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A Fair Share -

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Abstract

Using a choice experiment, we investigated preferences for distributing the economic burden of decreasing CO_2 emissions in the two largest CO_2-emitting countries: the United States and China. We asked respondents about their preferences for four burden-sharing rules to reduce CO_2 emissions according to their country's 1) historical emissions, 2) income level, 3) equal right to emit per person, and 4) current emissions. We found that U.S. respondents preferred the rule based on current emissions, while the equal right to emit rule was clearly least preferred. The Chinese respondents, on the other hand, preferred the historical rule, while the current emissions rule was the least preferred. Respondents overall favored the rule that was least costly for their country. These marked differences may explain the difficulties countries face in agreeing how to share costs, presenting a tough hurdle to overcome in future negotiations. We also found that the strength of the preferences was much stronger in China, suggesting that how mitigation costs are shared across countries is more important there.

Key words: Climate, burden-sharing, fairness, China, United States

JEL classification: Q51, Q52, Q54

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Introduction

By now, the difficulties in forging an international agreement on an effective international climate policy are well known. With the 15th Conference of the Parties in Copenhagen in December 2009, yet another meeting closed without a settlement on binding targets. Instead, the outcome of the meeting is the Copenhagen Accord, where countries *volunteer* to pledge to the United Nations Framework Convention on Climate Change that they will cut emissions until 2020.

Why is it so difficult for countries to agree on binding targets? Some of many plausible explanations are that different burden-sharing rules have different economic impacts on individual countries that the negotiators are sensitive to domestic public opinion, and that they want to insure the rules are "fair" to their country (see, e.g., Lange et al. 2007). Driven strictly by self-interest, climate negotiators from developing countries can thus be expected to support burden-sharing rules that favor poor countries, while their counterparts from rich countries will be equally tactical and support rules that cater to their interests. Citizens often adopt opinions that defend the reputation or interests of their country. A critical issue, therefore, is what citizens perceive as a fair distribution of the economic burden of decreasing CO_2 emissions among countries—in other words, their preferences for different burden-sharing rules.

The purpose of this paper is to shed light on this issue by presenting the results of a choice experiment that elicited preferences for different burden sharing rules, conducted among ordinary citizens in the United States and China. We focus on these countries because they are world's largest CO_2-emitting countries and are critical to the outcome of any negotiations to reduce emissions. If the people of these two countries are prone to evaluate their country more positively in relation to other countries—have an in-group bias (Tajfel 1982)—then this can affect the potential to reach agreement. Similarly, they can also exhibit a group-serving bias—distorted beliefs about their group—which is similar to a self-serving bias[1] (see, e.g., Festinger 1957; Babcock and Loewenstein 1997; Konow 2000), except that it takes place between groups instead of individuals. At the same time, these two countries are very different in their ability to pay, which might also have affected how citizens responded to the survey.

While there is a vast literature on burden-sharing rules, it is mostly on a country or negotiator level. The country-level studies are often either an assessment of burden-sharing rules (comparing and ranking them) or based on game theory, discussing what is rational

[1] Some researchers simply use the term "fairness-bias," which can be viewed as a combination of two joint effects, both a self-centered bias that is a discrepancy that the stakeholder is aware of, and a self-serving bias that is a distortion of the stakeholders' beliefs that is subconscious and drives perception of what is fair (Johansson-Stenman and Konow 2010). With climate policy, these two effects would reinforce one another.

behavior for a country or coalition of countries (see, e.g., Butraw and Toman 1993; Rose et al. 1998; Cazorla and Toman 2000; Ringius et al. 2002; Torvanger and Ringius 2002; and Torvanger and Godal 2004). Other studies have focused on the preferences of the negotiators, such as Lange et al. (2007) and Dannenberg et al. (2010).

Dannenberg et al. (2010) showed (in a simple non-strategic game, not related to climate change) that climate negotiators are inequality averse and that there are no significant differences in inequality aversion between negotiators from different regions. However, as the authors remarked, it is likely that negotiators are affected by public opinion at home, in addition to their own preferences for equality. There are also articles discussing the ethical aspects of burden-sharing rules (see, e.g., Miller 2004; Posner and Sunstein 2007; Klinsky and Dowlatabadi 2009). However, we argue that the outcome of future climate negotiations will ultimately depend on how politically acceptable the agreement is to the domestic constituencies in the affected countries.

The burden-sharing rules discussed in the literature can be traced back, in general, to the basic principles of distributive justice: equity, equality, and need (Adams 1965, 267–99; Deutsch 1975; Tyler et al. 1997). It seems that most countries appeal to some general principles of justice, but since there are several competing principles that give different results, this does not necessarily facilitate the negotiation process.[2] Based on the literature concerning burden-sharing rules in relation to international climate negotiations (see, e.g., Rose et al. 1998; Torvanger and Ringius 2002; Ringius et al. 2002; Lange et al. 2007), the burden-sharing rules we study are cost proportional to 1) historical emissions (burden sharing based on historical responsibility), 2) income level (burden sharing based on capacity to pay), 3) equal right to emit (burden sharing based on need), and 4) current emissions (burden sharing based on current responsibility).

Previous to our study, Cai et al. (2010) also analyzed how the distributional consequences of climate change policies influence policy preferences. However, their study included college students living in the United States and Canada and did not explicitly name any burden-sharing rules. They found that distributional consequences are important to respondents and can largely affect willingness to pay (WTP).[3]

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[2] Equity theory is based on the justice principle that reward should be in proportion to contribution. For example, someone who works two hours should earn twice as much as someone working one hour. With a need-based principle, the ones with the greatest need receive the most; with an equality principle, resources are divided equally between individuals.

[3] Instead of naming any burden-sharing rules, Cai et al. (2010) asked their respondents to rate how mitigation costs should be allocated among various domestic payers (individual taxpayers, consumers, energy users, industry, energy producers, and government) and international payers (industrialized countries; countries of the former Soviet Union; densely populated countries, such as China and India; United States and its major trading partners; developing countries, which are beginning to pollute heavily; smaller developing countries; and countries in proportion to their pollution) .

The main contribution of our study is that we use identical surveys of representative citizens in both the United States and China to estimate willingness to pay and elicit preferences for different burden-sharing rules. Our main finding shows quite distinct and dramatically counterpoised preferences for burden-sharing among U.S. and Chinese citizens. In particular, U.S. citizens prefer the rule that is most advantageous for the United States, but simultaneously is the least advantageous—or most costly—for the Chinese. Chinese preferences are almost a mirror image: rules that favor China and happen to disfavor the United States are preferred. This suggests that there is group-serving bias among both American and Chinese respondents, in that they strongly prefer rules that are advantageous to their respective countries.

Also, in the Chinese results, we found that the preferences are very strong, suggesting that they reflect deeply held views concerning perceived fairness. Since the total costs to be divided are considerable, this implies that negotiations will be difficult and protracted. Considering the issues and costs at stake, we believe that countries should make a careful and sustained effort to understand each other's preferences as a first step in international negotiations.

The paper is organized as follows. Section 1 gives a description of the survey and the sampling framework. In section 2, the results of the choice experiment are presented. Section 3 concludes the paper.

1. Description of the Survey

The survey consisted of four independent sections. In the first section, we elicited general attitudes about climate change. The main purpose of this section was to discover whether the respondents believe that climate change is occurring and if they believe that actions can be taken to reduce or stop the change. In the second section, the survey provided information on the effects of climate change, summarized from the *IPCC Fourth Assessment Report*. Respondents' attitudes towards reducing global CO_2 emissions were also elicited in this section. In the last part of section 2, a number of WTP questions for different reductions of CO_2 emissions were asked using a payment card.[4] (The results of this section are reported in Carlsson et al. 2010). The third section of the survey contained the choice experiment regarding the rules for allocating the responsibilities for the cost of CO_2 reductions across

[4] Although it is possible that the contingent valuation questions can affect the responses to the choice experiment, we believe that it was actually advantageous to include the WTP questions on the levels of CO_2 reductions before our experiment. In this way, it was clear to the respondents that the choice experiment did not concern the level of the reduction, and they had already had the opportunity to express their preferences for this. Moreover, since we used a payment card in the contingent valuation questions, there is less risk of a direct anchoring bias. We therefore decided to keep the order of these two different sections the same in all survey versions, even if it meant that we could not test for an order effect.

countries, which is the focus of this paper. Finally, section 4 of the survey contained questions about the respondents' socioeconomic characteristics.

In the choice experiment, we emphasized to the respondents that they should choose allocation (or burden-sharing) rules, *given* a 60 percent reduction of emissions. We did this to avoid confounding preferences for the different rules with preferences for different levels of reductions and to make clear that the total global costs are unaffected. More specifically, we gave the following instructions to the respondents:

> Reducing CO_2 emissions is costly, and an important question is how costs should be shared among countries. Suppose that countries have reached an international agreement that global reductions of CO_2 emissions should be 60 percent. We will now present four alternative "rules" for distributing the costs among countries to achieve this reduction. All four rules would result in the same cost to the world economy, but different costs to different countries.

In the choice experiment, the respondents chose between two alternatives in each choice situation, where the alternatives differed with respect to the burden-sharing rule and the cost to the household. Each respondent answered four choice sets. The burden-sharing rule attribute had four possible levels, as noted above (historical emissions, ability to pay, equal right to emit, and current emissions). While more rules could have been developed, we felt additional rules would have excessively increased the cognitive burden to respondents. Also, these four are the main rules in the literature.[5]

The other attribute, household cost per month until 2050, had four levels based on the results of pilot studies in both China and the United States. Examples of the typical ways in which this cost could be realized were provided, such as increased energy and gasoline prices.[6] Both the monthly and annual costs for a household were shown to ensure that the respondents understood how much they had to pay. The attribute levels are summarized in table 1. The costs were presented in U.S. dollars for the U.S. sample and in yuan for the Chinese sample; the table, however, reports PPP-adjusted US$ values for China (yuan 3.4 = $1).

[5] We also limited the discussion to CO_2 emissions, instead of all greenhouse gases, to make the survey cognitively less demanding for the respondents.

[6] Wiser (2007) found that the WTP to support climate change policy depends on the payment vehicle used in the study. For example, with a collective payment mechanism, the elicited WTP is higher, compared to using voluntary payment mechanisms. In our study, we did not test for different payment vehicles, but rather made clear how the payments would be made and kept this consistent across countries.

Table 1 Attributes

Attributes	Description
Income level (ability to pay)	Countries with high income levels must pay a larger share of the costs than countries with low income levels. This option says that countries with greater ability to pay should pay more.
Emissions level today	Countries with currently high emissions levels must pay a larger share of the costs than countries with currently low emissions levels. This option says that those countries that are currently a larger part of the problem should pay more.
Historical emissions level	Countries with a history of high emissions levels must pay a larger share of the costs than countries with a history of lower emissions. This option recognizes that CO_2 builds up in the atmosphere over many years. Thus, countries with a history of high emissions should pay more because they caused more of the problem.
Equal right to emit (need)	All countries have a right to emit an equal amount of emissions per person. Countries with emissions per person greater than an agreed amount must pay; and they must pay more the higher their emissions per person are.
Yearly cost for the household until year 2050 in US$)	U.S.: $168, $240, $288, $336 China: $159, $229, $300, $318

In order to illustrate more clearly to the respondent what the four burden-sharing rules imply, we created four groups relating to country income and current emissions. How much each group would pay differs, depending on which rule is used to distribute the costs of reducing CO_2 emissions. In table 2, we show different distributions of costs under each alternative rule and also provide information about the world population share of each group.[7]

[7] The data on income and emissions come from the *World Development Indicators* (World Bank 2009).

Table 2 Information of the Effect of the Four Burden-Sharing Rules

		Distribution of costs according to attributes			
Country groups by income and current emissions level	Share of the world's population	Share of the world's income	Share of emissions today	Share of historical emissions	Equal emissions per person
					
Countries with high income and very high emissions (e.g., United States and Canada)	13% 	47% 	42% 	67% 	55% 
Countries with high income and high emissions (e.g., Sweden and France)	7% 	16% 	11% 	12% 	7% 
Countries with low income and medium emissions (e.g., China and South Africa)	40% 	29% 	40% 	18% 	38% 
Countries with low income and low emissions (e.g., Ethiopia and India)	40% 	8% 	7% 	3%	0%

As can be seen in table 2, only 13 percent of the world's population lives in the high-income and very-high-emissions countries; however, their shares of the costs are much larger for all the rules. On the other hand, 40 percent of the world's population lives in the low-income and low-emissions countries, but their share of the costs is much smaller for all rules (ranging from 0 percent to 8 percent, depending on the rule). In particular, the rule on historical emissions has the lowest cost for China, while the rule generating its highest cost is based on current emissions. Exactly the opposite is true for the United States: the rule with the lowest cost is based on current emissions, and the rule with the highest cost is historical emissions. (An example of a choice set is given in the appendix, in table A2.)

The choice sets were created with a linear D-optimal design principle (Huber and Zwerina 1996; Carlsson and Martinsson 2003). In total, 16 choice sets were generated, with two alternatives in each set. After random blocking, each respondent was presented with four choice sets. Hence, we had four versions of the survey applied at random.

A standard concern when using a choice experiment (or other stated preference method) is the risk of hypothetical bias. The empirical evidence of hypothetical bias in a choice experiment is mixed (see, e.g., Carlsson and Martinsson 2001; Lusk and Schroeder 2004; Johansson-Stenman and Svedsäter 2008). To reduce the probability of a hypothetical bias, following Carlsson et al. (2005) and List et al. (2005), we used a cheap-talk script, as follows:

> Before making your choices, please consider how an increased cost would affect your ability to buy other things. Previous studies of this kind have shown that people claim to be willing to pay more money than they actually would in a real situation. It is important to us that respondents answer these questions as truthfully as possible.

1.1 Administration of the U.S. and Chinese Surveys

The surveys were conducted in November and December 2009. The questionnaire was designed with the aid of 10 focus groups across the two countries. Careful attention was given to develop a survey that was understandable and credible. The survey was also designed to be self-administered on the computer to eliminate interviewer bias and strategic answering to please the interviewer. In China, the survey was conducted on laptops in special rooms with invited respondents. In the United States, the respondents took the survey online. The survey yielded 909 responses in the United States and 1,264 responses in China.

The Chinese survey was administered in four cities—Shanghai, Nanning, Jiujiang, and Chongqing—chosen by the Chinese Ministry of the Environment as being representative of Chinese cities in size, location, and income. Respondents were randomly selected to participate in the survey via neighborhood-based databases used in previous surveys (Krupnick et al. 2010).[8] The respondents in the U.S. survey were reached by a survey company, Knowledge Networks. The participants were recruited by telephone, using random digit dialing and address-based sampling, and are representative of the U.S. population for gender, age, race, and income. Participants aged 18 years and older were randomly selected and invited to take the survey.[9]

1.2 Characteristics of Respondents

Descriptive statistics of the U.S. and Chinese samples are presented in table 3. There are some differences in the distribution of the socioeconomic characteristics between the two countries. In particular, the share of subjects with a university education is high in the Chinese

[8] This is a registration system used by local communities to provide reproductive service to married couples. Older people are also reached by this system because so many young married couples live with their parents.

[9] To obtain a more representative panel, if a household does not have a computer and/or internet, Knowledge-Networks provides a laptop computer and free internet access.

sample.[10] A number of attitudinal responses are also reported in the table. Notably, 23 percent of the citizens in the United States believe that the temperature has not increased globally, while in China only 5 percent of the respondents believe this.

[10] The share of people (for example, in Beijing) with a university education is around 20% (Beijing Statistical Yearbook 2009), while in our sample, 42.8% have a university education.

Table 3 Descriptive Statistics

Variable	Description	USA			China		
		Mean	Min.	Max.	Mean	Min.	Max.
Female	= 1 if female	0.520	0	1	0.464	0	1
University educ.	= 1 if completed university education	0.308	0	1	0.430	0	1
Income	Monthly income in US$ '000	3.407			1.250		
	(Std. dev.)	(2.812)	0.208	16.67	(0.864)	0.123	3.92
Low income	=1 if household belongs to low-income group	0.220	0	1	0.208	0	1
Medium income	=1 if household belongs to medium-income group	0.549	0	1	0.564	0	1
High income	=1 if household belongs to high-income group	0.231	0	1	0.228	0	1
Use tax money in US/China	=1 if tax money should primarily be used in own country	0.443	0	1	0.560	0	1
Own country should reduce	=1 if own country should decrease CO_2, if other countries do not	0.709	0	1	0.799	0	1
No global temperature increase	=1 if respondent believes temperature has not increased globally	0.232	0	1	0.045	0	1
Democrats	= 1 if Democrat (U.S.)	0.375	0	1			
Republican	=1 if Republican (U.S), reference category	0.245					
Green party	= 1 if Green party (U.S.)	0.011	0	1			
Other party	= 1 if other party (U.S.)	0.083	0	1			
Independent	= 1 if independent (U.S.)	0.286	0	1			
No. of respondents		909			1,264		

2. Results

To analyze the responses, we apply a standard random utility framework and estimated a random parameter logit model, where the choice depends on the two attributes of the choice experiment. The burden-sharing rules attribute is effects-coded, so we can directly compare *all* the rules with each other and between the two countries. [11] The three coefficients associated with the burden-sharing rule attribute are assumed to be normally distributed. Since respondents made several choices, we assume that the random parameters are constant across tasks for a given respondent.

Since there are large income differences within both countries, we estimate three separate cost coefficients for low-, medium- and high-income respondents. Low-income respondents are those belonging to the 20 percent of the sample with the lowest income, and high-income respondents are those belonging to the 20 percent of the sample with the highest income. These three income coefficients are assumed to be fixed, which means that marginal utility of income is constant within each income group.

In addition, in order to investigate the WTP for different respondent groups, we interact the random parameters with a set of household characteristics and attitudinal variables (see table 3). The models are estimated with simulated maximum likelihood using Halton draws with 500 replications. (See Train 2003 for details.) The coefficients of the random parameter models are presented in the appendix, in table A3, and WTP results are in table 4.

Table A3 also shows, in the U.S. case, that the estimated standard deviation for the ability to pay rule is significant, indicating differences in unobservable preferences for that rule; however, the standard deviations for the historical emissions and the need rules are not significant. The results of the Chinese sample show larger unobservable preference heterogeneity as the standard deviations are significant for all three rules. In order to compare the relative importance of the various burden-sharing rules between the two countries, we focus on the estimated WTP for the rules. The WTP is simply the ratio of the effect-coded attribute coefficient and the cost coefficient.

[11] "Effects-coded" means that instead of normalizing the WTP to zero for one of the attribute levels, we normalized the sum of WTP to zero (see, e.g., Louviere et al. 2000).

2.1 Willingness to Pay for the Four Burden-Sharing Rules

The estimated WTP in PPP-adjusted US$ values for the burden-sharing rules are reported in table 4.[12] The first column recapitulates the essential characteristics of each rule—its implied burden for the two country groups to which the United States and China belong, respectively. Since the estimated models included a set of interactions, we calculated WTP at sample means; the standard errors are estimated using the Delta-method.[13] For the Chinese sample, the estimates are made at the population mean for the share of university educated since our sample contained considerably more university educated than the population share.[14]

Table 4 Annual Household WTP in PPP-Adjusted U.S. Dollars for the United States and China

Burden-sharing rule	USA	China
Historical emissions	-9.10**	141.37***
(US 67%; China 18%)	(3.9)	(21.6)
Need	-22.20***	-77.53***
(US 55%; China 38%)	(4.4)	(14.7)
Ability to pay	9.4**	90.26***
(US 47%; China 29%)	(4.4)	(15.6)
Current emissions	21.90***	-154.11***
(US 42%; China 40%)	(4.3)	(26.6)

Standard errors are in parentheses.

*, **, *** denote WTP statistically significant at the 10%, 5%, and 1% levels, respectively.

There are very large differences in the level of WTP between the United States and China: Chinese respondents have on average considerably higher WTP for distributive preferences than U.S. citizens. This is a remarkable result, given that Chinese incomes are about one-third of U.S. incomes on average. This could be because U.S. respondents do not have a strong preference for the burden-sharing rules or that many of them, as a way of protesting against the survey, ignored the burden-sharing rules. At the same time, our major interest is not in the absolute level of WTP, but the preferences for the burden-sharing rules and the comparison between countries with respect to the ranking of the rules.

[12] Yuan 3.4 = US$ 1 at the time of the survey.

[13] For the U.S. sample, the absolute value of the cost coefficient decreases with increasing income. This means that there is a larger disparity in WTP among the burden-sharing rules for the high-income groups because the WTP is the ratio between the attribute coefficient and the cost coefficient. For the Chinese sample, the absolute value of the cost coefficient is actually lowest for the low-income group, which means that they have the largest disparity in WTP across the rules.

[14] This adjustment does not have any major impact on the estimated WTP measures. Unweighted results are available upon request.

The ranking of the burden-sharing rules are very different—almost opposite—in the two countries. For the Chinese respondents, the ranking of the rules in terms of WTP is the same as the ranking of the rules in terms of the costs for the country (see table 2). They have the strongest preference for the rule based on historical emissions, which means the lowest costs for the country, while the current emissions rule is least preferred (i.e., the most expensive rule for China). U.S. respondents have, on the other hand, the strongest preference for the current emissions rule, followed by the ability to pay rule; the need-based rule is the least preferred one. Thus, U.S. respondents also rank the preferences in accordance to the cost for their own country, at least to some extent. The two most preferred rules are the ones that result in the lowest cost for the United States. However, the least preferred rule, the need rule, is actually less costly than the second least preferred rule.

Nevertheless, the two countries are similar in that their respondents express preferences that are strongly correlated with how advantageous a particular rule is for their country. Since the countries have opposite characteristics in terms of income and historical emissions, the same type of group-serving bias would actually lead to opposite preferences in terms of the rules offered.

This finding could explain the difficulties in reaching agreement on the same rule in any negotiation regarding reduction of CO_2 emissions. The difficulty is reinforced by the huge difference in the WTP for the Chinese respondents. The WTP difference between the historical and current emissions rules in the Chinese sample is about $300 (while the difference for the United States is about $44); $300 corresponds to around 2 percent of the annual average household income of the Chinese sample.[15]Although the WTP values are considerably higher in China than in the United States, the relative differences between the WTP estimates across all four rules is about the same: in both countries, the WTP for the most preferred rule is about twice as big as for the least preferred rule, and the rule ranked as the second best has a WTP about half the size of that for the highest ranked rule.

Carlsson et al. (2010) estimated the annual WTP for decreasing the global CO_2 emissions by 60 percent (compared to business as usual) until 2050 to be around $340 in the United States, and around $100 in China. (This study is based on the same sample and survey as this one.) Thus, the WTP values for reducing emissions are considerably larger than the WTP values for different rules in the United States. In China, however, we find that the WTP for one principle,

[15] Two percent seems quite high. Possible explanations for this finding include 1) a large amount of income goes unreported in the Chinese sample; and 2) unfamiliarity with, and disbelief in, the ability of the government to collect or otherwise levy costs they were being asked to pay

compared to another, is as big as the WTP for the climate issue itself. This means that the Chinese feel very strongly about what they perceive as fair rules!

2.2 Willingness to Pay for Different Respondent Groups

In this section, we discuss differences in WTP and ranking of the rules between different groups of respondents within each country. The coefficients and standard deviations of the random parameter model with the interactions are reported in the appendix, in table A3. Table 5 presents the WTP estimates for the different groups of respondents.

Table 5 Annual Household Willingness to Pay in PPP-Adjusted U.S. Dollars for Different Respondent Groups

Rules	United States			China		
	Male	***Female***	***t-test: p-value†***	***Male***	***Female***	***t-test: p-value†***
Historical emissions	-10.9*	-7.4	0.659	112.7***	174.6***	0.025
Need	-24.8***	-19.8***	0.540	-58.7***	-99.4***	0.087
Ability to Pay	10.0	8.8	0.888	91.7***	88.6***	0.898
Current emissions	25.7***	18.4**	0.380	-145.7***	-163.9***	0.631
	No university	***University***	***t-test: p-value†***	***No university***	***University***	***t-test: p-value†***
Historical emissions	-4.9	-18.4***	0.092	138.3***	153.8***	0.570
Need	-21.2***	-24.4***	0.804	-86.3***	-42.3***	0.066
Ability to pay	9.8*	8.6	0.859	96.7***	64.6***	0.199
Current emissions	16.3***	34.3***	0.048	-148.6***	-176.2***	0.472
	Use tax money in US		***t-test: p-value†***	***Use tax money in China***		***t-test: p-value†***
	Do not agree	*Agree*		*Do not agree*	*Agree*	
Historical emissions	-14.2***	-2.7	0.175	160.5***	126.4***	0.216
Need	-16.5***	-29.3***	0.147	-101.4***	-58.8***	0.075
Ability to pay	13.0**	4.9	0.384	116.6***	69.6***	0.062
Current emissions	17.7***	27.1***	0.291	-175.6***	-137.2***	0.318
	Own country should reduce		***t-test: p-value†***	***Own country should reduce***		***t-test: p-value†***
	Do not agree	*Agree*		*Do not agree*	*Agree*	
Historical emissions	-8.4	-9.4	0.921	166.3***	135.1***	0.370
Need	-35.7***	-16.6***	0.068	-103.1***	-71.1***	0.287
Ability to pay	17.2*	6.2	0.325	152.7***	74.5***	0.017
Current emissions	26.9***	19.8***	0.505	-215.9***	-138.6***	0.123
	Temperature has increased		***t-test: p-value†***	***Temperature has increased***		***t-test: p-value†***
	Do not agree	*Agree*		*Do not agree*	*Agree*	
Historical emissions	-8.6	-9.2***	0.952	143.8**	141.3***	0.969
Need	-40.6***	-16.6***	0.026	-98.3*	-76.6***	0.713
Ability to pay	15.8	7.5	0.471	173.3**	86.3***	0.181
Current emissions	33.5***	18.4***	0.180	-228.8**	-151.1***	0.495

† P-values for the t-tests of equal WTP between the categories.

*, **, *** denote WTP is statistically significant at the 10%, 5%, and 1% levels, respectively.

Except for political preferences (which are discussed in more detail below), in the U.S. sample, there are no differences between any of the groups with respect to the ranking of the burden-sharing rules. For example, both males and females in the United States rank the current emissions rule as the best principle, and the need rule as least preferred. However, there are differences in the magnitudes of the WTPs across the different respondent groups. University-educated participants have a significantly higher WTP for the current emissions rule and a significantly lower WTP for the historical emissions rule, compared with other respondents. Thus, there is a group-serving bias in the United States, which is even stronger among the university educated, perhaps because they are more accurate in assessing all of the numbers.

Attitudes towards climate policy also affect the levels of WTP to a large extent in the U.S. sample. Both those who do *not* think that "the United States should decrease their CO_2 level if other countries won't" and those who "do *not* agree that the temperature has increased globally" have significantly lower WTP for the need rule, a rule that favors several of the E.U. countries, India, and countries in Africa.

While gender has no significant impact on the size of the WTP in the U.S. sample, females living in China have significantly higher WTP for the historical emissions rule and significantly lower WTP for the need rule, compared to male respondents. Also, attitudes seem to play a role in explaining the level of WTP (although attitudes and WTP may be two related ways of expressing preferences). Those who agree with the opinion that tax money should not be primarily used to reduce CO_2 in China appear to like the ability to pay rule (which is most costly for the European Union) more than those who want tax money to be primarily used in their own country.

Finally, the preferences of those who believe that the global temperature has increased and those who do not believe it do not significantly differ in the Chinese sample, while the U.S. respondents who are skeptical about climate change have significantly lower WTP for the need rule. This rule favors European Union and poor developing countries and is the second most expensive rule for the United States.

We also estimated two additional models where the burden-sharing attribute coefficients were interacted with political preferences of the respondents. The coefficients and standard deviations of the random parameter model with these interactions are reported in the appendix, in table A4, for the U.S. sample. For the Chinese sample, all interaction terms were insignificant: there were no significant differences in WTP between members and non-members of the communist party, so we do not report any results from that model. The WTP estimates for the various groups in the United States are reported in table 6.

Table 6 Annual Household WTP in PPP-Adjusted U.S. Dollars for Different Political Affiliations in the U.S. Sample

Burden-sharing rule	Democrats	Republicans	Independent	Green party	Other parties
Historical emissions	-3.3	-16.5**	-12.2*	18.5	-6.5
Need	-11.6*	-39.3***	-19.2**	84.7*	-35.1**
Ability to pay	-2.1	16.6*	11.6	-55.6	33.6**
Current emissions	17.1**	39.2***	19.8**	-47.7	8.0

*, **, *** denote WTP is statistically significant at the 10%, 5%, and 1% levels, respectively.

Table 6 shows that political preferences do have a clear impact on the WTP for the burden-sharing rules. Both the ranking of the rules and the size of the WTPs vary across the different U.S. political parties. Green party supporters are most different from the others, not only in environmental attitudes but also with burden sharing. They rank the need rule as most preferred, and the current emissions rule as least preferred. However, their WTP estimates are not statistically significant, probably due to the very small sample size of the Green party.

We also find that the preferences of independent voters are more similar to Republicans than to Democrats. Most of the differences in WTP among the different voters are not significantly different from zero using two-sided t-tests. However, Republicans have significantly different WTP than Democrats for three out of four principles. Furthermore, the difference in WTP between Green party supporters and Republicans for each principle is statistically significant for three out of four principles. Finally, apart from the Green party supporters, the Americans seem to have very strong and homogenous preferences for the current emissions rule.

3. Conclusions

The negotiations on climate change have been halting at best and it is clear that national leaders are nervous about making commitments that may turn out to be very expensive, particularly when they are unsure about the support of their citizenry. Among the many unsettled issues, we considered how the citizens of the United States and China feel about the allocation of emissions mitigation costs among different countries, not as a matter of attitudes, but as trade-offs that will cost them money.

In our choice experiment, we directed the respondents to choose allocation rules (or burden-sharing rules), *given* a 60 percent reduction of emissions (with the same total reduction cost globally). We considered four primary burden-sharing rules in our analysis, according to

each country's 1) historical emissions, 2) income (ability to pay), 3) equal right to emit per person (need), and 4) current emissions. The results from our study suggest there is considerable group-serving bias among both American and Chinese respondents, in that they strongly prefer rules that are advantageous to their respective countries. Because of the position of these countries on historical versus current CO_2 emissions, and with respect to economic development, the rules that these two groups favor are quite different. Specifically, the U.S. respondents prefer the current emissions rule, followed by the ability to pay and the historical emissions rule. The Chinese respondents, on the other hand, prefer the historical emissions rule, while the current emissions rule is the least preferred.

We also investigated whether different respondent groups within each country have different preferences for the burden-sharing rules. We found that university-educated respondents in the United States have a higher WTP for the rule that favors their country and a lower WTP for the rule that is the most expensive for their country, compared to those with lower education. There is, at least for the moment, no sign that greater education would lead to a higher probability of reaching compromise. We also found that people with different political preferences in the United States clearly disagree in their ranking of the burden-sharing rules.

In summary, respondents from both the United States and China prefer the rule that gives their country the most economic advantage, but the Chinese clearly care more about this. In fact, these rules have dramatically different consequences. These differences can be measured in terms of very large financial flows, which highlight the difficulties countries have finding agreement on the same rule. The fact that the Chinese and the U.S. respondents both chose the ability to pay rule as second best may, perhaps, give some faint hope and direction for coming climate negotiations and compromises.

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Appendix

Table A1 Global Emission Reduction, Temperature Increase, and Its Effects

Global emissions reduction	**85% reduction**	**60% reduction**	**30% reduction**
Temperature increase	**2°F increase**	**3°F increase**	**4°F increase**
Harvest	Harvests in countries near the equator decrease by 4%–6%. Harvests in countries in the northern hemisphere increase by 1%–3%.	Harvests in countries near the equator decrease by 10%–12%. Harvests in countries in the northern hemisphere are unaffected.	Harvests in countries near the equator decrease by 14%–16%. Harvests in the northern hemisphere decrease by 0%–2%.
Increased flooding and storms	Small tropical islands and lowland countries (e.g., Bangladesh), experience increased flooding and storms.	Additional low-lying areas in the Americas, Asia, and Africa experience increased flooding and storms.	Populous cities face increased flood risks from rivers and ocean storms. Existence of small island countries is threatened.
Threatened ecosystems	Sensitive ecosystems, such as coral reefs and the Arctic ecosystem, are threatened.	Most coral reefs die. Additional sensitive ecosystems and species around the world are threatened.	Sensitive and less-sensitive ecosystems and species around the world are threatened.

Table A2 Example of Choice Set in the U.S. Survey

Choice 1. Choose between these two alternative ways of decreasing global emissions by 60 percent:

	Alternative 1	**Alternative 2**
Distribution of cost	Share of the world income	Equal emissions per person
Countries with high income and very high emissions (e.g., United States and Canada)	47% 	55% 
Countries with high income and high emissions (e.g., Sweden and France)	16% 	7% 
Countries with low income and medium emissions (e.g., China and South Africa)	29% 	38% 
Countries with low income and low emissions (e.g., Ethiopia and India)	8% 	0%
Yearly (monthly) cost for your household until 2050	$ 336 (28)	$ 168 (14)

I would choose: □ Alternative 1 □ Alternative 2

Table A3 Random Parameter Logit with Household Characteristics and Attitudes

		United States		China	
		Coeff.	**Std. err.**	**Coeff.**	**Std. err.**
Random parameters					
Historical emissions		-0.117	0.106	0.998***	0.265
Need		-0.270**	0.111	-0.755***	0.222
Ability to pay		0.206*	0.118	1.191***	0.246
Fixed parameters					
Cost ×	Low-income	-0.014***	0.001	-0.001**	0.000
	Medium income	-0.010***	0.001	-0.002***	0.000
	High income	-0.007***	0.001	-0.002***	0.000
Heterogeneity in means					
Historical emissions ×	Female	0.036	0.081	0.403**	0.178
	University education	-0.140	0.088	0.101	0.178
	Use tax money in United States/China	0.119	0.087	-0.222	0.179
	Own country should reduce	-0.010	0.104	-0.203	0.227
	Temperature has increased	0.006	0.108	0.016	0.432
Need ×	Female	0.053	0.085	-0.265*	0.153
	University education	-0.034	0.092	0.287*	0.154
	Use tax money in US/China	-0.132	0.091	0.278*	0.155
	Own country should reduce	0.198*	0.109	0.208	0.195
	Temperature has increased	-0.249**	0.112	-0.141	0.383
Ability to pay ×	Female	-0.013	0.090	-0.020	0.159
	University education	-0.012	0.097	-0.209	0.162
	Use tax money in US/China	-0.084	0.097	-0.306*	0.162
	Own country should reduce	-0.114	0.116	-0.509**	0.211
	Temperature has increased	0.086	0.120	0.566	0.418
Standard deviations					
Historical emissions		0.105	0.291	2.259***	0.204
Need		0.144	0.206	1.762***	0.180
Ability to pay		0.390***	0.078	1.894***	0.185
Pseudo R2		0.134		0.133	
No. of individuals		911		1264	

No. of observations	3643	5056

*, **, *** denote coefficient statistically significant at the 10%, 5%, and 1% levels, respectively.

Table A4 Random Parameter Logit with Political Preferences for the United States

		United States	
		Coeff.	**Std. err.**
Random parameters			
Historical emissions		-0.171**	0.080
Need		-0.407***	0.086
Ability to pay		0.172*	0.091
Fixed parameters			
Cost ×	Low-income	-0.014***	0.001
	Medium income	-0.010***	0.001
	High income	-0.007***	0.001
Heterogeneity in means			
Historical emissions ×	Democrats	0.137	0.103
	Independent	0.044	0.111
	Green party	0.363	0.416
	Other party	0.104	0.169
Need ×	Democrats	0.287***	0.109
	Independent	0.209*	0.116
	Green party	1.284***	0.463
	Other party	0.044	0.170
Ability to pay ×	Democrats	-0.194*	0.117
	Independent	-0.052	0.124
	Green party	-0.747	0.462
	Other party	0.175	0.179
Standard deviations			
Historical emissions		0.073	0.390
Need		0.126	0.232
Ability to pay		0.384***	0.077
Pseudo R2		0.133	
No. of individuals		911	
No. of observations		3634	

Standard errors are in last column.

*, **, *** denote coefficient statistically significant at the 10%, 5%, and 1% levels, respectively.