types of selection at the same time in existing versions of Stata, I resort to using Limdep. Correcting for two types of selection at the same time using Limdep actually enhances both the significance and magnitude of my key coefficient (Table A.2).

[11] People with other types of insurance, such as commercial insurance, work unit insurance, cooperative medical insurance, dependents' medical insurance, Maternal and Child health care insurance and planned immunization insurance, are excluded from the sample.

[12] The initial rate of seeking professional care for the publicly insured is 76.98% (Table 5); the initial percentage of reported illness for the publicly insured is 7.23% (Table 7).

The large decrease in health care utilization may be evident for two reasons: first, previous studies claimed that "financial difficulty" is the main reason why people opted not to seek professional medical care during 1993-1998 (Gao et al., 2001; Renmin Daily, May 16, 1995). Facing a larger share of health expenses, the publicly insured were afraid to go to a hospital or clinic for professional care because they wished to avoid paying huge medical bills. Second, it indicates a large price elasticity of health care demand.

Price Elasticity

In this section, I will explore the price elasticity of demand for health care in China, based on the sample of participants who had some percentage of outpatient or inpatient reimbursement (the "Co-payment" participants). The "Co-payment" participants sample is used for the following two reasons:

1. Using the same data, my previous research identified that reforms over this time interval increased out-of-pocket medical care costs by 19% based on this group of people (Cai, 2007). This finding can be used to infer the price increase.

2. This group is the largest category among all major forms of public insurance schemes.[13]

[13] There were four major types of reimbursement methods. 1. "Upper limit" on reimbursement—patients had to pay a certain percentage if the expenditure was above the upper limit. 2. "Deductible"—expenditures could be reimbursed at a certain percentage if the expenditure was above the deductible, 3. "Co-payment"— a certain percentage of outpatient or inpatient care expenditure can be covered. The participants should pay the rest of the expenditure. 4. "Distributed medical expenses"—the work unit distributed a certain amount of money for medical care to each individual. He/she could keep the money if the person did not need it for medical expenses. Both the 1993 and 1997 surveys suggest these categories are mutually exclusive.

Thus, I apply the estimating specification from the last section to the "Co-payment" participants (the treatment group) and the uninsured group (the control group). The results are reported in Table 10. These estimates suggest that health care reforms between 1993 and 1997 reduced the rate of seeking professional health care for "Co-payment participants" by 24.1% compared to the uninsured, with a 95% confidence interval that includes increases from 6% to 42%. Therefore, the percentage-decrease in health care utilization is: 24.1/76.98%[14]= 31.30%, with a 95% confidence interval that includes percentage decreases from 7.79% to 54.55%. Thus, I divide the percentage-decrease in health care utilization (31.30%) by the percentage increase in price (19%) to estimate price elasticity of demand, obtaining a value of 1.647, with a 95% confidence interval that includes elasticities from 0.41 to 2.87.

Although the price elasticity of 0.7, identified in Chow's work, lies within my 95% confidence interval, my estimated price elasticity suggests that the demand of health care is price elastic, while his result does not. The disparity may be attributed to the different types of data used in the two studies. Individual-level data permits the analysis to control for personal characteristics for which provincial-level data cannot control. Therefore, the estimated price elasticity using provincial- or country-level data may not as accurate as the one estimated using individual-level data.

[14] The initial rate of seeking professional health care for the publicly insured is 76.98% (Table 5).

Conclusion

Using the CHNS data, I find that China's public health insurance reform between 1993 and 1997 lowered health care utilization rates for the publicly insured population by about 23% (after correcting for the selection problem), and increased the likelihood of reporting recent illness by 41% for publicly insured people. I use the Heckman selectivity correction method to adjust my the estimates for sample selection problems. This study provides the first solid empirical evidence that public health insurance reform adversely affected both health care access and health status for publicly insured individuals. It also provides new evidence concerning China's price and income elasticities of demand for health care using household-level data. My results indicate insignificant income elasticity but a price elasticity of 1.647. These findings may have significant policy implications for China's current health care reforms, as well as for other low and middle income countries intending to adapt their health services during the process of transition to a market economy.

Table 1. Descriptive statistics for the whole sample

	1989	1991	1993	1997	2000
Demographic information [a]					
Male=1	0.50	0.50	0.50	0.51	0.50
Urban=1	0.31	0.30	0.28	0.31	0.30
Age (in years)	29.28	29.84	31.53	33.92	35.84
Household income (Chinese Yuan)	4001.46	3145.26	4110.90	10815.54	11515.67
Work status & enterprises type					
Employed=1	0.77	0.80	0.89	0.78	0.69
State-owned enterprise=1	0.14	0.13	0.13	0.11	0.08
Small collective enterprise=1	0.07	0.05	0.05	0.04	0.02
Large collective enterprise=1	0.05	0.04	0.05	0.03	0.02
Other enterprises=1	0.51	0.58	0.66	0.60	0.57
Insurance					
Insured=1	0.25	0.24	0.23	0.24	0.16
Publicly insured [b] (either GIS or LIS) =1	0.18	0.16	0.16	0.08	0.04
Commercially insured=1	N/A	N/A	N/A	0.08	0.09
Education					
No school	0.19	0.17	0.21	0.16	0.11
Primary school	0.33	0.31	0.34	0.34	0.25
Low middle school	0.26	0.24	0.29	0.31	0.29
Upper middle school	0.09	0.08	0.09	0.10	0.10
Technical school	0.02	0.02	0.02	0.04	0.03
College or above	0.02	0.02	0.02	0.03	0.03
Missing data	0.09	0.16	0.03	0.02	0.19
Province [c]					
Liaoning	0.11	0.10	0.10	N/A	0.09
Heilongjiang	N/A	N/A	N/A	0.11	0.08
Jiangsu	0.10	0.10	0.10	0.12	0.09
Shandong	0.12	0.11	0.11	0.11	0.08
Henan	0.14	0.13	0.13	0.13	0.09
Hubei	0.13	0.12	0.13	0.13	0.09
Hunan	0.12	0.11	0.12	0.11	0.08
Guangxi	0.15	0.14	0.13	0.14	0.11
Guizhou	0.14	0.14	0.14	0.14	0.10
Observations	15924	16021	13856	13395	18604

[a] All values are sample means: all variables are binary indicators except "age" and "household income" Household income is nominal.

[b] Only people having GIS or LIS as first payer are counted as "publicly insured". In 1997 and 2000, some people had GIS or LIS as second payer and had commercial insurance as their first payor.

[c] Liaoning was not surveyed in 1997; Heilongjiang was not surveyed until 1997.

Table 2. Summary statistics for public insured (either GIS or LIS insured)

	1989	1991	1993	1997	2000
Demographic information[a]					
Male=1	0.58	0.58	0.58	0.57	0.55
Urban=1	0.63	0.64	0.63	0.77	0.70
Age (in years)	39.67	35.05	37.94	43.79	46.31
Household income (Chinese Yuan)	6236.97	4937.02	5933.04	16769.10	26108.3
Work status & enterprises type					
Employed=1	0.95	0.92	0.91	0.74	0.63
State-owned enterprises=1	0.64	0.65	0.66	0.56	0.44
Small collective enterprises=1	0.08	0.07	0.06	0.04	0.03
Large collective enterprises=	0.18	0.18	0.17	0.09	0.08
Other enterprises=1	0.05	0.02	0.02	0.05	0.08
Occupation					
Senior professional=1	0.066	0.058	0.069	0.084	0.065
Junior professional=1	0.088	0.081	0.076	0.091	0.105
Administrator=1	0.098	0.113	0.109	0.119	0.086
Staff=1	0.096	0.092	0.095	0.102	0.085
Farmer=1	0.010	0.008	0.006	0.005	0.004
Skilled worker=1	0.188	0.229	0.175	0.119	0.117
Non-skilled worker=1	0.262	0.227	0.261	0.136	0.075
Soldier=1	0.004	0.004	0.008	0.007	0.005
Driver=1	0.011	0.010	0.015	0.009	0.012
Service worker=1	0.092	0.091	0.085	0.044	0.057
Education					
No school	0.10	0.09	0.08	0.05	0.07
Primary school	0.21	0.23	0.22	0.16	0.16
Low middle school	0.33	0.32	0.32	0.26	0.24
Upper middle school	0.18	0.20	0.20	0.19	0.22
Technical school	0.09	0.07	0.09	0.15	0.14
College or above	0.08	0.09	0.10	0.17	0.16
Province					
Liaoning	0.180	0.177	0.176	N/A	0.027
Heilongjiang	N/A	N/A	N/A	0.124	0.011
Jiangsu	0.167	0.163	0.177	0.231	0.412
Shandong	0.109	0.131	0.104	0.115	0.004
Henan	0.093	0.082	0.077	0.105	0.080
Hubei	0.105	0.129	0.125	0.128	0.189
Hunan	0.113	0.100	0.109	0.032	0.105
Guangxi	0.148	0.123	0.134	0.126	0.119
Guizhou	0.085	0.095	0.097	0.141	0.054
Observations					
	2920	2603	2128	1010	801

[a] All values are sample means; all variables are binary indicators except "age" and "household income"

Table 3. Summary statistics for uninsured group (the control group)

	1989	1991	1993	1997	2000
Demographic information[a]					
Male=1	0.48	0.49	0.49	0.50	0.49
Urban=1	0.21	0.21	0.19	0.26	0.24
Age (in years)	27.79	29.85	30.39	33.03	35.27
Household income (Chinese Yuan)	3359.22	2668.53	3529.38	9565.53	9823.25
Work status & enterprises type					
Employed=1	0.79	0.81	0.87	0.79	0.69
State-owned enterprises=1	0.03	0.02	0.04	0.05	0.04
Small collective enterprises=1	0.07	0.03	0.05	0.03	0.02
Large collective enterprises=	0.02	0.02	0.03	0.02	0.01
Other enterprises=1	0.67	0.74	0.75	0.69	0.62
Occupation					
Senior professional=1	0.001	0.002	0.005	0.003	0.007
Junior professional=1	0.006	0.005	0.005	0.007	0.008
Administrator=1	0.004	0.007	0.010	0.014	0.010
Staff=1	0.006	0.004	0.007	0.012	0.011
Farmer=1	0.434	0.393	0.452	0.402	0.294
Skilled worker=1	0.021	0.017	0.022	0.027	0.026
Non-skilled worker=1	0.037	0.033	0.054	0.048	0.042
Soldier=1	0.001	0.001	0.001	0.001	0.001
Driver=1	0.004	0.004	0.007	0.012	0.010
Service worker=1	0.029	0.016	0.041	0.050	0.043
Education					
No school	0.206	0.182	0.228	0.170	0.112
Primary school	0.374	0.321	0.375	0.369	0.255
Low middle school	0.248	0.228	0.292	0.320	0.292
Upper middle school	0.068	0.058	0.072	0.089	0.085
Technical school	0.005	0.006	0.008	0.022	0.022
College or above	0.003	0.002	0.004	0.011	0.016
Province					
Liaoning	0.09	0.08	0.09	N/A	0.08
Heilongjiang	N/A	N/A	N/A	0.12	0.08
Jiangsu	0.07	0.06	0.08	0.08	0.05
Shandong	0.12	0.11	0.10	0.08	0.07
Henan	0.14	0.13	0.15	0.13	0.10
Hubei	0.13	0.65	0.14	0.14	0.10
Hunan	0.12	0.12	0.14	0.12	0.08
Guangxi	0.15	0.16	0.15	0.15	0.10
Guizhou	0.17	0.16	0.16	0.17	0.11
Observations					
	11743	12196	10081	10163	15520

[a] All values are sample means; all variables are binary indicators except "age" and "household income"

Table 4. Weighted means: publicly insured vs. uninsured

	1993 public insured	1993 uninsured	1997 public insured	1997 uninsured	Difference in Difference[a]
Demographic information					
Male=1	0.58 (-0.49)	0.49 (-0.50)	0.57 (0.49)	0.50 (0.50)	0.02 (0.02)
Urban=1	0.63 (-0.48)	0.19 (0.39)	0.77 (0.42)	0.26 (0.44)	0.07*** (-0.02)
Age (in years)	37.94 (-16 01)	30.39 (19.80)	43.79 (15.65)	33.17 (35.33)	-0 .017 (0.53)
Household income (Chinese Yuan)	5909 (-7523)	3530 (9610)	16769 (11293)	9595 (12664)	4794*** (448)
Work status & enterprise type					
work	0.75 (-0.20)	0.87 (0 33)	0.74 (0.44)	0.79 (0.41)	0.020 (.018)
State-owned enterprise=1	0.66 (-0.47)	0.04 (0.19)	0.56 (0.50)	0.05 (0.21)	-0.11*** (0.01)
Small collective enterprise=1	0.06 (-0.23)	0.05 (0.21)	0.04 (0.19)	0.03 (0.16)	-0.001 (0.008)
Large collective enterprise=1	0.17 (-0.38)	0.03 (0.16)	0.09 (0.29)	0.02 (0.13)	-0.07*** (0.01)
Occupation					
Senior professional=1	0.07 (-0.26)	0.01 (0.07)	0.08 (0.28)	0.003 (0.05)	0.02*** (0.00)
Junior professional=1	0.08 (-0.27)	0.01 (0.07)	0.09 (0.29)	0.007 (0.09)	0.01 (0.01)
Administrator=1	0.11 (-0.32)	0.02 (0.10)	0.12 (0.32)	0.01 (0.12)	(0.01 (0.62)
Staff=1	0.09 (-0.29)	0.01 (0.08)	0.10 (0.30)	0.01 (0.11)	0.01 (0.01)
Farmer=1	0.01 (-0.08)	0.45 (0.50)	0.00 (0.07)	0.40 (0 49)	0.05*** (0.02)
Skilled worker=1	0.18 (-0.38)	0.02 (0.15)	0.12 (0.32)	0.03 (0.16)	-0.06*** (0.01)
Non-skilled worker=1	0.25 (-0.44)	0.05 (0.23)	0.14 (0.34)	0.05 (0.21)	-0.11*** (0.01)
Soldier=1	0.01	0.001	0.01	0.01	-0.0008

[a] All means are weighted. Standard deviations are reported in parentheses for the first four columns and standard errors in parentheses are reported for difference-in-difference column. which compares the means of the public insured group before and after the health reform to the means of the uninsured group before and after the reform. Standard errors of difference-in-difference are obtained by regressing the characteristic on "year1997" and "public insured" dummies and an interaction term between "year1997" and "public insured".

***significant at 1%; **significant at 5%;*significant at 10%

Table 4 (continued)

	(-0.09)	(0.03)	(0.08)	(0.03)	(0.002)
Driver=1	0.01	0.01	0.01	0.01	-0.01***
	(-0.12)	(0.08)	(0.09)	(0.11)	(0.00)
Service worker=1	0.09	0.04	0.04	0.05	-0.05***
	(-0.28)	(0.20)	(0.20)	(0.22)	(0.01)
Education					
No school	0.08	0.23	0.05	0.17	0.03***
	(0.27)	(0.42)	(0.23)	(0.38)	(0.02)
Primary school	0.21	0.37	0.16	0.37	-0.05***
	(0.41)	(0.48)	(0.37)	(0.48)	(0.02)
Low middle school	0.32	0.29	0.26	0.32	-0.08***
	(0.47)	(0.45)	(0.44)	(0.47)	(0.02)
Upper middle school	0.20	0.07	0.19	0.09	-0.02***
	(0.40)	(0.26)	(0.39)	(0.28)	(0.01)
Technical school	0.09	0.01	0.15	0.02	0.05***
	(0.28)	(0.09)	(0.35)	(0.15)	(0.01)
College or above	0.11	0.004	0.17	0.01	0.06***
	(0.31)	(0.06)	(0.38)	(0.11)	(0.01)
Province					
Liaoning	0.18	0.09	N/A	N/A	-0.09***
	(-0.38)	(0.28)			(0.01)
Heilongjiang	N/A	N/A	0.12	0.12	0.01
			(0.33)	(0.33)	(0.01)
Jiangsu	0.17	0.08	0.23	0.08	0.06***
	(-0.38)	(0.27)	(0.42)	(0.27)	(0.01)
Shandong	0.11	0.10	0.11	0.08	0.03***
	(0.31)	(0.30)	(0.32)	(0.28)	(0.01)
Henan	0.08	0.15	0.10	0.13	0.04***
	(0.27)	(0.35)	(0.31)	(0.34)	(0.01)
Hubei	0.13	0.14	0.13	0.14	0.01
	(0.33)	(0.35)	(0.33)	(0.35)	(0.01)
Hunan	0.11	0.14	0.03	0.12	-0.06***
	(0.31)	(0.34)	(0.18)	(0.33)	(0.01)
Guangxi	0.13	0.14	0.13	0.15	-0.01
	(0.33)	(0.35)	(0.33)	(0.36)	(0.01)
Guizhou	0.10	0.16	0.14	0.17	0.04***
	0.30)	(0.37)	(0.35)	(0.37)	(0.01)
Observations	2128	10081	1010	10163	

Table 5. Illustration of DD calculation for Health Care Utilization

Public insured vs. uninsured

Group/year	1993	1997	Time difference within group
public insured	A= 0.7698 (N93= 137)	C= 0.6506 (N97=83)	C-A= -0.1192
uninsured	B= 0.7270 (N93=326)	D= 0.7638 (N97=343)	D-B= +0.0369
difference in proportions at each point in time	A-B= 0.0428	C-D= -0.1132	
		Difference-in-difference	(C-A) - (D-B)= -0.1560

Note: Numbers are the proportion seeking professional care when sick; non-workers are excluded.

Table 6. Assessing effects of policy change on health care utilization [a]

	LPM with individual Fixed effect	Heckman selection model		Simple LPM
	care	care	selection	care
year1997	0.046	0.060	-5.641	0.067
	(1.21)	(1.37)	(0.70)	(2.37)**
publicinsured	0.090	0.135		0.123
	(1.37)	(1.97)**		(1.99)**
publicinsured×year1997	-0.195	-0.189		-0.178
	(2.59)***	(2.48)**		(2.66)***
household income	-1.663	-1.576	-15.90	-1.109
(in '000000 Yuan)	(0.73)	(0.69)	(1.93)*	(0.43)
age	-0.002	-0.001	-0.030	-0.001
	(1.96)**	(1.20)	(2.08)**	(1.06)
educational attainment	0.005	0.004	-0.048	0.005
(in years)	(2.05)**	(1.98)**	(2.00)**	(2.24)**
male		-0.045	0.228	-0.022
		(1.38)	(0.63)	(1.53)
urban		-0.044	-1.762	-0.007
		(1.19)	(3.65)***	(1.02)
Constant	1.004	0.883	-0.158	0.880
	(4.02)***	(4.00)***	(0.02)	(11.05)***
Sick level included	yes	yes	yes	yes
Occupation &enterprises included	yes	yes	yes	yes
Interaction terms included	no	no	yes	no
Province dummy variables	no	yes	yes	yes
Observations	890	998	2432	998
P-value of t-test for ρ =0		0.248		
R-squared				0.06

Absolute value of z statistics in parentheses* significant at 10%; ** significant at 5%; *** significant at 1%

[a] For the simple LPM and the Heckman selectivity correction models, the robust standard errors are reported to adjust the possible heteroscedasticity.

Table 7. Illustration of DD for health status

public insured vs. uninsured

Group/year	1993	1997	Time difference within group
public insured	A= 0.072389 (N93=1934)	C= 0.112925 (N97=735)	C-A= +0.0405364
uninsured	B= 0.053453 (N93= 6,306)	D= 0.058147 (N97= 6,128)	D-B= +0.0046949
difference in proportions at each point in time	A-B= 0.018936	C-D= 0.054778	
		Difference-in-difference	(C-A) –(D-B) = +0.0358415

Note: numbers are mean ratio of people gets sick; non-workers are excluded.

Table 8. The effects of policy change on health status[a]

	LPM with individual fixed effect	Heckman selection model		LPM
	sick	sick	selection	sick
year1997	0.006	0.007	-1.603	0.005
	(1.33)	(1.10)	(3.44)***	(0.68)
publicinsured	0.018	0.008		0.011
	(2.24)**	(0.93)		(1.49)
publicinsured×year1997	0.037	0.034		0.036
	(3.26)***	(3.10)**		(2.80)***
household income	-4.431	-3.867	-49.32	-3.421
(in '0000000 Yuan)	(2.38)**	(2.33)**	(1.60)	(3.56)***
age	0.0004	0.0004	-0.012	0.0004
	(6.12)***	(6.32)***	(3.53)***	(1.20)
educational attainment	-0.007	-0.002	-0.023	-0.001
(in years)	(3.45)***	(5.83)***	(3.69)***	(3.31)***
male		0.001	0.086	-0.001
		(1.34)	(0.58)	
urban		0.026	-1.283	0.027
		(4.23)***	(12.38)***	(4.87)***
Constant	0.227	0.074	1.985	0.069
	(1.49)	(4.15)***	(3.93)***	(2.99)***
Occupation &enterprise included	yes	yes	yes	yes
Interaction terms included	no	no	yes	no
Province dummy variables	no	yes	yes	yes
Observations	14997	15039	16573	15039
P-value of t-test for ρ =0		0.228		
R-squared				0.02

Absolute value of z statistics in parentheses * significant at 10%; ** significant at 5%;***significant at 1%

[a] For the simple LPM and the Heckman selectivity correction models, the robust standard errors are reported to adjust the possible heteroscedasticity.

Table 9. Further Robustness Check.

	Heckman selection model		LPM
	(1) care	(2) sick	(3) care
year1997	0.083	0.078	0.078
	(1.48)	(1.90)*	(2.07)**
public insured	0.098	0.224	0.087
	(1.47)	(3.34)***	(1.55)
publicinsured × year1997	-0.186		-0.184
	(2.15)**		(2.34)**
household income	-10.15	-46.91	-7.956
(in '0000000 Yuan)	(0.29)	(2.17)**	(0.29)
age	-0.001	0.002	-0.001
	(0.96)	(4.67)***	(1.02)
educational attainment	0.005	-0.015	0.006
(in years)	(1.52)	(6.96)***	(2.13)**
male	-0.046	0.028	-0.047
	(0.98)	(0.79)	(0.96)
urban	-0.030	0.221	-0.039
	(0.24)	(5.48)***	(0.32)
Constant	0.925	-1.414	0.993
	(2.66)***	(21.65)***	(13.12)***
Sick level	yes	no	yes
Occupation & enterprises included	yes	yes	yes
Province dummy	yes	yes	yes
Observations	883	14986	883
P-value of t-test for ρ =0	0.952		
R-squared			0.05

Absolute value of z statistics in parentheses * significant at 5%; ** significant at 1%

Table 10. Estimation using the sample consisting of "co-payment" participants and "uninsured"

	Heckman selection model		LPM
	(1)	(2)	(3)
	care	sick	care
year1997	0.112	0.048	0.111
	(2.92)***	(1.17)	(2.85)***
public insured	0.133	0.289	0.128
	(1.74)*	(3.67)***	(1.64)*
publicinsured×year1997	-0.241		-0.241
	(2.64)**		(2.59)**
household income	-1.425	-5.740	-0.9341
(in 0.000000's)	(0.72)	(2.67)***	(0.55)
age	-0.002	0.001	-0.002
	(1.44)	(1.46)	(1.44)
educational attainment	0.002	-0.016	0.002
(in years)	(0.85)	(6.83)***	(0.97)
male	-0.043	-0.037	-0.030
	(1.34)	(1.00)	(0.74)
urban	-0.026	0.202	-0.030
	(0.65)	(4.75)***	(0.74)
Constant	1.023	-1.481	1.078
	(5.73)***	(9.67)***	(6.06)***
Sick level	yes	no	yes
Occupation &enterprises included	yes	yes	yes
Province dummy	yes	yes	yes
Observations	783	13605	783
P value of t test for Estimated ρ	0.205		
R squared			0.057

Absolute value of z statistics in parentheses * significant at 10%; ** significant at 5%;***significant at 1%

CHAPTER III

PREFERENCE OVER THE DISTRIBUTION OF ENVIRONMENTAL POLICY COSTS: CONSTRUCT VALIDITY OF DISTRIBUTIONAL PREFERENCE ON PAYMENT VEHICLES

Introduction

In stated preference (SP) studies, the researcher's choice of a payment vehicle can be a crucial element in obtaining estimates of willingness to pay (WTP) for non-market environmental goods. Economists would find it convenient if WTP for a public good could be measured independent of preferences for the manner in which the good is to be provided. However, the choice of payment vehicle seems to affect estimated WTP in various ways. For example, respondents' valuations of a good can be quite sensitive to whether periodic or lump sum payment schedules are employed (Stevens et al., 1997). A lack of unfamiliarity with the selected payment vehicle can affect the plausibility of that payment vehicle, and lead to potential payment vehicle bias (Morrison et al., 2000). Payment mechanisms with differing incentive structures give rise to different contingent values (Champ et al., 2002). Most importantly, evidence has been widely found that estimated WTP varies across different payment vehicles. For instance, it has been deduced from a meta-analysis that the "value of statistical life" depends upon the type of payment vehicle invoked in the study (de Blaeij et al., 2003). An empirical study of wilderness canoeing in Ontario's wilderness parks suggests that WTP is higher when the

payment vehicle is an increase in the provincial park backcountry permit price, and it is lower when the payment vehicle is an increase in general trip cost (Rollins, 1997). A study about protecting the quality of ground water suggests that WTP with a reallocation of current tax revenues is higher than WTP with a special tax (Bergstrom et al., 2004). Together, these studies suggest that the chosen payment vehicle can be an important driver of valuation results (Florax et al., 2005). This undesirable sensitivity of estimated WTP to different payment vehicles reveals the fact that respondents prefer some payment vehicles to others.

Respondents' preferences over payment vehicles can play an important role in managing protest votes. Traditionally, SP researchers have tended to discard protest votes from the sample. However, this process may result in either an upward or a downward bias in estimated WTP. Rather than simply ignoring protest votes, recent studies focus on potential reasons for not voting and methodological strategies for dealing with protest votes. It has been pointed out that for some instances of protest responses, voters may object to only one aspect of the CV survey, such as the selected payment vehicle and its coverage (Jorgensen et al., 2000). Evidence has been found which suggests that incorporating respondents' attitudes toward the selected payment vehicle reduces differences in protest rates across different payment vehicles, and minimising bias resulting from differences in the coverage of payment vehicles (Morrison et al., 2000).

Too few SP surveys ask respondents specifically about their attitudes toward different payment vehicles. In addition, according to Schlapfer's review of existing SP

studies, very few SP surveys employ payment mechanisms that are sophisticated enough to cover various payment vehicles with specific cost distributions (Schlapfer, 2006).

The online climate change survey used in this study departs from conventional SP surveys in that it queries respondents regarding their attitudes toward alternative payment vehicles. Policy costs in the choice scenario are also described as being borne in a mixture of ways, with the nature of the mix being defined by a distribution. Most importantly, the cost share associated with each payment vehicle is randomized as part of the experimental design of this study. The Existing literature suggests that the distribution of costs affects respondents' WTP estimates, such that individuals are inclined to pay more when the cost share paid by polluters increases (Johnson, 2006). "Polluter-pays" and responsibility issues have been examined in previous studies and are not the focus of the present study. We are more interested in individuals' preferences over the distribution of costs among various payment vehicles, when the general population is required to pay all the cost. In this study, we emphasize that individuals may play a variety of roles in society, such as individual tax-payers, consumers, energy-users, and industry investors. Therefore, payment of the domestic costs is likely to be realized through several payment vehicles simultaneously, including income tax increases, consumer price increases, energy tax increases, and decreases in investment returns. We randomly assign a stated cost share for all four of these payment vehicles, and examine how people's marginal utility differs when the cost share assigned to each payment vehicle varies. Stated international shares of mitigation costs

are also randomly assigned for the same research purpose. This aspect of the survey design allows us to examine the influence on policy choices of respondents' preferences across payment vehicles (domestically) and different groups of countries (internationally).

Due to the fact that stated preference methods are afforded much greater scrutiny as a tool for benefit-cost analysis (Kahneman et al., 1992; Diamond et al., 1994), researchers endeavor to verify the so-called construct validity of SP estimates in variety of ways. Sometimes this is done by assessing the correspondence between averting costs and WTP estimates (Laughland et al., 1996). Alternately it is sometimes possible to compare WTP inferences from respondents' expressed voting preference and estimated WTP (Berrens et al., 1998), or between WTP estimates obtained from different elicitation methods (Whitehead et al., 1998). However, none of the existing studies concerning payment vehicles uses respondents' preferences over selected payment vehicles as an underlying criterion to test the construct validity. SP studies which use respondents' attitudes toward payment vehicles to reduce WTP bias from protest votes might be more convincing if the researcher can explore respondents' preferences concerning alternative payment vehicles to ensure that there is a plausible systematic relationship between stated payment vehicle preferences and stated choice behavior.

In this chapter, we consider the construct validity of respondents' WTP for climate change mitigation programs as a function of their stated attitudes about who should be responsible to bear the costs of climate change mitigation programs. The

findings appear to confirm that respondents' utility levels are higher when they contemplate a policy that would require a larger share of policy costs to be paid through their preferred vehicle. Their utility levels are lower when they are asked to pay a larger cost share via a less-preferred payment vehicle. Taken together, these findings suggest that choices in our climate change survey display a reasonable degree of construct validity in terms of systematic heterogeneity in WTP that can be traced to respondents' preference over payment vehicles. These findings should encourage future researchers to elicit, and take advantage of, respondents' subjective attitudes toward different payment vehicles. This information may provide a methodological remedy for coping with understanding "protest votes" that may be more complex than simply a respondent's outright rejection of an alternative due to their personal objections to the payment vehicle.

The rest of chapter is organized as follows: Section II: Available data: the online climate change survey; Section III: Theoretical Model and Estimating Specification; Section IV: Results and Discussion; and Section V: Conclusion.

Available Data: the Online Climate Change Survey

Our full dataset consists of approximately 2000 responses to a comprehensive online survey of climate change. This multi-campus analog to a conventional classroom survey (http://globalpolicysurvey.ucla.edu) uses a remotely administered Web-based questionnaire. Each version of the questionnaire includes one of an extensive array of stated preference choice experiments designed to measure preferences with respect to

alternative climate change policies. The design of the questionnaire incorporates an unusually wide array of dynamically generated randomized elicitation formats that permit assessment of the sensitivity of choices to different elicitation strategies. On the surface, these different elicitation formats may appear to be arbitrary and inconsequential, but empirically, they may have a systematic effect upon choices. The sample used here consists primarily of college students—recruited by 114 different instructors from classes at 92 different colleges and universities throughout the U.S. and Canada—who responded to the survey over the internet (Cameron et al., 2006).

Predicted Impacts of Climate Change

Many scientists have believed that climate change has the potential to pose major threats to agriculture, weather, human health, and ecosystems (Kinnell et al., 2002; Kelly et al., 2005; Bosello et al., 2006; Kurukulasuriya et al., 2006). In addition to these potential impacts, economists realize that failure to equalize the marginal cost of preventing climate change (i.e. of curtailing greenhouse gas emissions through abatement efforts across different sources) may imply a loss of efficiency, which constitutes another major impact of climate change (Sheeran, 2006). In our survey, we elicited respondents' subjective concerns about climate change impacts across five broad categories. We asked: "How worried are you about the vulnerability to climate change of each of the following?" The categories of impacts were described as "Agriculture and water," "Ecosystems," "Human health," "Oceans and weather," and "Equity." Respondents' levels of concern regarding each category of impacts can be

described as one of the alternatives "not worried," "somewhat worried," "very worried," and "don't know." We also elicited respondents' subjective expected ratings of climate change impacts: "Worldwide, how do you think climate change will affect each of the following, by 30 years from now, if a policy of 'Business-as-Usual' is followed?" Respondents were invited to rate climate change impacts as either single values or intervals on a simple nine-point scale (ranging from -4 for extremely negative impacts, to +4 for extremely positive impacts). We use the point values or interval midpoints for these ratings as an approximately continuous measure of anticipated climate change impacts on each dimension (Cameron et al., 2006).

Attitudes toward Payment Vehicles

Respondents were asked to indicate their attitudes about the extent to which responsibility for the costs of climate change mitigation should be borne by various potential payors. Six domestic payors were proposed, including individual tax-payers, consumers, energy users, industry (investors), energy producers, and "government." While respondents might not recognize themselves as "government," or as direct or indirect stakeholders in the financial success of "energy producers," they do play various possible roles such as tax-payers, consumers, energy users and industry investors.

Seven possible international payors were also proposed, including the industrialized countries, the countries of the former Soviet Union, densely populated developing countries like India and China, the United States and its major trading

partners, developing countries that are beginning to pollute heavily, the smaller developing countries, and "countries in proportion to their contribution to the problem." Respondents' attitudes could be one of the following: "agree strongly," "agree," "neutral," "disagree," or "disagree strongly."

Climate Policy Choices

In split samples, either two or three policy alternatives were proposed. When three alternative policies were proposed, these included Complete Mitigation (CM), Business-as-Usual (BAU), and Partial Mitigation (PM). The consequences of the policies were assumed to affect respondents' prior statements of their anticipated climate change impacts (see part A of section II). Maximum climate change prevention—"Complete Mitigation" (CM) is when climate change is essentially prevented, keeping the climate much as it is today. However substantial costs would be incurred for this policy. Under a Business-as-Usual (BAU) policy, however, the respondents' anticipated impacts will be realized, but no additional mitigation costs will be incurred. Respondent who were presented with three-alternative choice sets also saw an intermediate option called "Partial Prevention" (PM), where the Business-as-Usual impacts are scaled back, but not eliminated, and the cost of the policy is lower than complete mitigation (CM).

Under PM and CM, the overall domestic prevention cost is randomized in terms of the expected costs that households will have to pay, subject to the constraint that the cost for PM is always less than that for CM. There is no mitigation cost incurred for

BAU. We seek to convey to individuals that the initial incidence of climate change mitigation costs could be felt in a variety of different ways, according to how the policy is implemented. Domestic costs are experienced through four payment vehicles, including decreases in investment returns and increases in consumer prices, income taxes, and energy taxes. The cost shares experienced via each payment vehicle, in percentage terms, are randomized over the range of 10 to 70%.

The international costs of climate change mitigation, explained separately, are shared across four subsets of the world's countries: "US and Japan," "other industrialized countries," "India and China," and "other developing countries." International costs are not borne by domestic households. Domestic costs are understood to be one component of a coordinated international climate policy. Each group of countries needs to pay a certain percentage of the global cost. International cost shares also range from 10-70% and are completely randomized.

Individuals' Concerns about Climate Change

Individuals' stated levels of concern about climate change may play an important role in their willingness to incur the costs of prevention. Respondents were asked to rate their personal priority levels for eleven randomly ordered issues likely to be of global concern. These issues included preventing climate change, improving food safety, preventing wars, reducing poverty and hunger, etc. The priority levels the individual could assign included "very high priority," "high priority," "modest priority," "low priority," "not a priority at all" and "not sure." Collected prior to the individuals'

stated preferences over climate policy, this information reveals respondents' likely baseline level of concern about climate change. Finally, among the concluding socio-demographic questions, respondents were also asked whether they belong to any environmental groups.

Theoretical Model and Econometric Model

Suppose respondent *i* saw all three alternative policies: Complete Mitigation, Partial Mitigation and Business-as-Usual.[15] Respondents' utility of voting for a specific program *j* (*j*= CM, PM, or BAU) can be described as

$$U_j(C_j, B_j, DC_{j1}, DC_{j2}, DC_{j3}, DC_{j4}, IC_{j1}, IC_{j2}, IC_{j3}, IC_{j4}) \quad (5)$$

Where C_j denotes the choice-specific prevention cost that the household will have to pay per month (in dollars), and B_j denotes the choice-specific expected or stated benefits. We assume that $U_j'(C_j) < 0$, and $U_j'(B_j) > 0$. The variables DC_{jh} (h=1, 2, 3 or 4) capture the cost shares borne via each of the four domestic payment vehicles, so, $\sum_{h=1}^{4} DC_{jh} = 1$. The variables IC_{jg} (g=1, 2, 3 or 4) capture the cost shares paid by each of the four groups of countries (internationally), where we have $\sum_{g=1}^{4} IC_{jg} = 1$.

The attitudes that respondents have concerning the extent to which different groups should be held responsible for the costs of climate change prevention, and the stated cost shares for each group, may interact to influence the respondent's vote on the

[15] Individuals who selected the "would not vote" option are excluded from our analysis.

proposed program. Suppose a respondent agrees that domestic institution *h* should pay the cost ($U_i'(DC_{ih}) > 0$), his/her marginal utility is expected to increase when the cost share that *h* is required to pay increases. On the other hand, suppose respondent *i* disagrees that *g* should pay the cost ($U_j'(IC_{jg}) < 0$), his/her marginal utility is expected to decrease when the cost share that *g* is required to pay increases. These constitute the main hypotheses to be tested in this chapter.

We use a conditional logit model, in combination with respondents voting decisions, to estimate the parameters of equation. Based on the discussion above, the basic form of utility function associated with policy j for individual *i* can be specified as follows:

$$U_i^j = \alpha_1 C_i^j + (\beta_1 Z_i) B_i^j + \sum_{h=1}^{4}\left[\theta_{h0} + \sum_{m=1}^{6}\theta_{hm} att_{hmi}\right] * DC_{hi}^j + \sum_{g=1}^{4}\left[\theta_{g0} + \sum_{n=1}^{7}\theta_{gn} att_{gni}\right] * IC_{gi}^j + \varepsilon_i^j \quad (6)$$

where

U_i^j denotes the utility under policy *j* for individual *i*;

C_i^j and B_i^j denote the individual's choice-specific expected cost and benefits;

Z_i is a set of individual characteristics;

DC_{hi}^j and IC_{gi}^j denote the cost shares for domestic payor *h* and international payor *g*;

att_{hmi} is the attitudes revealing respondents' attitudes concerning the responsibility over each of an expanded list of m=1,...6 categories of domestic payors.

Analogously, att_{gni} is the attitudes variable revealing respondents' attitudes concerning the responsibility over each of an expanded list of n=1, 2, 3…7 seven international country groups.

As part of the experimental design of the survey, respondents saw different numbers of response options in the attitude elicitation questions. Two-alternative versions only included "agree" and "disagree;" three-alternative-versions added a "neutral" option; four-alternative versions included "agree strongly" and "disagree strongly", but dropped "neutral"; five-alternative-versions put "neutral" back in.

To simplify the analysis, we combine "strongly disagree" with the "disagree" category, and combine "strongly agree" with the "agree" category. Therefore, we have two possible sets of attitude dummy variables— "agrees" and "disagrees." Including both "agree" and "disagree" in the one model is not appropriate, because respondents who saw versions not having "neutral" (eg. the two-alternative version or the four-alternative version) would then lose their omitted category. Therefore, we consider the two different sets of attitude dummy variables in separate models, both of which are based on equation (6). The first model, identified in equation (7) below, uses the "agrees" version of the attitude dummy variables, implying the omitted category of "disagrees" or "neutral." The second model, equation (8), uses the "disagrees" version of the attitude dummy variables, implying the omitted category of "agrees" or "neutral."

$$U_i^j = \alpha_1 C_i^j + (\beta_1 Z_i) B_i^j + \sum_{h=1}^{4} \left[\theta_{h0} + \sum_{m=1}^{6} \theta_{hm} ag_{hmi} \right] * DC_{hi}^j + \sum_{g=1}^{4} \left[\theta_{g0} + \sum_{n=1}^{7} \theta_{gn} ag_{gni} \right] * IC_{gi}^j + \varepsilon_i^j \quad (7)$$

$$U_i^j = \alpha_1 C_i^j + (\beta_1 Z_i) B_i^j + \sum_{h=1}^{4}\left[\theta_{h0} + \sum_{m=1}^{6}\theta_{hm} da_{hmi}\right] * DC_{hi}^j + \sum_{g=1}^{4}\left[\theta_{g0} + \sum_{n=1}^{7}\theta_{gn} da_{gni}\right] * IC_{gi}^j + \varepsilon_i^j \quad (8)$$

The descriptive statistics for the selected choice variables are reported in Table 11. We intend to use the above models to examine whether the direction of the respondents' utility change is consistent with our theoretical predictions. However, these models, if they include the whole set of attitude variables, may suffer from collinearity problems. In auxiliary regressions, where we regress the attitudes toward each single payor on attitudes toward all other payors, we observe large R^2 values and individually large t statistics in many cases. The simple pairwise correlation matrix also suggests that respondents may have systematically related attitudes towards different types of payors. Rather than including the universe of potential payors from the attitude questions as shifters on *every* cost share in the policy choice models, we elect to match each payor with the most closely related attitudes. The interaction terms between the cost share of a payment vehicle and the respondents' attitudes toward the responsibility of each associated payor constitute the set of "construct validity assessment variables."[16]

Figure 1 describes the way in which we construct the domestic validity assessment variables. The left part of Figure 1 shows the six domestic payor categories, toward which respondents were asked about their attitudes. Each of the four payment

[16] Additionally, the log likelihood hypothesis testing between the restricted model (with only the validity assessment variables in) and unrestricted models (the original model) suggests that the restricted model cannot be rejected.

vehicles on the right was allocated a cost share in the policy choice scenarios. In some cases, one payment vehicle very likely induces only one payor to pay the cost. For example, "price increase" would most likely affect "consumers;" "investment return decrease" would very possibly hurt "industry investors;" "income tax increase" may hurt "individual tax payors." In other cases, one payment vehicle on the right induces multiple possible payors to pay the cost. For example, "energy tax increase" would hurt not only "energy users," but also "individual tax-payers," and "energy producers." We connect the matching pairs to illustrate our a priori associations.

Figure 2 explains the way in which we construct the international validity assessment variables. "US and Japan" maps most closely to "US and its major trading partners," and "India and China" matches "Densely populated developing countries, like India and China." However, the other two payment vehicles may not perfectly match any individual payor category on the left. "Other industrialized countries" may describe "Industrialized countries" excluding US and Japan, and "Other developing countries" describes "Developing countries" excluding India and China. We associate each of these cost shares with their most closely related payor categories. As in the domestic case, we connect these possible pairs, including the closely matched (solid lines) and somewhat-matched ones (dash lines). These correspondences define our international construct validity assessment variables. Due to imperfect matching, we foresee that the somewhat-matching pairs may not exhibit as strong an effect as other validity assessment variables.

In the most general possible model, the potential benefit of each policy (B_j) should comprise five categories of anticipated impacts, including agriculture and water, oceans and weather, human health, ecosystems, and equity. However, in our case, the responses concerning anticipated impacts on human health and oceans/weather are very different from the other three categories. For these two categories, nearly 70 percent of the respondents rated the "human health" impacts under BAU as -4, about the same percentage of people rated the "oceans and weather" impacts as -4 (Table A.3). In addition, responses for these two categories were all concentrated on the far negative side of the rating scale. Compared to the other three categories, these two categories, with little variability across responses, may reflect respondents' tendencies to rank these two types of impacts as "worst" relative to the other, about which they are less concerned. Since these two ratings display little variability across respondents, we use an indicator variable for "all other benefits" associated with "Complete Mitigation" and a further indicator associated with "Partial Mitigation." These two variables will capture all net benefits not appearing specifically in our model.

The correlations within the rest of the impacts ("agriculture," "ecosystems" and "equity") cannot be overlooked, especially the ones between ecosystems and agriculture (Table A.4). The correlations among these anticipated impacts preclude putting them all in one model. To avoid the collinearity, we decide to rotate through the three specific categories of anticipated impacts in separate models.

Estimation Results

The parsimonious form of estimation results for equation (7) is reported in Table 12. To facilitate, we use symbols "+" and "-" to denote positive and negative coefficients respectively. Complete results are contained in Tables A.5 and A.6. The level of significance is marked by the number of "*," where "***" denotes significant at 1%, "**" denotes significant at 5%, and "*" denotes significant at 10%. We employ nine different specifications to check the robustness of our results. The first three columns (Models 1a, 1b and 1c) use respondents' anticipated impacts on agriculture to represent the potential consequences of a policy, the next three columns (Models 2a, 2b and 2c) and the last three columns (Models 3a, 3b and 3c) employ the impacts on ecosystems and equity, respectively. Type (a), (b) and (c) differ in the individual characteristics used as control variables (by interacting them with choice specific variables).

For the validity assessment variables, we expect people who specifically agree that a particular payor should pay the cost will derive higher utility when a program requires a larger cost share from that payor. Therefore, the signs of these validity assessment variables are expected to be positive. In this table, we retain only these validity assessment variables that are significant in at least one of these models, at 10% significance level.

Interestingly, the significant coefficients are all positive, and these results are robust across all nine different specifications. The domestic validity assessment variables suggest that if respondents agree that "Energy User," "Individual Taxpayer,"

or "Industry Investors" should pay the cost, their marginal utility is higher, the greater the cost share borne as increases in energy tax, increase in income taxes, or decreases in investment returns, respectively. Our international validity assessment variables suggest that respondents who agree that US and its trading partners, or India and China, should pay the cost, derive a higher utility when the cost share from US and Japan or India and China is greater, respectively. Other coefficients of validity variables, although not significant, are positive with very few exceptions (Table A.5). Occasional negative signs associated with some insignificant coefficients may reflect the imperfect matches between attitudes and cost shares. The fact that all significant validity assessment variables are positive is evidence of construct validity in terms of respondents' distributional preferences.[17]

Table A.5 reports the extensive form of the conditional logit choice models. It is suggested in all nine specifications that people derive less utility from a program requiring higher household cost, which is consistent with intuition. Besides the construct validity assessment variables, other attitude-based interaction terms also deserve our attention. We use the symbol "►" to denote all attitude-based interaction terms in this table. For the benefit (avoided impacts) variables, it is suggested that people derive greater utility from preventing a severely impacts of climate change. In addition, respondents who were worried about a particular impact (Type A), or those who were high informed about environment (Type B), derive greater utility from a program to avoid severely or moderately bad impacts than their counterparts did. For

[17] Under stepwise clogit estimation, the statistically significant coefficients of the construct validity assessment variables remain significant when we drop the insignificant ones. We also ran a model that has all three categories of impacts included, the signs of the significant coefficients remain unchanged.

the elicitation format variables, all nine specifications commonly suggest that an individual's marginal utility was higher when voting for PM than for BAU and CM. Individuals who saw PM conveyed a higher utility from CM than those who did not. Type (C) models suggest that respondents who thought climate change was a high priorities among global policy issues or those who belong to at least one environment group, derive a higher utility from CM. On the other hand, respondents who considered climate change as low priority derive less utility from complete mitigation. These findings are consistent with our expectations. Although not the primary focus of this study, these findings additionally support construct validity for the online climate change survey.

The extensive form of our conditional logit models using the attitudes characterization "disagrees" is reported in Tables A.6. Specifications in the models using the "disagrees" dummies follow the same ordering as those which use the "agrees" dummies. Estimation results described in Table A.6 additionally support construct validity: respondents who disagreed that a particular group payor should bear the cost derive a lower utility when the cost share from that payor is larger. Other attitude-based construct validity variables exhibit similar variations to those in Table A.5.

Conclusion

In this study, we assess the construct validity of climate change mitigation policy preferences elicited using an online survey. We do this by testing the logical

consistency between respondents' subjective attitudes concerning the responsibility of various groups of payors and the survey's stated cost distributions among selected payors. The key finding suggests that respondents are likely to derive higher utility from a policy that requires a larger share of the costs to be borne via their most-preferred type of payment vehicle, and a lower utility from a policy requiring a larger cost share to be borne via their less-preferred payment vehicle. Additional evidence is also consistent with theoretical predictions. Taken together, these findings support the construct validity of this climate change survey in terms of respondents' distributional preferences over payment vehicles.

Previous literature has shown that respondents' attitudes toward payment vehicles may play an important role in managing protest votes resulting from objections to the chosen payment vehicles. Attention to these attitudes may reduce the bias of WTP estimates. The current study provides evidence that respondents' attitudes toward different possible payment vehicles can have a statistically significant effect on their stated policy preferences in our online climate change survey. This research strongly suggests that future stated preference studies should recognize that respondents' attitudes toward payment vehicles can have an important and systematic influence upon their stated policy choices. Thus researchers may be ill-advised to use just a single payment vehicle and to presume that policy preferences (and the implied willingness to pay for public goods) are independent of this aspect of the choice scenario.

Figure 1. Construct domestic validity assessment variables

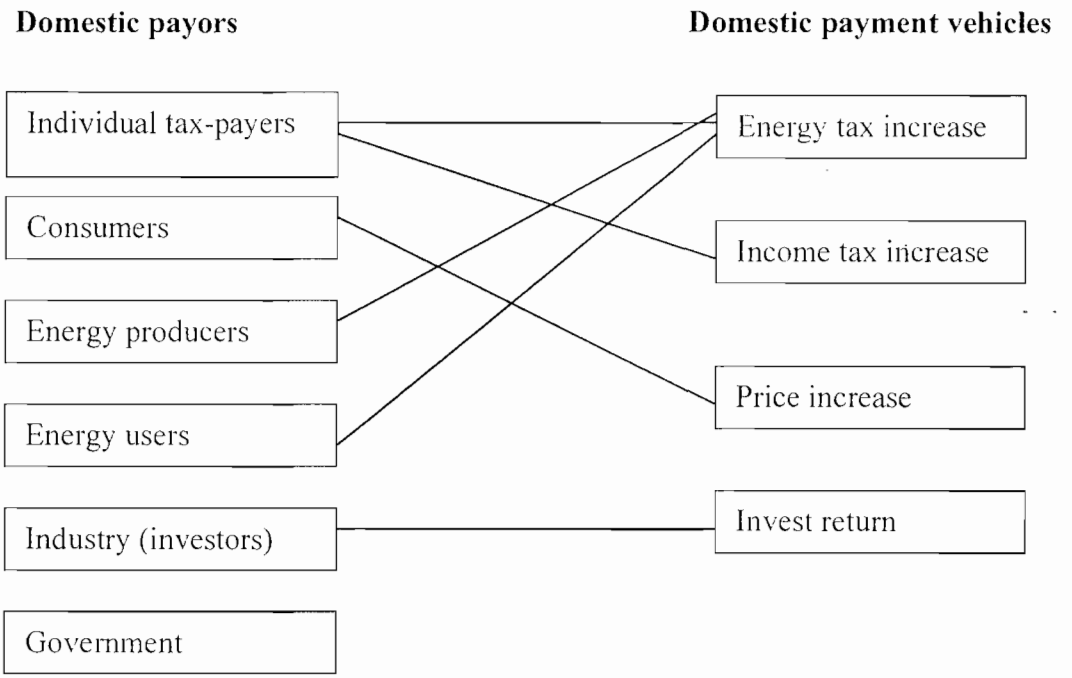

Figure 2. Construct international validity assessment variables

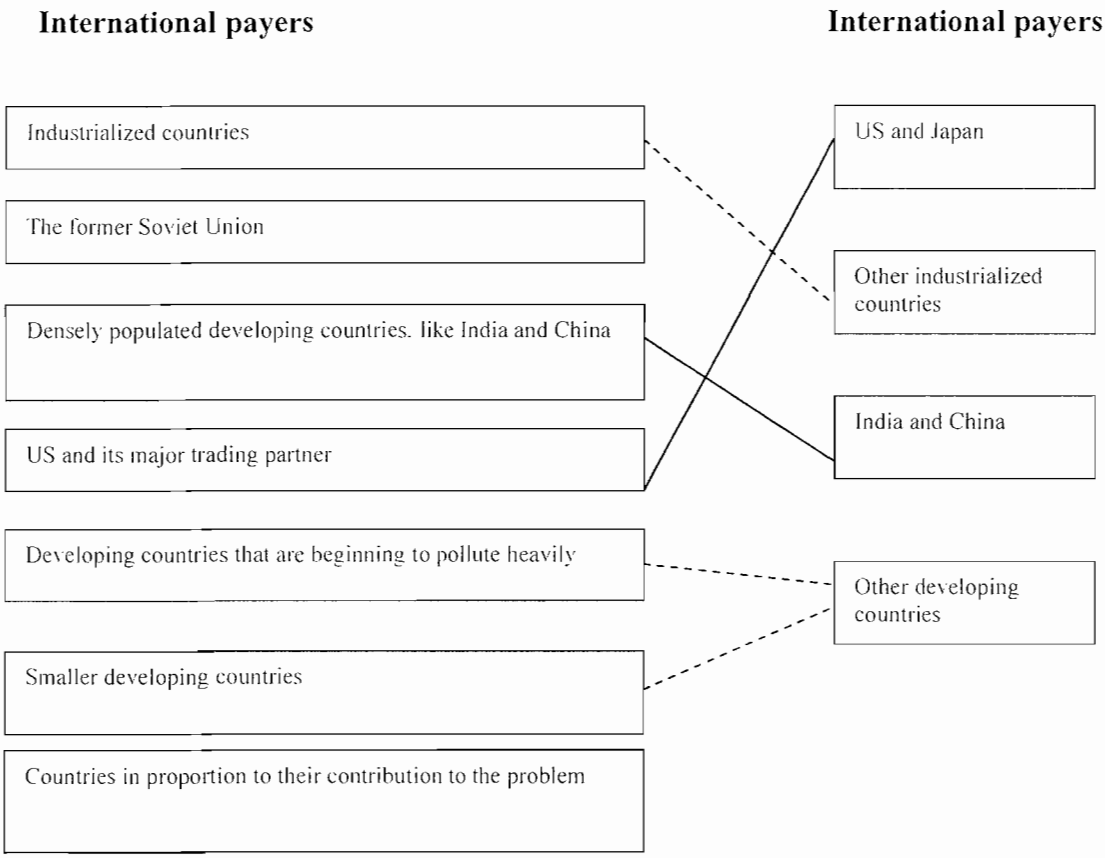

Table 11. Descriptive statistics for selected variables

Variables	Complete Mitigation		Partial Mitigation	
A. Randomized choice scenarios:	Mean	Std. Dev.	Mean	Std. Dev.
Expected policy cost ($'000/year)	3.11	0.98	1.56	1.66
a.)Domestic cost shares (%)				
Increased prices	24.77	16.00	25.30	16.35
Increased energy taxes	25.40	15.90	24.49	16.24
Increased income taxes	24.60	16.02	25.63	15.93
Decreased investment returns	25.20	16.14	24.58	15.83
b.)International cost shares (%)				
US and Japan	24.66	15.92	24.74	16.05
Other industrialized countries	25.61	16.50	24.41	15.38
India and China	24.80	15.96	24.34	15.57
Other developing countries	24.92	16.07	26.51	16.95
B. Respondents' attitudes:				
1. Costs:				
a.)Domestic responsibility for costs?	1(agree)[a]		1(disagree)[b]	
Consumers	0.688		0.166	
Industry (investors)	0.849		0.078	
Individual taxpayers	0.432		0.078	
Energy users	0.810		0.087	
Government	0.799		0.010	
Energy producers	0.863		0.064	
b.) Int'l responsibility for costs?	1(agree)		1(disagree)	
Industrialized countries	0.582		0.264	
Former Soviet Union	0.431		0.318	
Densely pop. Dev. India China	0.597		0.233	
US and major trade partners	0.747		0.131	
Smaller dev. Countries	0.513		0.513	
Countries in prop. to contribution	0.881		0.064	
2. Benefits (avoided climate change impacts):	1(severe)		1(moderate)	
Agriculture, Water	0.275		0.603	
Ecosystems	0.438		0.505	
Human Health	0.991		0.012	

[a] The 1(agree) indicator distinguishes "agrees" from "neutral or disagrees"
[b] The 1(disagree) indicator distinguishes "disagrees" from "neutral or agrees"

Table 11. (Continued)

Oceans, Weather	0.988	0.015
Equity, Fairness	0.204	0.528
3. Respondent individual characteristics:		
a.) Worry: vulnerability to climate change	1(worried) [c]	1(not) [a]
Agriculture, Water	0.618	0.186
Ecosystems	0.617	0.189
Human Health	0.550	0.259
Oceans, Weather	0.464	0.313
Equity, Fairness	0.363	0.348
b.) Concerns about climate change& enviro.	1(high) [d]	1(low) [b]
Climate change high priority	0.445	0.315
	1(high) [e]	1(low) [c]
Well-informed about enviro. issues	0.302	0.171
	1(yes)	1(no)
Belongs to enviro. group/s	0.248	0.752

[a] The 1(worried) indicator signifies either "extremely worried" or "very worried," while the 1(not) indicator signifies "not too worried" or "not worried at all." The omitted category is "somewhat worried" or "don't know."

[b] The 1(high) indicator signifies "very high priority" or "high priority," while the 1(low) indicator signifies "low priority" or "not a priority at all." The omitted category is "moderate priority" or "not sure."

[c] The 1(high informed) indicator and the 1(low informed) indicators are defined relative to the statement "I consider myself well-informed about environmental issues," where the answer options are "agree," "disagree," and the omitted category is "neutral."

Table 12. Main results of conditional logit choice models using the attitudes characterization "agrees" (versus omitted category consisting of "disagree" or "neutral"): "+" denotes a positive coefficient, and "-" denotes a negative coefficient: ***significant at 1%; **significant at 5%; significant at 10%

	X=Agriculture, Water impacts only			X=Ecosystems impacts only			X=Equity, Fairness impacts only		
	(1a)	(1b)	(1c)	(2a)	(2b)	(2c)	(3a)	(3b)	(3c)
Domestic validity assessment variables									
Increased energy taxes									
* 1(Agree)_Energyusers	+**	+*	+*	+**	+**	+**	+**	+*	+
Increased income taxes									
* 1(Agree)_Taxpayers	+**	+*	+*	+**	+**	+*	+**	+*	+*
Decreased investment returns									
* 1(Agree)_Industry	+**	+**	+**	+**	+**	+**	+**	+**	+**
International validity assessment variables									
India and China									
* 1(Agree)_IndiaChina	+**	+**	+**	+**	+**	+**	+**	+**	+**
US and Japan									
*1(Agree)_USJapan	+***	+***	+**	+**	+**	+*	+***	+***	+**
Program cost	-***	-***	-***	-***	-***	-***	-***	-***	-***
Anticipated climate change impacts (baseline)	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
1(severely bad impact on X)	-***	-***	-***	-**	-***	-**	-*	-***	-***
… *1(worried about the impact on X)	+			-**			-*		
… *1(high informed)		-**			-**			-**	
Elicitation formats included (baseline)	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
1(partial mitigation)	-***	-***	-***	-***	-***	-***	-***	-***	-***
1(complete mitigation)	-	-	-	-	-	-	-	-	
… *1(saw partial mitigation)	+***	+***	+***	+***	+***	+***	+***	+***	+***
… *1(climate a high priority)			-***			-***			-***
… *1(climate a low priority)			-***			-***			-***
… *1(Belongs to enviro. Group/s)			+***			+***			+***
Cost shares (baseline) included	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Observations	4235	4235	4203	4235	4235	4203	4235	4235	4203

CHAPTER IV

ORDER EFFECTS ON WTP VIA THE PRIOR ELICITATION OF ATTITUDES IN STATED PREFERENCE SURVEYS

Introduction

In stated preference (SP) surveys, order effects occur when responses to a given question vary in a theoretically unexpected manner due to the positioning of that question or item relative to others (Powe et al., 2003). A number of SP studies find that a good's placement in a sequence of goods in valuation questions has a substantial impact on people's valuation of this particular good (Carson et al., 1998; Dupont, 2003; Powe et al., 2003). Goods are likely to evoke higher values if they appear earlier in a sequence (Payne et al., 2000; Veisten et al., 2004).[18]

However, these studies focus on order effects in a quite limited sense. In addition to the order of valuation questions, the order of preamble questions may also lead to theoretically unanticipated responses, as has been suggested in the physiology or survey literatures (Carpenter et al., 1979; Crespi et al., 1984; Bishop et al., 1985; Krosnick et al., 1987; Mitchell et al., 1989; Colasanto et al., 1992; Dillman, 2000;

[18] Order effects were sometimes referred to as "embedding effects" (Boyle et al., 1993). The term "embedding" stems from Kahneman and Knetsch (1992), where they use the term to describe a wide variety of nesting and sequencing issues (Dupont, 2003). Since the term has been applied to distinct phenomena, it is ill-defined (Kahneman et al., 1992; Loomis et al., 1993). Hanemann provides a useful categorization of three different effects that have been associated with embedding, including the sequencing effect (order effect), the scope effect and the sub-additivity effect (Carson et al., 1995). The embedding effects describe the limited sense of order effects in a way that WTP varies with the placement of a good in a sequence of goods.

Tourangeau et al., 2000; Bishop et al., 2001; Moore, 2002). These studies document a considerable amount of evidence that order effects are prevalent in surveys. However, due to the non-economic nature of these studies, they provide few implications about potential order effects in the valuation of public goods via stated preference surveys.

Among economic studies, in contrast to the substantial number of studies investigating order effects in valuation questions themselves (i.e. a good's placement in a sequence of goods to be valued), the empirical literature is remarkably thin concerning order effects which stem from the order of presentation of the preliminary information given to respondents, prior to any choice exercises. The problem can be ignored if respondents' inherent attitudes toward the good are not vulnerable to being swayed by information ordering. However, the effects cannot be overlooked if respondents adjust their opinions in response to the ways in which prior attitude-elicitation questions were ordered. These changes might further affect their choices in the stated preference portion of the survey and thus lead to biased WTP estimates.

To our knowledge, only the paper by Boyle et al. (1993) has explored these distinct types of order effects. Using a contingent valuation survey concerning Grand Canyon white-water boating, they find that the ordering of the prior elicitation questions does matter to the valuation of public goods, and inexperienced boaters are more susceptible to ordering effects than experienced boaters.[19] The scarcity of order-effects

[19] Their work indicates that experience and familiarity about the environmental goods in question play an important role in reducing order effects. In the broader survey literature, a considerable amount of evidence has also been found that the magnitude of order effects also differs by other individual characteristics, such as age, and education (Hanemann, 1994; Dupont, 2003), and types of users (active, potentially active and passive users) (Knauper, 1999)

studies in a valuation context means that economic non-market valuation research lags behind non-economic social science research in this area.

Using an online climate change survey, the present study identifies order effects stemming from prior elicitation questions, and examines the potential economic consequences of these effects. Our results suggest that the ordering of information in these preamble questions may alter people's attitudes toward various attributes of the goods, and thus affect the estimated WTP amount derived in the survey. This chapter is arranged as follows: Section II describes our available data from the existing online climate change survey; Section III reviews some preliminary scoping models; Section IV discusses our main empirical models to assess the impacts of order effects on policy choices, and Section V itemizes our empirical findings: Section VI considers the implications of order effects for simulated WTP amounts, and Section VII concludes.

Available Data: The Online Climate Change Survey

Our full dataset consists of approximately 2000 responses to a comprehensive online survey of climate change. The sample used here consists primarily of college students—recruited by 114 different instructors from classes at 92 different colleges and universities throughout the U.S. and Canada—who responded to the survey over the internet. This is a multi-campus analog to a conventional classroom survey (http://globalpolicysurvey.ucla.edu) which uses a remotely administered Web-based questionnaire. Each dynamically generated questionnaire includes one of an extensive array of stated preference choice experiments designed to measure preferences with

respect to alternative climate change policies in the form of willingness to incur the potential costs of climate change mitigation and adaptation. The design of the questionnaire also incorporates an unusually wide range of dynamically generated randomized elicitation formats for *other* information that permits assessment of the sensitivity of respondents' choices to different elicitation strategies (Cameron et al., 2006). On the surface, these different elicitation formats may appear to be arbitrary and inconsequential. Empirically, however, order effects may have a systematic effect upon choices.[20]

Prior Elicitation Questions

Five Categories of Climate Change Impacts

Many scientists believe that climate change has the potential to pose major threats to agriculture, weather, human health, and ecosystems (Kinnell et al., 2002; Kelly et al., 2005; Bosello et al., 2006; Kurukulasuriya et al., 2006). In addition to these potential impacts, economists realize that failure to equalize the marginal cost of preventing climate change (i.e. of curtailing greenhouse gas emissions through abatement efforts across different sources) may imply a loss of efficiency, and this constitutes another major impact of climate change (Sheeran, 2006).

In our survey, we elicit respondents' subjective levels of concern about climate change impacts across five broad categories, including "Agriculture and water,"

[20] Most such survey involve just a single format for all questionnaires. However, it is impossible to know the extent of order effects unless orderings are varied across questionnaires.

"Ecosystems," "Human health," "Oceans and weather," and "Equity." Respondents' levels of concern regarding each category of impacts are categorized as "not worried," "somewhat worried," "very worried," and "don't know". We also elicit respondents' subjective expected ratings of the likely magnitudes of climate change impacts for each of the five categories, by thirty years from now, if a policy of "Business-as-Usual" is followed. Respondents are invited to rate climate change impacts either as single values or as intervals on a simple nine-point scale (ranging from -4 for extremely negative impacts, to +4 for extremely positive impacts). In this chapter, we use the point values (or interval midpoints) for these ratings as an approximately continuous measure of anticipated climate change impacts on each of the five dimensions (Cameron et al., 2006).[21]

Attitudes toward Various Payment Vehicles

Respondents were asked to indicate their attitudes about the extent to which responsibility for the costs of climate change mitigation should be borne by various groups. Six domestic groups were proposed and randomly ordered, including individual taxpayers, consumers, energy users, industry (investors), energy producers, and government. Seven international country groups as possible payors were also proposed and randomly ordered. These include industrialized countries, the countries of the

[21] The orderings of the five categories of impacts are constant throughout the survey for any one respondent, but are randomized across respondents (except "equity", which is always placed at the end). In addition, we find that the orderings of the five categories affect both respondents' level of concern and their expected ratings of impacts. Therefore, it is possible that the ordering of these five categories might affect policy choices via two different avenues: 1. by affecting their level of concern; 2. by affecting their rating of expected climate change impacts.

former Soviet Union, densely populated developing countries like India and China, the United States and its major trading partners, developing countries that are beginning to pollute heavily, smaller developing countries, and "countries in proportion to their contribution to the problem." Responses concerning the extent to which each payor should be responsible for bearing the costs of preventing climate change could be one of the following: "agree strongly," "agree," "neutral," "disagree," or "disagree strongly." Responses to these questions about responsibility and the position of each group in its respective list are summarized in Table 13. The 1(agree) indicator distinguishes "agree" from "neutral" or "disagree", while the 1(disagree) indicator distinguishes "disagree" from "neutral" or "agree".

Individuals' Concern about Various Issues Including Climate Change

Individuals' stated levels of concern about climate change may play an important role in their willingness to incur the costs of prevention. Respondents were asked to rate their personal priority levels for eleven randomly ordered issues likely to be of global concern. These issues included preventing climate change, improving food safety, preventing wars, reducing poverty and hunger, etc. Across respondents, the order of these issues is completely shuffled, and these orders are also summarized in Table 13. The responses individuals could give included "very high priority," "high priority," "moderate priority," "low priority," "not a priority at all" and "not sure." The 1(high) indicator signifies "very high priority" or "high priority"; while the 1(low) indicator

signifies "low priority" or "not a priority at all." The omitted category is the union of "moderate priority" or "not sure."

Policy Alternatives

In split samples, either two or three policy alternatives were proposed. When three alternative policies were proposed, these included Complete Mitigation (CM), Business-as-Usual (BAU), and Partial Mitigation (PM). When two alternative policies were proposed, these included just CM and BAU. Maximum climate change prevention—"Complete Mitigation" (CM) is when climate change is essentially prevented, keeping the climate much as it is today. However substantial costs would be incurred for this policy. Under a Business-as-Usual (BAU) policy, however, the respondent's anticipated impacts will be realized, but no additional mitigation costs will be incurred. Respondent who were presented with three-alternative choice sets also saw an intermediate option called "Partial Prevention" (PM), where the Business-as-Usual impacts are scaled back, but not eliminated and the cost of the policy is lower than for complete mitigation (CM)[22].

Under PM and CM, overall domestic prevention costs are randomized in terms of the expected costs that the respondent's household will have to pay, subject to the constraint that the cost for PM is always less than that for CM. There is no mitigation cost incurred for BAU. Policy costs are therefore uncorrelated with any other policy

[22] These policies were arranged in two ways: either BAU is on the left or otherwise. The orderings of these policies are shown not to affect their voting decisions. Results are available from the authors.

attributes, including the respondent's anticipated BAU climate change impacts and any other respondent's attributes.

We also seek to convey to individuals that the *initial incidence* of climate change mitigation costs could be felt in a variety of different ways, according to how the policy is implemented. Domestic costs are described as being experienced through four different "payment vehicles" including increases in consumer prices, income taxes, energy taxes, and decreases in investment returns. The cost shares experienced via each type of payment vehicle, in percentage terms, are randomized over the range of 10 to 70%. Thus, these policy attributes are, by design, uncorrelated with any other program features or respondent characteristics.

The international costs of climate change mitigation, explained separately, are shared across four subsets of the world's countries: "US and Japan," "other industrialized countries," "India and China," and "other developing countries." Domestic costs are one component of a more-or-less coordinated international climate policy. In any given policy scenario, each group of countries needs to contribute a certain percentage of the global cost. International cost shares are also randomized over the range of 10-70%, and are likewise uncorrelated with other policy attributes and respondents' characteristics.

Preliminary Models: Attitudes as a Function of Position

Table 13 summarizes responses as well as the positions of questions for which the questions were randomly ordered. In this part of our analysis, we investigate how

the relative position of a question affects responses. Note that if order effects do indeed exist, these responses may vary not only with the placement of the particular question, but also with other questions on the list which may provide more background information (i.e. create a different context) and lead the respondent to rethink his or her attitudes, either consciously or unconsciously. This behavior can be referred to as a "context effect" (Colasanto et al., 1992).

To reveal how a category's position in the list affects stated attitudes, we estimate some simple probit models, where each "attitude" is converted into a binary indicator and used as the dependent variable. We use a probit model to explain respondent i's attitude about each global policy problem, and each group's responsibility to bear the costs of climate change mitigation. Generically, these models can be specified as follows:

$$ATTITUDE_i^* = \alpha + \sum_{j=1}^{m} \beta_j POSITION_j + \beta_i Z_i + \varepsilon_i \tag{9}$$

$ATTITUDE_i^*$ is a latent variable capturing the respondent's propensity to rate the global policy problem as a high priority, or his/her propensity to agree with the responsibility of the group in question to bear the costs of climate change mitigation. $POSITION_j$ is a simple integer variable which denotes the position in the relevant list of global policy problem j or payor group j (where a value of 1 indicates the first

position and higher values indicate that the item was further down the list). The vector Z_i includes a selection of respondent characteristics as summarized in Table A.7.[23]

Table A.8 reveals evidence of order effects in respondents' answers to the question concerning the extent to which climate change is a policy priority. "Preventing wars" is the omitted category. The positions of three different global policy problem, relative to the position of "preventing wars," appear to have a significant effect on responses. Most importantly, when "preventing climate change" is placed higher on the list (i.e. when its "position" takes on a smaller value), respondents are more likely to indicate that climate change is a high policy priority for them (indicated in bold). This result is hardly surprising. In addition, climate change is also likely to be rated as a high policy priority when "improving food safety" and "improving education" are placed more highly compared to the omitted category "preventing wars." Note also that the climate change priority questions were asked very near the beginning of the survey, unlike the cost responsibility questions, which were asked close to the policy choice task later in the survey. Order effects from the initial global policy priority question may subside during the course of the survey, especially since it became apparent to respondents after the initial "global policy question" that this particular survey would be entirely about climate change.

[23] Each characteristic enters in a simple linear additive form as a control; the slope coefficients on these variables are not reported here. Results are available from the authors. Note, however, that since the positions in each of the three lists were randomly assigned, there should be no correlation between any of the position variables and any individual characteristics, and thus no omitted variables bias if these controls are omitted.

Table A.9 presents the results of analogous probit models to explain respondents' propensity to agree with assertions about the responsibility of different categories of domestic payors to bear the costs of climate change mitigation. Six models are shown, since we are interested in order effects on each rating (a key to the categories of payors is included at the bottom of the table).[24] Many coefficients are significant, which suggest the evidence of order effects. The "own-effects" are indicated in bold. The statistically significant "own-effects" coefficients suggest that an earlier placement makes respondents more likely to "agree" this payor's responsibility. For instance, an earlier placement of "industry" increases the chance that the respondent will "agree" that industry should be responsible for paying the cost of climate change mitigation; an earlier placement of "taxpayers" increase the probability that the individual would "agree" income taxpayers paying the cost.

Finally, in Table A.10, we consider the position effects on the propensity of respondents to agree with the responsibility of each of a number of international country groups to bear the cost of climate change mitigation. A number of position variables of international payment vehicles can be seen to have significant effects on attitudes. For instance, a latter position for "industrialized countries" makes respondents more likely to "agree" US and its major trade partner bear the cost; a latter placement of "densely populated countries, like India or China" makes respondents more likely to "agree" these countries should bear the cost.[25]

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[24] One must remember that one of the positions is completely defined once the other positions are set (i.e. "government" is the left-out category).

[25] In Table A.4, "smaller developing countries" is the left-out category).

The preliminary probit estimation results reported in Tables A.2-4 indicate that arbitrary questions orderings, usually considered to be innocuous (and often an overlooked element of most surveys), can sometimes have statistically significant impacts on responses. Why these order effects exist in the form that they do is a complex question, more in the purview of psychological research. The researcher's decision about the ordering of information in a survey could have negligible effects on the attitudes elicited from respondents if these respondents choose climate change policies based upon their own prior opinions which have not been affected by the ordering effects. However, if respondents choose among policy options based upon attitudes or opinions that have been manipulated (either intentionally or unintentionally) by the framing of attitude questions, these ordering effects became an inconvenient factor that could potentially lead to biased WTP estimates.

Cai et al., (2007) examine whether people's choices among climate policy options are correlated with their prior responses to attitudinal questions.[26] Table A.11 briefly summarizes the findings from that study. If a respondent agrees that a particular group should bear the costs of mitigation, his/her utility is higher when this group is required to pay a larger share of the costs. If a respondent personally thinks climate change is a high priority, he/she derives greater utility from a policy of complete mitigation. These results suggest that respondents make their stated policy choices based in part upon the attitudes elicited in the survey's preamble questions. Thus, it is

[26] Estimation results are available from the authors.

very likely that order effects might influence people's policy voting decisions, and therefore lead to distortions in predicted WTP amounts.

Empirical Models: The Impacts of Order Effects on Policy Choices

In this section, we outline our basic models for climate policy choices which permit us to examine how a researcher, through an arbitrary single ordering of preliminary elicitation questions, might unwittingly affect policy choices and thus estimated WTP. Suppose respondent i sees all three alternative policies: CM, PM, and BAU.[27] This respondent's anticipated indirect utility under policy j (where j= CM, PM, or BAU) can be described generically as

$$V_i^{*j}((Y_i - C_i^j), DC_1^j, DC_2^j, DC_3^j, DC_4^j, IC_1^j, IC_2^j, IC_3^j, IC_4^j, B_i^j, Program^j)$$

where $(Y_i - C_i^j)$ denotes the choice-specific net income (after any mitigation costs) that the respondent's household will enjoy under policy j. The variables DC_h^j (h=1, 2, 3 or 4) capture the choice scenario's stated initial incidence of domestic costs under policy j (measured by the cost shares borne via each of the four different payment vehicles, so that $\sum_{h=1}^{4} DC_h^j = 1$). The variables IC_g^j (g=1, 2, 3 or 4) capture the international distribution of climate change mitigation costs (measured by the stated cost shares borne by each of the four

[27] Individuals who selected the "would not vote" option are excluded from our analysis. A more-complex econometric specification is required to accommodate this additional type of "response" to the choice question.

groups of countries, so that $\sum_{g=1}^{4} IC_g^j = 1$).[28] The variable B_j denotes the choice-specific subjective expected benefits (i.e. the avoided climate change impacts), and $Program^j$ allows for individuals to derive a systematically higher or lower level of utility simply for choosing CM or PM, rather than BAU, independent of the specific attributes of the policy.

Now we can consider how to introduce heterogeneity into the preference function. Let $ATTITUDE\_m_i$ and $ATTITUDE\_n_i$ be the attitudes concerning responsibility to bear the costs of climate change mitigation (for domestic and international payors, respectively). Let $ATTITUDE\_p_i$ be the degree of priority that the respondent assigns to climate change as a policy problem. The indirect utility conveyed through complete mitigation could be generalized as follows:

$$\begin{aligned} V_i^{*CM} = {} & \alpha_1 (Y_i - C_i^{CM}) + \sum_{h=1}^{4} \left[\theta_{h0}^{'} + \sum_{m=1}^{6} \theta_{hm}^{'} ATTITUDE\_m_i \right] DC_{hi}^{CM} \\ & + \sum_{g=1}^{4} \left[\theta_{g0}^{'} + \sum_{n=1}^{7} \theta_{gn}^{'} ATTITUDE\_n_i \right] IC_{gi}^{CM} + \beta_1 B_{1i}^{CM} \\ & + \left[\beta_{20}^{'} + \beta_{21}^{'} ATTITUDE\_p_i \right] program_i^{CM} + \varepsilon_i^{CM} \end{aligned} \tag{10}$$

However, we have established that these attitudinal variables can be explained in part by the arbitrary positions of specific topics in the preliminary questions. Instead of modeling V_i^{*CM} as a function of attitudes, we will examine "reduced form" models where indirect utility from climate change policies is

[28] For each set of shares, only three of the four shares will be independent.

allowed to vary directly with the position of relevant topics in the relevant preamble questions. Specifically:

$$V_i^{*CM} = \alpha_1(Y_i - C_i^{CM}) + \sum_{h=1}^{4}\left[\theta_{h0} + \sum_{m=1}^{6}\theta_{hm} POSITION\_m_i\right] DC_{hi}^{CM}$$
$$+\sum_{g=1}^{4}\left[\theta_{g0} + \sum_{n=1}^{7}\theta_{gn} POSITION\_n_i\right] IC_{gi}^{CM} + \beta_1 B_{1i}^{CM}$$
$$+\left[\beta_{20} + \beta_{21} POSITION\_p_i\right] program_i^{CM} + \varepsilon_i^{CM} \qquad (11)$$

The $POSITION\_m_i$ variables describe the ordering of the preliminary attitude questions concerning the responsibility for climate change mitigation costs for each of m =1,..., 6 categories of domestic payors; the $POSITION\_n_i$ variables are analogous, but they instead record the ordering of the preliminary attitude questions concerning the responsibility over each of an expanded list of n = 1, 2, 3…7 international country groups. $POSITION\_p_i$ describes the ordering of global issues in the preliminary question concerning policy priorities p =1,…,11.

For the partial mitigation alternative, when it is offered, the indirect utility function is given analogously by:

$$V_i^{*PM} = \alpha_1(Y_i - C_i^{PM}) + \sum_{h=1}^{4}\left[\theta_{h0} + \sum_{m=1}^{6}\theta_{hm} POSITION\_m_i\right] DC_{hi}^{PM}$$
$$+\sum_{g=1}^{4}\left[\theta_{g0} + \sum_{n=1}^{7}\theta_{gn} POSITION\_n_i\right] IC_{gi}^{PM} + \beta_1 B_{1i}^{PM}$$
$$+\left[\beta_{20} + \beta_{21} POSITION\_p_i\right] program_i^{PM} + \varepsilon_i^{PM} \qquad (12)$$

Finally, under the status quo alternative (BAU), the individual will bear no costs and in this case there will be no concerns about the distribution of these costs, either

domestically or internationally. Thus we will have $C_i^{BAU} = 0$, and all of the cost shares (implicitly interacted with a dummy variable for the presence of any mitigation costs) will be zero. Likewise, there will be no benefits (i.e. no "impact reductions") so we will have $B_i^{BAU} = 0$ for the explicit benefits, and $PM_i^{BAU} = CM_i^{BAU} = 0$ for the alternative-specific dummy variables that we use to capture the implicit benefits of each policy alternative. Only the income term remains relevant, so that

$$V_i^{*BAU} = \alpha_1(Y_i) + \varepsilon_i^{BAU} \tag{13}$$

For random utility models (RUMs), it is customary to allow the indirect utility difference, relative to a numeraire alternative (here, the BAU alternative) to drive respondent's choices among the available alternatives. In our context, there are two such utility differences. The first is for complete mitigation versus business-as-usual:[29]

$$\begin{aligned}\Delta V_i^{*CM} &= \left(V_i^{*CM} - V_i^{*BAU}\right) \\ &= \alpha_1(-C_i^{CM}) + \sum_{h=1}^{4}\left[\theta_{h0} + \sum_{m=1}^{6}\theta_{hm} POSITION\_m_i\right] DC_{hi}^{CM} \\ &\quad + \sum_{g=1}^{4}\left[\theta_{g0} + \sum_{n=1}^{7}\theta_{gn} POSITION\_n_i\right] IC_{gi}^{CM} + \beta_1 B_{1i}^{CM} \\ &\quad + \left[\beta_{20} + \beta_{21} POSITION\_p_i\right]*(1) + \left(\varepsilon_i^{CM} - \varepsilon_i^{BAU}\right)\end{aligned} \tag{14}$$

Similarly the indirect utility-difference for the partial mitigation alternative is:

$$\begin{aligned}\Delta V_i^{*PM} &= \left(V_i^{*PM} - V_i^{*BAU}\right) \\ &= \alpha_1(-C_i^{PM}) + \sum_{h=1}^{4}\left[\theta_{h0} + \sum_{m=1}^{6}\theta_{hm} POSITION\_m_i\right] DC_{hi}^{PM} \\ &\quad + \sum_{g=1}^{4}\left[\theta_{g0} + \sum_{n=1}^{7}\theta_{gn} POSITION\_n_i\right] IC_{gi}^{PM} + \beta_1 B_{1i}^{PM}\end{aligned}$$

[29] "*program*" is 1 for both CM and PM.

$$+\left[\beta_{20}+\beta_{21}POSITION\_p_i\right]*(1)+\left(\varepsilon_i^{PM}-\varepsilon_i^{BAU}\right) \qquad (15)$$

For the business-as-usual (numeraire) alternative, of course, this indirect utility-difference is simply zero.

To estimate the basic marginal utility parameters for this model, as well as the key coefficients identifying order effects (i.e. $\theta_{hm}, \theta_{gn}, and \beta_{21}$), one typically employs some variant of a conditional logit estimator. Variations across individuals, and across alternatives for each individual, in the variables in equation (6) and (7) permit the marginal utility parameters and shift coefficients to be estimated. The systematic portions of the indirect utility functions in these two expressions are commonly known as the "index" for the discrete choice problem, where the value of the index for the numeraire alternative is zero.

If we represent the systematic portions of these indirect utility-differences generically as $\gamma' W_i^j$, since they are linear-in-parameters, the conditional logit probabilities associated with choosing each alternative, in the three-alternative context, can be expressed as:

$$\begin{aligned}
P_i^{CM} &= \frac{\exp(\gamma' W_i^{CM})}{\exp(\gamma' W_i^{CM})+\exp(\gamma' W_i^{PM})+1} \\
P_i^{PM} &= \frac{\exp(\gamma' W_i^{PM})}{\exp(\gamma' W_i^{CM})+\exp(\gamma' W_i^{PM})+1} \\
P_i^{BAU} &= \frac{1}{\exp(\gamma' W_i^{CM})+\exp(\gamma' W_i^{PM})+1}
\end{aligned} \qquad (16)$$

The log-likelihood function to be maximized with respect to the unknown parameters is then

$$\log L = \sum_{i=1}^{N} \left[y_i^{CM} \log(P_i^{CM}) + y_i^{PM} \log(P_i^{PM}) + y_i^{BAU} \log(P_i^{BAU}) \right] \qquad (17)$$

Where the y_i^j indicators take on the value of 1 if alternative j is chosen and zero otherwise.

Estimation Results

In the most general possible model, the potential benefit of each policy (B_i) should comprise all five available categories of anticipated impacts, including Agriculture&Water, Oceans&Weather, HumanHealth, Ecosystems, and Equity. In our data, however, respondents' anticipated impacts on HumanHealth and Oceans&Weather are distributed very differently from the other three categories. Nearly 70 percent of the respondents rated the HumanHealth impacts under business-as-usual -4, about the same percentage of people rated the Oceans&Weather impacts as -4. Virtually 99% of respondents rated the HumanHealth and Oceans&Weather impacts as "severe" (i.e. either -3 or -4), so compared to the other three types of impacts, these two impacts exhibit very little variation across respondents. Thus, we will not attempt to estimate distinct marginal utilities associated with avoided HumanHealth or Oceans&Weather impacts. Correlations among the other three types of impacts (Agriculture & Water, Ecosystems, and Equity) cannot be overlooked, especially the ones between ecosystems and agriculture/water. To accommodate these collinearities, we will rotate through a set

of three basic models. In each specification, we will "feature" just one of these three types of impacts.

The key estimation results are reported in Table 14. Models 1-3 differ in the benefit category which is specifically featured. In Model 4, we run a parsimonious regression with only those terms that were shown to be persistently significant in Models 1-3, and we feature Agriculture& water as the expected benefit category. The variable "program cost" has an estimated coefficient that is negative and significant across specifications, which indicates that people derive a lower utility from a policy that involves higher household costs. This is consistent with our expectations. The interaction terms, combining the baseline policy attributes with the position variables, are the key variables that capture the impacts of question orderings on the estimated marginal utility associated with different climate policy attributes.

For cost shares and shifters, we estimated a full specification which incorporates a large set of position-based interaction terms, but many of the estimated coefficients turn out to be statistically insignificant. Thus, we drop the insignificant interaction terms. Only those interaction terms with robustly significant coefficients are included in the specification reported in Table 14, where the terms indicated with the symbol "▶" are the position-based interaction terms which should have zero coefficients if there are no order effects of the type we allow for in this chapter.

The interaction term "(cost shares paid through decreased investment return)×(position of industry)," which bears a coefficient with a negative sign, indicates that if a person saw "industry" in an earlier position on the list when attitudes were

elicited about responsibility for the domestic costs of climate change mitigation, then he/she would have a higher utility when more cost is paid through "decreased investment returns." The preliminary models in Table A.9 suggest a reason for this effect. An earlier placement of "industry" on the list seems to make respondents statistically significantly more likely to "agree" that industry should bear the cost. Cai et al. (2007) shows if one "agrees" that industry should bear the cost, he/she would have a higher utility from a policy wherein a higher share of the cost is paid through decreased investment returns. Thus, the negative sign associated with this term suggests order effects from earlier tasks can carry over to policy preference in a later choice problem on the survey.

The coefficients of other interaction terms, "(cost shares paid through increased income tax)×(position of tax payers)", "(cost shares paid through increased income tax)×(position of energy producers)", both with negative signs, suggest people would have a higher utility from a policy that collects higher share of cost through income tax when "tax payers" or "energy producers" were positioned earlier on the list in the prior elicitation questions. These results also suggest measurable order effects.

The interaction term "(cost share paid by India and China)×(position of India and China)." is significant only in the specification which features climate change impacts on ecosystems. The positive sign on its coefficient again suggests order effects. This implies that if a person sees a later placement of "India and China", he/she would derive higher utility from policies that require "India and China" to pay a higher share. The preliminary models in Table A.10 suggest a later placement of "densely populated

countries" would more likely lead to a response of "agree" with respect to whether these countries should bear the cost. Our previous work shows that those who "agree" that these countries should pay the cost would derive a higher utility when higher cost shares are actually borne by these countries. Therefore, if the ordering of international payors alters people's subjective attitudes toward the responsibility of these payors in an earlier survey question, we expect that those who saw a later placement of "densely populated countries" derive higher utility when greater shares are paid by these countries. Again, the estimated coefficient is consistent with our expectations.

Some interaction terms involving position variables for cost responsibility bear coefficients which are statistically significant. However, the β_{21} coefficients (on the interaction terms between 1(Program) indicator and the ordering of global policy problems do not suggest a statistically significant order effect. Thus, we only report the estimates involving what should be the most important interaction term (i.e. the one concerning the position of "preventing climate change") in Models 1-3. The preliminary model of attitudes has shown that when climate change is placed near the top of the list, people are more likely to say "climate change is a high priority." When climate policy is identified as a high priority, people should derive a higher level of utility for policies involving either complete or a partial mitigation. Therefore, we might expect that when "climate change" is higher on the list, people are more likely to derive a higher utility from an active program (CM or PM). Although the coefficient on the relevant interaction term bears the expected sign, it is not significant even at the 10% level. It is possible that because these global policy problems were presented at the very beginning

of the survey, respondents may have recovered from any influence of ordering by the time the policy voting questions were presented near the end of the survey.[30] Since these terms do not suggest significant order effects, they are dropped from Model 4.

Simulated WTP Bias

Based on the conditional logit estimates for Model 4 in Table 14, we simulate WTP amounts for a "complete mitigation" policy to prevent (a.) MODERATE and (b.) SEVERE anticipated impacts on agriculture&water, for a case where cost is assumed to be equally distributed among each of the four domestic and international payors. Model 4 in Table 14 suggests that later placement of "industry," " taxpayers," and "energy producers" tends to decrease the utility derived from a climate change policy. Simulations 1 and 2, in each case, differ only in their orderings in the prior attitude elicitation questions which seem to influence stated preferences in the policy choice task. In Simulation 1, we assume that "industry," "taxpayers," and "energy producers" appear later on the domestic payor list (positions 6, 4, and 5 respectively). In Simulation 2, "industry," "taxpayers," and "energy producers" are simulated as being placed at the top of the domestic payor list (positions 3, 1, and 2 respectively). Comparing simulations 1 and 2, we can see that the implied WTP amount could differ by nearly $300 per month.

[30] In a more extensive model, we found the coefficient on an interaction term combining program and position of education (complete mitigation × position of education) is significant but positive. This is a perplexing result that is not consistent with what can be expected from our preliminary estimation results, thus, it does not suggest order effects. Further research could examine the reason why this term is statistically significant.

Now consider two scenarios where the respondent expects *severe* impacts of climate change on Agriculture&Water. All settings for simulations 3 and 4 are the same as for simulations 1 and 2, except the expected avoided climate change impacts are set to "severe." The implied WTP amount could also differ by nearly $300 per month. The simulations in Table 15 indicate that if researchers strategically arrange prior elicitation questions in the two different orders, the implied WTP amount could differ by a significant amount. The arrangement of topics could be an unintentional effect, or it could be strategic.

Conclusion

This study reveals that there can be statistically significant order effects stemming from the presentation of prior elicitation questions in a stated preference survey. We also calculate examples of the potential magnitudes of these order effects on the simulated distribution of WTP, in the case of complete mitigation policy. The results suggest the orderings of prior elicitation questions may affect responses to these questions. Most importantly, arbitrary researcher decisions about the ordering of information may inadvertently alter people's opinions or attitudes toward some attributes of the good, and therefore influence their responses to valuation questions. As an example, if researchers arrange prior elicitation questions differently in two questionnaires, the simulated WTP amounts for complete prevention of climate change impacts could differ by nearly $300 per month in our sample.

This chapter emphasizes the significance of question ordering in prior elicitation questions, and it supports our contention that future stated preference survey research should randomize the information presented in each section of the questionnaire to avoid potential ordering effects to the fullest extent possible. The use of random orderings will also permit the researcher to assess the potential extent of any possible order effects.

Table 13. Descriptive statistics for responses and positions to preliminary and voting decisions

	Responses		Positions in ordering	
	Mean	Mean	Mean	Std. Dev.
What are your personal relative priorities for each of the following world issues?				
	1(high)	1(low)	Range from 1 to 11	
climate change	0.453	0.308	6.055	3.169
poverty	0.668	0.151	5.984	3.168
education	0.817	0.071	5.961	3.193
crime	0.681	0.133	6.087	3.187
endangered species	0.549	0.229	6.028	3.152
nuclear weapon	0.551	0.254	5.907	3.164
food	0.478	0.277	6.052	3.166
health	0.707	0.112	6.019	3.174
race	0.547	0.228	5.988	3.152
environment	0.747	0.090	5.928	3.182
wars	0.622	0.186	5.991	3.082
Responsibility for costs:				
Domestic payment vehicles				
	1(agree)	1(disagree)	Range from 1 to 6	
Consumer	0.688	0.166	3.529	1.729
Industry	0.849	0.078	3.539	1.720
Taxpayers	0.432	0.078	3.510	1.685
Energy Users	0.810	0.087	3.545	1.702
Energy Producers	0.863	0.064	3.496	1.722
Government	0.799	0.010	2.929	1.393
International payment vehicles				
	1(agree)	1(disagree)	Range from 1 to 7	
Proportional to their contribution	0.881	0.064	4.047	1.980
Industrialized countries	0.582	0.264	3.976	2.006
US and its major trade partners	0.747	0.131	4.035	2.011
Developing countries	0.763	0.133	3.869	2.004
Densely populated countries, like India and China	0.597	0.233	4.016	2.016
Countries of former Soviet Union	0.431	0.318	3.483	1.667
Smaller developing countries	0.278	0.512	4.102	2.016
Voting decision				
	1(yes)			
Vote for BAU	0.275			
Vote for PM	0.219			
Vote for CM	0.506			

Table 14. Estimations explaining the influence of order effect on WTP; "►" denotes a position-biased interaction term.

	Model 1 Featured Impacts: X=Ecosystems	Model 2 Featured Impacts: X=Equity, Fairness	Model 3 Featured Impacts: X=Agriculture, Water	Model 4 Parsimonious Model X=Agriculture, Water
Cost, cost shares, shifters:				
Program cost	-0.145	-0.149	-0.145	-0.144
	(4.38)***	(4.53)***	(4.41)***	(4.38)***
Decreased investment returns (in '00s)	0.767	0.728	0.785	0.888
	(1.53)	(1.46)	(1.58)	(1.89)*
► ..*position of "industry"	-0.176	-0.170	-0.185	-0.181
	(1.74)*	(1.70)*	(1.85)*	(1.81)*
Increased income taxes (in '00s)	1.245	1.456	1.368	1.449
	(1.90)*	(2.23)**	(2.09)**	(2.29)**
► ..*position of "taxpayers"	-0.241	-0.242	-0.238	-0.237
	(2.32)**	(2.33)**	(2.30)**	(2.29)**
► ...*position of "energy producers"	-0.202	-0.235	-0.223	-0.216
	(2.00)**	(2.34)**	(2.22)**	(2.15)**
Increased energy taxes (in '00s)	-0.149	-0.182	-0.214	
	(0.46)	(0.56)	(0.66)	
US and Japan (in '00s)	0.345	0.360	0.315	
	(1.22)	(1.28)	(1.12)	
India and China (in '00s)	-0.611	0.048	0.013	
	(1.35)	(0.17)	(0.05)	
► ..*position of "India and China"	0.147			
	(1.68)*			
Benefits (avoided impacts), informedness:				
1(moderate)_ X^a (baseline)	0.113	0.241	0.319	0.324
	(0.70)	(2.18)**	(2.39)**	(2.43)**
1(severe)_X^a (baseline)	0.943	0.976	0.890	0.890
	(5.66)***	(6.62)***	(5.76)***	(5.77)***

Table 14. (Continued)

Elicitation Formats:				
Partial mitigation	2.189	2.148	2.210	2.034
	(7.05)***	(6.98)***	(7.17)***	(11.04)***
► ..*position of "climate change"	-0.026	-0.020	-0.027	
	(0.92)	(0.70)	(0.97)	
Complete mitigation	0.681	0.760	0.702	0.533
	(2.24)**	(2.71)***	(2.42)**	(2.75)***
► ..*position of "climate change"	-0.025	-0.020	-0.026	
	(1.37)	(1.13)	(1.44)	
...*1(saw partial mitigation alternative)	0.567	0.614	0.616	0.613
	(3.62)***	(3.94)***	(3.96)***	(3.95)***
Observations	4389	4389	4389	4389

Absolute value of z statistics in parentheses ***significant at 10%;** significant at 5%; *** significant at 1%

a Ratings of climate change impacts are grouped for this analysis. 1(Severe) implies a substantial negative impact; 1(moderate) implies a moderate negative impact; the omitted category is interpreted as neutral or positive impact

Table 15. Simulated WTP (median, 5th, 95th percentiles) for complete mitigation, based on 1000 random draws from the asymptotically normal joint distribution of the parameter estimates based on Model 4—the parsimonious specification for impacts on Agriculture (median monthly income in sample = $5208)

	(a.) **Moderate Impact** on Agriculture		(b.) **Severe Impact** on Agriculture	
	Simulation 1	Simulation 2	Simulation 3	Simulation 4
Cost, cost shares, shifters:				
Decreased investment returns (in '00s)	0.25	0.25	0.25	0.25
► ..*position of "industry"	6	3	6	3
Increased income taxes (in '00s)	0.25	0.25	0.25	0.25
► ..*position of "taxpayers"	4	1	4	1
► ...*position of "energy producers"	5	2	5	2
Increased energy taxes (in '00s)	N/A	N/A	N/A	N/A
US and Japan (in '00s)	N/A	N/A	N/A	N/A
India and China (in '00s)	N/A	N/A	N/A	N/A
Benefits (avoided impacts)				
1(moderate)	1	1	0	0
1(severe)	0	0	1	1
Elicitation Format				
Partial mitigation	0	0	0	0
Complete mitigation	1	1	1	1
...*1(saw partial mitigation)	0	0	0	0
Willingness to pay (WTP)	$365	$639	$689	$964
	[259, 502]	[506, 888]	[532, 993]	[748, 1395]

APPENDIX

VARIABLES AND EMPIRICAL EVIDENCE

Table A. 1. Variable definition

Variable Name	Definition
Key Policy Generosity Measurements	
Inpatient	Percentage of reimbursement for inpatient care
Outpatient	Percentage of reimbursement for outpatient care
Education Attachment	
No school	=1 if did not attend any school education
Primary	=1 if got some primary education
Low middle	=1 if attended junior high school
Upper middle	=1 if attended high school
College	=1 if has college education
Demographic Variables	
Household income	Household income
Male	=1 if the person is male
Urban	=1 if the observation is urban
Age	Age of the individual
Occupation	
Senior professional	=1 if senior professional
Junior professional	=1 if junior professional
Administrator	=1 if is administrator
Staff	=1 if office staff
Farmer	=1 if farmer
Skilled worker	=1 if skilled worker
Non-skilled worker	=1 if non-skilled worker
Employer	
State	=1 if works for state-owned company
Large collective	=1 if works for large collective company
Private	=1 if works for private company
Year Dummies	
Year1993	=1 if year =1993
Year1997	=1 if year =1997

Table A.2 Heckman selectivity correction model controlling for two types of selection at the same time using Limdep

	Heckman selection model		
	care	Selection 1[a]	Selection 2[b]
year1997	0.08	3.734	-0.067
	(-1.947)*	(-0.004)	(-0.22)
publicinsured	0.112		10.13
	(-1.302)		(-0.1)
publicinsured ×year1997	-0.198		
	(-2.44)***		
household income	0.046	20.91	-0.978
(in '00000 Yuan)	(-0.30)	(-1.18)	(-1.35)
age	-0.003	0.301	0.009
	(-2.75)***	(-0.62)	(-2.18)**
education	0.003	-0.068	0.009
	(-2.09)**	(-0.27)	(-0.90)
urban	-0.057	6.224	-0.688
	(-1.74)*	(-0.07)	(-3.18)***
constant	1.032	1.447	1.103
	(-4.15)***	(-0.80)	(5.03)***
Sick level included	yes	no	no
Occupation &enterprises included	yes	yes	yes
Interaction terms included	no	no	yes
Province dummy variable	yes	yes	yes
Observations	1043	16573	16573
P-value of t-test for $\rho=0$		0.999	
P-value of t-test for Lambda-A	0.242		
P-value of t-test for Lambda-B	0.529		

Absolute value of z statistics in parenthesis * significant at 10%; ** significant at 5%; *** significant at 1%

[a] Selection 1 controls for systematic selections into the sample of "being recently sick."

[b] Selection 2 controls for systematic selections into the sample of the treatment and control groups (i.e. the publicly insured and uninsured groups).

Table A.3 - Distributions of climate change impact ratings; five types of impacts, absolute frequency and percent; universal sample

Posterior rating (or rating interval midpoint)		agriculture & water impacts		ecosystems impacts		human health impacts		oceans & weather impacts		equity impacts	
Descriptor		Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent	Freq.	Percent
extremely harmed	-4	144	6.7	261	12.1	1,437	66.7	1,453	67.5	104	4.8
	-3.5	29	1.4	48	2.2	341	15.8	310	14.4	18	0.8
	-3	319	14.8	468	21.7	305	14.2	310	14.4	216	10.0
	-2.5	63	2.9	117	5.4	43	2.0	50	2.3	66	3.1
	-2	593	27.5	535	24.8	22	1.0	21	1.0	410	19.0
	-1.5	145	6.7	120	5.6	3	0.1	6	0.3	114	5.3
	-1	422	19.6	294	13.7	-	-	3	0.1	428	19.9
	-0.5	80	3.7	58	2.7	1	0.1	-	-	124	5.8
unaffected	0	176	8.2	112	5.2	2	0.1	1	0.1	432	20.1
	0.5	18	0.8	12	0.6	-	-	-	-	44	2.0
	1	82	3.8	52	2.4	-	-	-	-	102	4.7
	1.5	13	0.6	5	0.2	-	-	-	-	27	1.3
	2	44	2.0	36	1.7	-	-	-	-	46	2.1
	2.5	1	0.1	4	0.2	-	-	-	-	5	0.2
	3	18	0.8	22	1.0	-	-	-	-	13	0.6
	0	-	-	1	0.1	-	-	-	-	-	-
extremely improved	4	7	0.3	9	0.4	-	-	-	-	5	0.2
	Total	2,154	100.0	2,154	100.0	2,154	100.0	2,154	100.0	2,154	100.0

Table A.4 Pairwise correlations in climate change impact ratings (obs=2154)

	agriculture & water impacts	ecosystems impacts	human health impacts	oceans & weather impacts	equity impacts
agriculture & water impacts	1.0000				
ecosystems impacts	0.7017	1.0000			
human health impacts	0.0803	0.0919	1.0000		
oceans & weather impacts	0.1262	0.1282	0.5787	1.0000	
equity impacts	0.4497	0.4493	0.0852	0.0621	1.0000

Table A.5. Extensive form of conditional logit choice models using attitudes characterization "agrees" (versus omitted category consisting of "disagree" or "neutral"); "►" denotes an attitude-based construct validity interaction term.

	X = Agriculture & Water impacts			X = Ecosystems impacts			X = Equity, Fairness impacts		
	(1a)	(1b)	(1c)	(2a)	(2b)	(2c)	(3a)	(3b)	(3c)
Cost, cost shares, shifters:									
Program cost	-0.152	-0.153	-0.162	-0.151	-0.153	-0.162	-0.155	-0.153	-0.164
	(4.43)***	(4.45)***	(4.52)***	(4.32)***	(4.41)***	(4.51)***	(4.48)***	(4.47)***	(4.59)***
Domestic validity assessment variables									
Increased energy taxes (in '00s)									
► ...* 1(Agree)_Energyusers	0.988	0.934	0.844	1.213	0.921	0.796	1.095	1.106	1.016
	(2.06)**	(1.94)*	(1.70)*	(2.48)**	(2.28)**	(2.03)**	(2.27)**	(1.93)*	(1.61)
► ...* 1(Agree)_Taxpayers	0.381	0.357	0.404	0.311	0.388	0.428	0.422	0.315	0.351
	(0.91)	(0.86)	(0.94)	(0.73)	(0.75)	(0.81)	(1.00)	(0.93)	(0.99)
► ...* 1(Agree)_EnergyProducers	0.277	0.313	0.109	0.234	0.428	0.236	0.49	0.213	0.054
	(0.51)	(0.57)	(0.19)	(0.42)	(0.39)	(0.09)	(0.90)	(0.79)	(0.42)
Increased income taxes (in '00s)									
► ...* 1(Agree)_Taxpayers	0.814	0.773	0.72	0.894	0.752	0.712	0.885	0.833	0.786
	(0.51)	(0.57)	(0.19)	(0.42)	(0.39)	(0.09)	(0.90)	(0.79)	(0.42)
Decreased investment returns									
► ...* 1(Agree)_Industry	1.264	1.182	1.217	1.243	1.153	1.164	1.17	1.238	1.22
	(0.93)	(0.68)	(0.11)	(0.42)	(0.66)	(0.10)	(1.00)	(0.95)	(0.09)
Increased consumer price (in '00s)									
► ..* 1(Agree)_consumers	0.374	0.273	-0.0431	0.173	0.381	0.036	0.405	0.267	-0.0432
	(0.93)	(0.68)	(0.11)	(0.42)	(0.66)	(0.10)	(1.00)	(0.95)	(0.09)
International validity assessment variables									
India and China(in '00s)									
► ...* 1(Agree)_IndiaChina	0.879	0.91	0.93	0.861	0.866	0.897	0.938	0.926	0.958
	(2.35)**	(2.43)**	(2.40)**	(2.25)**	(2.45)**	(2.46)**	(2.48)**	(2.31)**	(2.32)**
Other developing countries (in '00s)									
► ...* 1(Agree)_DevelopingCountries	0.179	0.329	0.455	0.135	0.343	0.499	0.275	0.267	0.416
	(0.43)	(0.79)	(1.06)	(0.32)	(0.63)	(0.96)	(0.66)	(0.82)	(1.15)
► ...* 1(Agree)_SmallerDeveloping	-0.152	-0.115	-0.046	-0.205	-0.142	-0.063	-0.133	-0.113	-0.079
	(0.36)	(0.27)	(0.10)	(0.47)	(0.26)	(0.18)	(0.31)	(0.33)	(0.14)
US and Japan (in '00s)									
► ...* 1(Agree)_USJapan	1.231	1.187	0.919	1.037	1.152	0.872	1.101	1.043	0.826
	(2.94)***	(2.83)***	(2.12)**	(2.43)**	(2.47)**	(1.89)*	(2.59)***	(2.75)***	(2.02)**

Table A.5 (Continued)

Other industrialized countries (in '00s)									
► ...* I(Agree)_IndustrializedCountries	-0.00412	0.0283	-0.0081	-0.0129	0.0122	-0.0167	-0.0978	0.0623	0.0266
	(0.01)	(0.08)	(0.02)	(0.03)	(0.17)	(0.07)	(0.27)	(0.03)	(0.04)
Domestic Cost Shares (baseline) (omitted category= increased price)									
Increased energy taxes (in '00s)	-1.275	-1.268	-1.265	-1.422	-1.235	-1.208	-1.394	-1.213	-1.241
	(1.73)*	(1.72)*	(1.68)*	(1.90)*	(1.64)	(1.64)	(1.89)*	(1.68)*	(1.60)
Decreased investment returns (in '00s)	-0.782	-0.745	-1.065	-0.841	-0.641	-0.958	-0.677	-0.793	-1.062
	(1.28)	(1.22)	(1.68)*	(1.35)	(1.28)	(1.66)*	(1.10)	(1.05)	(1.52)
Increased income taxes (in '00s)	-0.399	-0.49	-0.714	-0.609	-0.375	-0.621	-0.332	-0.597	-0.822
	(0.84)	(1.03)	(1.47)	(1.26)	(1.25)	(1.68)*	(0.69)	(0.79)	(1.28)
International Cost Shares (baseline) (omitted category= other industrialized countries)									
US and Japan(in '00s)	-0.593	-0.538	-0.459	-0.541	-0.472	-0.386	-0.593	-0.423	-0.382
	(1.14)	(1.03)	(0.86)	(1.02)	(0.81)	(0.71)	(1.12)	(0.90)	(0.72)
India and China (in '00s)	-0.414	-0.421	-0.479	-0.547	-0.387	-0.454	-0.565	-0.506	-0.564
	(0.89)	(0.91)	(1.01)	(1.15)	(1.08)	(1.17)	(1.20)	(0.83)	(0.95)
Other developing (in '00s)	-0.0591	-0.134	-0.464	-0.174	-0.157	-0.511	-0.267	-0.152	-0.481
	(0.12)	(0.27)	(0.92)	(0.35)	(0.30)	(0.94)	(0.54)	(0.32)	(1.01)
Benefits (avoided impacts), attitudes, informedness:									
(where X= impact in question)									
I(Severe)_ X[a] (baseline)	-0.885	-0.618	-0.517	-0.575	-0.620	-0.446	-0.419	-0.646	-0.543
	(2.64)***	(3.27)***	(2.66)***	(2.13)**	(3.27)***	(2.29)**	(1.86)*	(3.26)***	(2.65)***
► ...* I(Worried)_ X	0.032			-0.532			-0.465		
	(0.10)			(2.17)**			(1.75)*		
► ...* I(Not Worried)_ X	0.989			0.708			-0.051		
	(2.00)**			(2.10)**			(0.30)		
► ...* I(high informed)		-0.521	-0.196		-0.847	-0.604		-0.746	-0.519
		(2.29)**	(0.82)		(4.54)***	(3.07)***		(2.66)***	(1.77)*
► ...* I(low informed)		0.107	-0.061		-0.117	-0.286		0.310	0.068
		(0.35)	(0.20)		(0.49)	(1.17)		(0.90)	(0.19)
I(Moderate)_ X[a] (baseline)	-0.162	-0.072	-0.015	-0.030	0.024	0.093	-0.195	-0.038	-0.023
	(0.90)	(0.48)	(0.09)	(0.14)	(0.13)	(0.50)	(1.68)*	(0.29)	(0.17)
► ...* I(Worried)_ X	-0.328			-0.346			0.146		

Table A.5 (Continued)

	(2.02)**			(1.89)*			(0.97)		
► ...* 1(Not Worried)_ X	0.286			0.744			0.880		
	(1.39)			(3.23)***			(6.18)***		
► ...* 1(high informed)		-0.676	-0.399		-0.446	-0.159		-0.565	-0.253
		(4.41)***	(2.45)**		(2.65)***	(0.89)		(3.49)***	(1.47)
► ...* 1(low informed)		-0.159	-0.243		0.046	-0.007		-0.043	-0.133
		(0.85)	(1.26)		(0.22)	(0.03)		(0.21)	(0.64)
Elicitation formats:									
Partial mitigation (alt-spec. constant)	2.015	1.939	2.125	2.289	1.963	2.251	2.058	1.846	2.048
	(4.10)***	(3.97)***	(3.27)***	(4.56)***	(4.00)***	(3.44)***	(4.16)***	(3.79)***	(3.15)***
► ...* 1(Climate a high priority)			-0.222			-0.244			-0.241
			(0.83)			(0.90)			(0.90)
► ...* 1(Climate a low priority)			0.325			0.297			0.320
			(1.24)			(1.12)			(1.22)
► ...* 1(Belongs to enviro. group/s))			0.203			0.241			0.235
			(0.88)			(1.03)			(1.01)
Complete mitigation (alt-spec. constant)	0.453	0.477	0.727	0.657	0.498	0.844	0.802	0.477	0.751
	(0.92)	(0.97)	(1.26)	(1.30)	(1.00)	(1.44)	(1.64)	(0.99)	(1.33)
...* 1(Saw Partial Mitigation alternative)	0.606	0.609	0.578	0.511	0.549	0.538	0.584	0.606	0.581
	(3.76)***	(3.78)***	(3.45)***	(3.12)***	(3.37)***	(3.18)***	(3.60)***	(3.75)***	(3.46)***
► ...* 1(Climate a high priority)			0.592			0.555			0.626
			(3.51)***			(3.26)***			(3.71)***
► ...* 1(Climate a low priority)			-0.658			-0.669			-0.623
			(3.95)***			(3.99)***			(3.73)***
► ...* 1(Belongs to enviro. group/s)			0.532			0.490			0.523
			(3.33)***			(3.05)***			(3.28)***
Observations	4235	4235	4203	4235	4235	4203	4235	4235	4203

[a] Ratings of climate change impacts are grouped for this analysis 1(Severe) implies a substantial negative impact: $-4 \le rating < -2$; 1(moderate) implies a moderate negative impact: $-2 \le rating < 0$; the omitted category is $0 \le rating \le +4$ (interpreted as neutral or positive impact)

Table A.6. Extensive form of conditional logit choice models using attitudes characterization "disagrees" (versus omitted category consisting of "agree" or "neutral"); "►" denotes an attitude-based construct validity interaction term.

	Agriculture, Water impacts only			Ecosystems impacts only			Equity, Fairness impacts only		
	(1a)	(1b)	(1c)	(2a)	(2b)	(2c)	(3a)	(3b)	(3c)
Cost, cost shares, shifters:									
Program cost	-0.150	-0.150	-0.158	-0.147	-0.151	-0.159	-0.154	-0.151	-0.161
	(4.38)***	(4.39)***	(4.43)***	(4.21)***	(4.37)***	(4.44)***	(4.47)***	(4.41)***	(4.51)***
Domestic validity assessment variables									
Increased energy taxes (in '00s)									
► ...* I(Disagree)_Energyusers	-1.009	-0.851	-0.752	-1.242	-0.875	-0.695	-1.071	-0.976	-0.832
	(1.53)	(1.28)	(1.10)	(1.85)*	(1.46)	(1.21)	(1.63)	(1.33)	(1.03)
► ...* I(Disagree)_Taxpayers	-0.936	-0.971	-0.948	-0.952	-0.917	-0.913	-0.878	-0.99	-0.966
	(2.24)**	(2.31)**	(2.20)**	(2.24)**	(2.34)**	(2.22)**	(2.08)**	(2.19)**	(2.11)**
► ...* I(Disagree)_EnergyProducers	-0.585	-0.663	-0.348	-0.346	-0.906	-0.635	-0.887	-0.546	-0.322
	(0.76)	(0.87)	(0.43)	(0.45)	(0.71)	(0.40)	(1.18)	(1.20)	(0.80)
Increased income taxes (in '00s)									
► ...* I(Disagree)_Taxpayers	-0.379	-0.367	-0.32	-0.425	-0.369	-0.31	-0.419	-0.467	-0.402
	(0.94)	(0.91)	(0.77)	(1.04)	(1.15)	(0.96)	(1.04)	(0.92)	(0.75)
Decreased investment returns (in '00s)									
► ...* I(Disagree)_Industry	-1.054	-1.035	-1.063	-1.147	-0.997	-1.001	-0.915	-1.026	-1.011
	(1.60)	(1.57)	(1.55)	(1.72)*	(1.53)	(1.47)	(1.37)	(1.51)	(1.47)
Increased consumer price									
► ...* I(Disagree)_consumers	-1.006	-0.919	-0.745	-0.678	-0.94	-0.784	-0.854	-0.85	-0.691
	(2.02)**	(1.85)*	(1.45)	(1.35)	(1.70)*	(1.34)	(1.71)*	(1.90)*	(1.53)
International validity assessment variables									
India and China (in '00s)									
► ...* I(Disagree)_IndiaChina	-0.658	-0.697	-0.765	-0.738	-0.656	-0.749	-0.737	-0.756	-0.822
	(1.49)	(1.59)	(1.68)*	(1.64)	(1.70)*	(1.79)*	(1.67)*	(1.50)	(1.65)*
Other developing countries (in '00s)									
► ...* I(Disagree)_DevelopingCountries	0.255	0.185	0.154	0.163	0.232	0.184	0.178	0.14	0.14
	(0.50)	(0.36)	(0.29)	(0.31)	(0.27)	(0.26)	(0.34)	(0.45)	(0.34)
► ...* I(Disagree)_SmallerDeveloping	-0.091	-0.19	-0.154	-0.047	-0.139	-0.111	-0.039	-0.151	-0.109
	(0.36)	(0.27)	(0.10)	(0.47)	(0.26)	(0.18)	(0.31)	(0.33)	(0.14)
US and Japan (in '00s)									
► ...* I(Disagree)_USJapan	-1.343	-1.27	-1.038	-1.076	-1.266	-1.035	-1.249	-1.036	-0.886
	(2.60)***	(2.45)**	(1.94)*	(2.03)**	(1.98)**	(1.64)	(2.38)**	(2.45)**	(1.95)*

Table A.6 (Continued)

Other industrialized countries (in '00s)									
► …* 1(Disagree)_IndustrializedCountries	-0.229	-0.205	-0.202	-0.161	-0.185	-0.2	-0.097	-0.194	-0.186
	(0.57)	(0.52)	(0.49)	(0.39)	(0.48)	(0.45)	(0.24)	(0.46)	(0.48)
Domestic Cost Shares (baseline) (omitted category= increased income taxes)									
Increased energy taxes (in '00s)	0.298	0.387	0.404	0.443	0.41	0.453	0.341	0.524	0.547
	(0.68)	(0.88)	(0.90)	(1.00)	(1.19)	(1.22)	(0.78)	(0.94)	(1.01)
Decreased investment returns(in '00s)	0.3	0.369	0.352	0.385	0.331	0.322	0.184	0.404	0.398
	(0.80)	(0.98)	(0.92)	(1.02)	(1.07)	(1.03)	(0.49)	(0.89)	(0.84)
Increased consumer prices(in '00s)	0.301	0.314	0.335	0.268	0.293	0.315	0.187	0.345	0.378
	(0.78)	(0.82)	(0.86)	(0.69)	(0.89)	(0.96)	(0.48)	(0.76)	(0.80)
International Cost Shares (baseline) (omitted category= other industrialized countries)									
US and Japan (in '00s)	0.415	0.407	0.306	0.319	0.462	0.348	0.403	0.358	0.27
	(1.16)	(1.14)	(0.83)	(0.88)	(0.99)	(0.73)	(1.12)	(1.29)	(0.94)
India and China (in '00s)	0.082	0.083	0.125	-0.013	0.101	0.14	0.069	-0.003	0.045
	(0.22)	(0.23)	(0.33)	(0.04)	(0.01)	(0.12)	(0.19)	(0.28)	(0.37)
Other developing (in '00s)	-0.066	0.031	-0.162	-0.247	-0.013	-0.203	-0.122	-0.065	-0.259
	(0.17)	(0.08)	(0.40)	(0.62)	(0.16)	(0.64)	(0.31)	(0.03)	(0.50)
Benefits (avoided impacts), attitudes, informedness:									
(where X= impact in question)									
1(Severe)_ X [a] (baseline)	-0.778	-0.642	-0.537	-0.429	-0.623	-0.465	-0.397	-0.649	-0.538
	(2.28)**	(3.39)***	(2.74)***	(1.57)	(3.27)***	(2.36)**	(1.76)*	(3.27)***	(2.62)***
► …* 1(Worried)_ X	-0.102			-0.726			-0.465		
	(0.30)			(2.96)***			(1.75)*		
► …* 1(Not Worried)_ X	0.800			0.456			-0.051		
	(1.61)			(1.34)			(0.30)		
► …* 1(high informed)		-0.511	-0.199		-0.844	-0.591		-0.797	-0.572
		(2.25)**	(0.83)		(4.53)***	(3.01)***		(2.85)***	(1.95)*
► …* 1(low informed)		0.124	-0.061		-0.085	-0.263		(0.90)	(0.19)
		(0.41)	(0.20)		(0.35)	(1.08)		(0.90)	(0.19)
1(Moderate)_ X [a] (baseline)	-0.050	-0.081	-0.033	0.113	0.028	0.086	-0.211	-0.056	-0.041
	(0.28)	(0.54)	(0.21)	(0.52)	(0.16)	(0.46)	(1.82)*	(0.43)	(0.30)
► …* 1(Worried)_ X	-0.469			-0.569			0.146		
	(2.87)***			(3.12)***			(0.97)		
► …* 1(Not Worried)_ X	0.056			0.475			0.780		
	(0.27)			(2.06)**			(6.18)***		
► …* 1(high informed)		-0.701	-0.411		-0.487	-0.191		-0.561	-0.253

Table A.6 (Continued)

		(4.57)***	(2.53)**		(2.91)***	(1.07)		(3.47)***	(1.47)
► ...* I(low informed)		-0.123	-0.217		0.054	-0.005		-0.027	-0.132
		(0.65)	(1.13)		(0.26)	(0.02)		(0.13)	(0.63)
Elicitation formats:									
Partial mitigation (alt-spec. constant)	2.210	2.049	2.018	2.120	2.050	2.114	2.271	2.046	2.022
	(5.81)***	(5.41)***	(3.54)***	(5.55)***	(5.38)***	(3.69)***	(5.95)***	(5.42)***	(3.56)***
► ...* I(Climate a high priority)			0.614			0.588			0.610
			(2.36)**			(2.24)**			(2.34)**
► ...* I(Climate a low priority)			0.081			0.060			0.062
			(0.30)			(0.22)			(0.23)
► ...* I(Belongs to enviro. group/s))			0.176			0.213			0.205
			(0.76)			(0.92)			(0.89)
Complete mitigation (alt-spec. constant)	0.618	0.559	0.534	0.619	0.551	0.627	0.956	0.662	0.654
	(1.61)	(1.45)	(1.09)	(1.56)	(1.39)	(1.25)	(2.50)**	(1.76)*	(1.36)
...* I(Saw Partial Mitigation alternative)	0.612	0.613	0.580	0.512	0.548	0.536	0.588	0.605	0.581
	(3.80)***	(3.80)***	(3.46)***	(3.13)***	(3.37)***	(3.17)***	(3.64)***	(3.75)***	(3.46)***
► ...* I(Climate a high priority)			0.844			0.808			0.880
			(5.03)***			(4.79)***			(5.26)***
► ...* I(Climate a low priority)			-0.376			-0.390			-0.342
			(2.23)**			(2.30)**			(2.03)**
► ...* I(Belongs to enviro. group/s)			0.518			0.473			0.503
			(3.27)***			(2.96)***			(3.18)***
Observations	4235	4235	4203	4235	4235	4203	4235	4235	4203

[a] Ratings of climate change impacts are grouped for this analysis I(Severe) implies a substantial negative impact: $-4 \leq rating < -2$; I(moderate) implies a moderate negative impact: $-2 \leq rating < 0$; the omitted category is $0 \leq rating \leq +4$ (interpreted as neutral or positive impact)

Table A.7. Descriptive statistics for individual characteristics

Variables	Min	Max	Mean	Std. Dev.
Demographic information				
Family income (in levels)*	0	6	3.854	1.735
Money qualified to borrow (in levels)**	0	6	2.733	1.172
Female	0	1	0.496	0.500
Age in years	18	69	22.301	5.474
Education				
Yeas of college study completed	0	6	2.712	1.674
Major in physics science	0	1	0.106	0.307
Major in life science	0	1	0.140	0.347
Major in social science	0	1	0.301	0.459
Major in art	0	1	0.082	0.275
Major in English	0	1	0.079	0.269
Major in business	0	1	0.349	0.477
Knowledge about Environment & Economics				
Have taken class on climate change	0	1	0.517	0.500
Have taken courses on economics	0	1	0.880	0.325
# of participating environment groups	0	6	0.399	0.832
Number right of nine climate quiz questions	0	9	5.274	1.760
Work status				
Work status=work full-time	0	1	0.068	0.251
Work status=work part-time	0	1	0.363	0.481
Work status=student	0	1	0.928	0.258
Work status=non-paid work	0	1	0.041	0.199
Work status=retired	0	1	0.003	0.053
Work status=childcare/eldercare provider	0	1	0.013	0.115
Other information				
Maximum time (seconds) spent on Socio module	0.37	110.7 3	3.291	4.185
# of lottery tickets bought per year	0	6	1.655	1.052

Note: * Family annual income were described in levels from 0 to 6, where the income brackets were: 0 (< $10,000); 1 ($10,000 - $20,000); 2 ($20,000- $30,000); 3 ($30,000 - $50,000); 4 ($50,000 - $75,000); 5 ($75,000 - $100,000); 6 (> $100,000).

** The amount of money qualified to borrow was described in levels from 0 to 6, where the levels were interpreted as: 0 ($0); 1 ($100); 2 ($ 1,000); 3 ($10,000); 4 ($50,000); 5 ($100,000); 6 (>$100,000).

Table A.8. First stage probit estimation (evidence of ordering effect in questions concerning climate change priority).

Position: (1=first,…,11=last)	I(Climate change is high priority)	
	coefficient[a]	t-stats
preventing climate change	**-0.027**	**(3.03)*** **
reducing poverty	-0.014	(1.63)
improving education	-0.017	(1.89)*
reducing violent crime	-0.006	(0.74)
protecting endangered species	-0.014	(1.60)
reducing nuclear threats	-0.001	(0.13)
improving food safety	-0.027	(3.13)***
improving health	-0.008	(0.96)
race/ethnic tension	-0.001	(0.07)
cleaning up environment	-0.006	(0.67)
Preventing wars[b]	-	-
Constant	-0.114	(0.31)
Individual characteristics included[c]	yes	

Absolute value of z statistics in parentheses
***significant at 10%; ** significant at 5%; *** significant at 1%

[a] All these coefficients are negative. Those significant ones indicate that their positions (relative to the position of "preventing wars") do not alter responses. However, those significant ones suggest their relative positions do matter, and if they are placed earlier than "preventing wars," respondents are more likely to say climate change is a high priority.
[b] "Preventing wars" is the omitted category.
[c] These include all variables in Table A.1 (Full results are available from the authors)

Table A.9. First stage probit estimation (evidence of ordering effect in questions concerning which domestic payors should bear the mitigation costs of climate change); "government" is the omitted category.

Position of:	1(agree) responsibility of:					
	A	B	C	D	E	F
A	**0.012**	-0.038	-0.013	0.022	-0.039	0.017
	(0.78)	(2.05)**	(0.89)	(1.27)	(2.05)**	(0.99)
B	0.022	**-0.035**	-0.031	0.017	0.004	0.004
	(1.37)	**(1.84)***	(1.99)**	(0.95)	(0.21)	(0.24)
C	-0.015	-0.016	**-0.060**	-0.027	-0.008	-0.009
	(0.91)	(0.83)	**(3.95)*****	(1.53)	(0.45)	(0.51)
D	0.019	0.000	0.019	**-0.012**	-0.014	0.023
	(1.23)	(0.03)	(1.26)	**(0.66)**	(0.74)	(1.30)
E	0.017	0.029	-0.028	0.009	**-0.017**	0.022
	(1.08)	(1.60)	(1.91)*	(0.50)	**(0.92)**	(1.29)
Constant	-0.402	0.665	0.485	-0.290	0.714	1.431
	(1.46)	(2.06)**	(1.84)*	(0.95)	(2.20)**	(4.81)***
Individual characteristics	yes	yes	yes	yes	yes	yes

Absolute value of z statistics in parentheses ***significant at 10%;** significant at 5%; *** significant at 1%

Note: A. consumer
B. industry
C. taxpayers
D. energy users
E. energy producers
F. government

Table A.10. First stage probit estimation (evidence of ordering effect in questions concerning which international country groups should bear the mitigation costs of climate change); "smaller developing countries" is the omitted category.

Position of:	I(agree) responsibility of:						
	G	H	I	J	K	L	M
G	**-0.048**	0.086	0.068	0.046	0.034	0.082	0.061
	(2.62)***	(6.18)***	(4.46)***	(3.05)***	(2.43)**	(5.91)***	(4.18)***
H	0.005	**-0.008**	0.072	0.004	0.023	0.069	-0.005
	(0.30)	**(0.60)**	(4.78)***	(0.29)	(1.67)*	(5.03)***	(0.34)
I	-0.029	0.031	**0.028**	0.017	-0.002	-0.036	-0.000
	(1.61)	(2.29)**	**(1.90)***	(1.15)	(0.13)	(2.63)***	(0.03)
J	0.045	0.033	-0.009	**0.045**	-0.005	0.018	-0.012
	(2.53)**	(2.43)**	(0.64)	**(3.05)*****	(0.38)	(1.27)	(0.83)
K	-0.031	0.005	0.020	0.042	**0.047**	0.032	0.025
	(1.67)*	(0.34)	(1.34)	(2.77)***	**(3.39)*****	(2.29)**	(1.72)*
L	0.008	-0.002	0.010	0.002	-0.031	**0.018**	-0.025
	(0.40)	(0.10)	(0.62)	(0.13)	(2.03)**	**(1.16)**	(1.53)
Constant	0.834	-0.088	-0.361	0.332	0.012	-1.272	-0.380
	(2.09)**	(0.29)	(1.08)	(1.00)	(0.04)	(4.08)***	(1.18)
Individual characteristics	yes	yes	yes	yes	yes	yes	yes

Absolute value of z statistics in parentheses ***significant at 10%;** significant at 5%; *** significant at 1%

Note: G. countries in proportion to their contribution to the problem
H. industrialized countries
I. US and its major trade partners
J. developing countries
K. densely populated countries, like India and China
L. countries of former Soviet Union
M. smaller developing countries

Table A.11 Summary of our previous findings: consistency between attitudes and policy choices

Individuals whose attitude is...	**would convey a higher utility from a policy that...**
Agree industry paying the mitigation cost	Higher cost share paid through decreased investment return
Agree energy users paying the mitigation cost	Higher cost share paid through energy tax
Agree tax payer paying the mitigation cost	Higher cost share paid through income tax
Agree India and China paying the cost	Higher cost share paid through India and China
Agree US and Japan paying the cost	Higher cost share paid through US and Japan
Climate change is high priority	Complete mitigation

BIBILOGRAPHY

Chapter II

Akin, J. S., W. H. Dow, et al. (2004). "Did the distribution of health insurance in China continue to grow less equitable in the nineties? Results from a longitudinal Survey". *Social Science & Medicine* 58, 293-304.

Bloom, G. (1998). "Primary health care meets the market in China and Vietnam". *Health Policy* 44 (3), 233-252.

Blumenthal, D. and W. Hsiao (2005). "Privatization and its discontents - The evolving Chinese health care system". *New England Journal of Medicine* 353 (11), 1165-1170.

Cai, B. (2007). "The Impact of Chinese Public Health Insurance Reform on Program Generosity: Correcting Sample Selections ". University of Oregon

Chow, G. C. (2006). "An economic analysis of health care in China". Department of Economics, Princeton University, Center for Economic Policy Studies Discussion Paper No. 132, August 2006.

Ding, Y. (1994). "Disscuss about Public Health Insurance Reform (in Chinese)". *Sociology Study* (No.3,1994).

Finkelstein, A. (2002). "The effect of tax subsidies to employer provided supplementary health insurance:evidence from Canada". *Journal of Public Economics* 84, 305-339.

Gao, J., S. L. Tang, et al. (2001). "Changing access to health services in urban China: implications for equity". *Health Policy and Planning* 16 (3), 302-312.

Greene, W. H. (2003). "Econometric Analysis".

Grogan, C. M. (1995). "Urban Economic-Reform and Access to Health-Care Coverage in the Peoples-Republic-of-China". *Social Science & Medicine* 41 (8), 1073-1084.

Guo, B. (2003). "Transforming China's Urban Health-care System". *Asian Survey* 43 (2), 385-403.

Henderson, G., S. G. Jin, et al. (1995). "Distribution of Medical Insurance in China". *Social Science & Medicine* 41 (8), 1119-1130.

Hirano, K., G. W. Imbens, et al. (2001). "Combining panel data sets with attrition and refreshment samples". *Econometrica* 69 (6), 1645-1659.

Langan, P. (1993), "Health Sector Reform in Devoloping Countires:Issues for the 1990's". DOI:

Liu, X. Z. and W. C. L. Hsiao (1995). "The Cost Escalation of Social Health-Insurance Plans in China - Its Implication for Public-Policy". *Social Science & Medicine* 41 (8), 1095-1101.

Liu, Y. L. (2002). "Reforming China's urban health insurance system". *Health Policy* 60 (2), 133-150.

Renmin Daily (May 16, 1995). "The overprescription--Health service workers talk about high price of medical services (in Chinese)". Renmin Daily.

The Xinhua General Overseas News Service (January 29, 1993). "China's insurance industry to undergo rapid development".

Wong, B. A. and S. J. Gabriel "The Influence of economic liberalization on Urban health care access in the people's republic of China". DOI:

World Bank (1997). "China 2020: Financing Health care". Washington: The World Bank, World Bank.

Xinhua News Agency (December 5, 1995). "china's life insurance has bright future". Xinhua News Agency.

Chapter III

Bergstrom, J. C., K. J. Boyle, et al. (2004). "Trading taxes vs. paying taxes to value and finance public environmental goods." *Environmental & Resource Economics* 28(4): 533-549.

Berrens, R. P., A. K. Bohara, et al. (1998). "A joint investigation of public support and public values: case of instream flows in New Mexico." *Ecological Economics* 27(2): 189-203.

Bosello, F., R. Roson, et al. (2006). "Economy-wide estimates of the implications of climate change: Human health." *Ecological Economics* 58(3): 579-591.

Cameron, T. A. and G. R. Gerdes (2006). Discounting versus risk aversion: the effects of time and risk preferences on individual demands for climate change mitigation.

Champ, P. A., N. E. Flores, et al. (2002). "Contingent valuation and incentives." *Land Economics* 78(4): 591-604.

de Blaeij, A., R. Florax, et al. (2003). "The value of statistical life in road safety: a meta-analysis." *Accident Analysis and Prevention* 35(6): 973-986.

Diamond, P. A. and J. A. Hausman (1994). "Contingent Valuation - Is Some Number Better Than No Number." *Journal of Economic Perspectives* 8(4): 45-64.

Florax, R., C. M. Travisi, et al. (2005). "A meta-analysis of the willingness to pay for reductions in pesticide risk exposure." *European Review of Agricultural Economics* 32(4): 441-467.

Johnson, L. T. (2006). "Distributional preferences in contingent valuation surveys." *Ecological Economics* 56(4): 475-487.

Jorgensen, B. S. and G. J. Syme (2000). "Protest responses and willingness to pay: attitude toward paying for stormwater pollution abatement." *Ecological Economics* 33(2): 251-265.

Kahneman, D. and J. L. Knetsch (1992). "Valuing Public-Goods - the Purchase of Moral Satisfaction." *Journal of Environmental Economics and Management* 22(1): 57-70.

Kelly, D. L., C. D. Kolstad, et al. (2005). "Adjustment costs from environmental change." *Journal of Environmental Economics and Management* 50(3): 468-495.

Kinnell, J., J. K. Lazo, et al. (2002). "Perceptions and values for preventing ecosystem change: Pennsylvania duck hunters and the Prairie Pothole Region." *Land Economics* 78(2): 228-244.

Kurukulasuriya, P., R. Mendelsohn, et al. (2006). "Will African agriculture survive climate change?" *World Bank Economic Review* 20(3): 367-388.

Laughland, A. S., W. N. Musser, et al. (1996). "Construct validity of averting cost measures of environmental benefits." *Land Economics* 72(1): 100-112.

Morrison, M. D., R. K. Blamey, et al. (2000). "Minimising payment vehicle bias in contingent valuation studies." *Environmental & Resource Economics* 16(4): 407-422.

Rollins, K. (1997). "Wilderness canoeing in Ontario: Using cumulative results to update dichotomous choice contingent valuation offer amounts." *Canadian Journal of Agricultural Economics-Revue Canadienne D Economie Rurale* 45(1): 1-16.

Schlapfer, F. (2006). "Survey protocol and income effects in the contingent valuation of public goods: A meta-analysis." *Ecological Economics* 57(3): 415-429.

Sheeran, K. A. (2006). "Who should abate carbon emissions? A note." *Environmental & Resource Economics* 35(2): 89-98.

Stevens, T. H., N. E. DeCoteau, et al. (1997). "Sensitivity of contingent valuation to alternative payment schedules." *Land Economics* 73(1): 140-148.

Whitehead, J. C., G. C. Blomquist, et al. (1998). "Construct validity of dichotomous and polychotomous choice contingent valuation questions." *Environmental & Resource Economics* 11(1): 107-116.

Chapter IV

Bishop, G. and A. Smith (2001). "Response-order effects and the early gallup split-ballots". *Public Opinion Quarterly* 65 (4), 479-505.

Bishop, G. F., R. W. Oldendick, et al. (1985). "The Importance of Replicating a Failure to Replicate - Order Effects on Abortion Items". *Public Opinion Quarterly* 49 (1), 105-114.

Bosello, F., R. Roson, et al. (2006). "Economy-wide estimates of the implications of climate change: Human health". *Ecological Economics* 58 (3), 579-591.

Boyle, K. J., M. P. Welsh, et al. (1993). "The Role of Question Order and Respondent Experience in Contingent-Valuation Studies". *Journal of Environmental Economics and Management* 25 (1), S80-S99.

Cai, B., T. A. Cameron, et al. (2007). "Preference over the distribution of environmental policy costs: construct validity of distributional preference on payment vehicles".

Cameron, T. A. and G. R. Gerdes (2006). "Discounting versus risk aversion: the effects of time and risk preferences on individual demands for climate change mitigation".

Carpenter, E. H. and L. G. Blackwood (1979). "Effect of Question Position on Responses to Attitudinal Questions". *Rural Sociology* 44 (1), 56-72.

Carson, R., N. E. Flores, et al. (1998). "Sequencing and valuing public goods". *Journal of Environmental Economics and Management* 36 (3), 314-323.

Carson, R. T. and R. C. Mitchell (1995). "Sequencing and Nesting in Contingent Valuation Surveys". *Journal of Environmental Economics and Management* 28 (2), 155-173.

Colasanto, D., E. Singer, et al. (1992). "Context Effects on Responses to Questions About Aids". *Public Opinion Quarterly* 56 (4), 515-518.

Crespi, I. and D. Morris (1984). "Question Order Effect and the Measurement of Candidate Preference in the 1982 Connecticut Elections". *Public Opinion Quarterly* 48 (3), 578-591.

Dillman, D. A. (2000). "Mail and Internet Surveys", John Wiley &Sons, Inc.

Dupont, D. P. (2003). "CVM embedding effects when there are active, potentially active and passive users of environmental goods". *Environmental & Resource Economics* 25 (3), 319-341.

Hanemann, W. M. (1994). "Valuing the Environment Through Contingent Valuation". *The Journal of Economic Perspectives* 8 (4), 19-43.

Kahneman, D. and J. L. Knetsch (1992). "Valuing Public-Goods - the Purchase of Moral Satisfaction". *Journal of Environmental Economics and Management* 22 (1), 57-70.

Kelly, D. L., C. D. Kolstad, et al. (2005). "Adjustment costs from environmental change". *Journal of Environmental Economics and Management* 50 (3), 468-495.

Kinnell, J., J. K. Lazo, et al. (2002). "Perceptions and values for preventing ecosystem change: Pennsylvania duck hunters and the Prairie Pothole Region". *Land Economics* 78 (2), 228-244.

Knauper, B. (1999). "The impact of age and education on response order effects in attitude measurement". *Public Opinion Quarterly* 63 (3), 347-370.

Krosnick, J. A. and D. F. Alwin (1987). "An Evaluation of a Cognitive Theory of Response-Order Effects in Survey Measurement". *Public Opinion Quarterly* 51 (2), 201-219.

Kurukulasuriya, P., R. Mendelsohn, et al. (2006). "Will African agriculture survive climate change?" *World Bank Economic Review* 20 (3), 367-388.

Loomis, J., M. Lockwood, et al. (1993). "Some Empirical-Evidence on Embedding Effects in Contingent Valuation of Forest Protection". *Journal of Environmental Economics and Management* 25 (1), 45-55.

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

Moore, D. W. (2002). "Measuring new types of question-order effects - Additive and subtractive". *Public Opinion Quarterly* 66 (1), 80-91.

Payne, J. W., D. A. Schkade, et al. (2000). "Valuation of multiple environmental programs". *Journal of Risk and Uncertainty* 21 (1), 95-115.

Powe, N. A. and I. J. Bateman (2003). "Ordering effects in nested 'top-down' and 'bottom-up' contingent valuation designs". *Ecological Economics* 45 (2), 255-270.

Sheeran, K. A. (2006). "Who should abate carbon emissions? A note". *Environmental & Resource Economics* 35 (2), 89-98.

Tourangeau, R., L. J.Rips, et al. (2000). "The Psychology of Survey Response", Cambridge University Press.

Veisten, K., H. F. Hoen, et al. (2004). "Sequencing and the adding-up property in contingent valuation of endangered species: Are contingent non-use values economic values?" *Environmental & Resource Economics* 29 (4), 419-433.