Perceived Relative Income and Revealed Preferences for Clean Air*

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Pre-Analysis Plan
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1 Research Objective

We run an online survey experiment with a sample from India to primarily study the relationship between perceived relative income and revealed preferences for environmental quality.

Main Research Questions:

RQ-1 What is the impact of perceived own relative income on revealed preferences for environmental quality?

We will answer RQ-1 by exogenously varying the perceived relative income of participants, exploiting a specific type of the base rate fallacy, as explained below. Following the manipulation, participants can voluntarily contribute part of their survey reward to a pro-environmental NGO in India.

RQ-2 What is the impact of informing participants about official statistics regarding their relative income on revealed preferences for environmental quality?

To answer RQ-2, we will inform participants of the income decile their household belongs to in their state of residence, according to representative annual income data (2019 to 2020) provided by the Indian Ministry of Labour.

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Auxiliary Research Questions:

In addition to our main research questions, we study a number of stated outcome variables. Specifically, we examine the impact of varying participants' perceived relative income and the impact of informing participants about official statistics concerning their place in the state-specific income distribution on perceived health impacts of air pollution (see AQ-1 and AQ-4), stated preferences for supporting public policies on air pollution reduction (see AQ-2 and AQ-5), and the intended adoption of defensive measures against air pollution (see AQ-3 and AQ-6).

AQ-1 What is the impact of perceived relative income on the perceived health impacts of air pollution?

AQ-2 What is the impact of perceived relative income on stated preferences for supporting public policies on air pollution reduction?

AQ-3 What is the impact of perceived relative income on the intended adoption of defensive mechanisms against air pollution?

AQ-4 What is the impact of informing participants about official statistics regarding their relative income on the perceived health impacts of air pollution?

AQ-5 What is the impact of informing participants about official statistics regarding their relative income on stated preferences for supporting public policies on air pollution reduction?

AQ-6 What is the impact of informing participants about official statistics regarding their relative income on the intended adoption of defensive mechanisms against air pollution?

Furthermore, we will study whether perceived own relative income at baseline is in line with official statistics (see AQ-7) and whether beliefs are updated following the provision of information about the official statistics (see AQ-8). Finally, we test whether the exogenous manipulation of relative income through priming participants on a very poor or very rich household is successful (see AQ-9).

AQ-7 Are there misperceptions in own relative income compared to official statistics?

AQ-8 Do participants update beliefs about their own place in the income distribution after receiving information about official statistics?

AQ-9 Does priming respondents on a very poor or very rich household affect their perception of own relative income?

2 Sampling

2.1 Sampling Frame

Participants will be sampled from the available Indian users of the Amazon Mechnical Turk (MTurk) platform. We aim to collect a total sample size of 2,500 study participants with 500 participants per treatment arm (after applying exlcusion criteria).

To understand the characteristics of the sample on Amazon Mechanical Turk, we conducted a survey with 200 participants in July 2021. That sample is well-balanced across gender and participants are on average 32 years old, ranging from 20 to 62 years. The sample approximates the current age structure of the Indian population. On average, the sample is well educated with 78% holding a Bachelor and 15% holding a Master degree. Moreover, the sample is relatively wealthy with only 33% reporting an annual household income below $2,50,000$ INR (USD $\approx 3,250$, with a GDP per capita at USD 1,927 in 2020 according to the World Bank). Although our sample is not representative of the Indian population at large, we expect it to be a good depiction of the broad social class that has the financial means to (partially) support the costs of policies that aim to reduce air pollution in urban India.

All survey participants listed English as one of their two most preferred languages. Geographically, the sample was mainly concentrated in the South of India with 80% of our survey participants residing in the state of Tamil Nadu and 8% in the state of Kerala.

2.2 Statistical Power

We perform two separate power calculation exercises. First, we consider our main outcome variable, the extensive margin of contributions, *i.e.*, whether respondents voluntarily contribute a positive amount to an Indian NGO that fights air pollution in India. Since the outcome is a binary variable, we base the power analysis on a non-parametric two-sided Wilcoxon-Mann-Whitney test and a logistic parent distribution. Figure 1 illustrates the relationship between the minimum detectable effect (MDE) at a varying total sample size for a significance level of $\alpha = 0.05$ and statistical power of $(1-\beta) = 0.8$.

We aim for a sample size of $N = 500$ per treatment arm (after applying exclusion criteria). When comparing two groups (total sample size of $N = 1,000$), we would be able to detect an effect size of 0.17. Assuming an extensive margin of 0.8 at baseline (80% of all respondents chose to donate) and a standard deviation of 0.4, we would therefore able to detect a change in the extensive margin of 6.8 percentage points. Alternatively

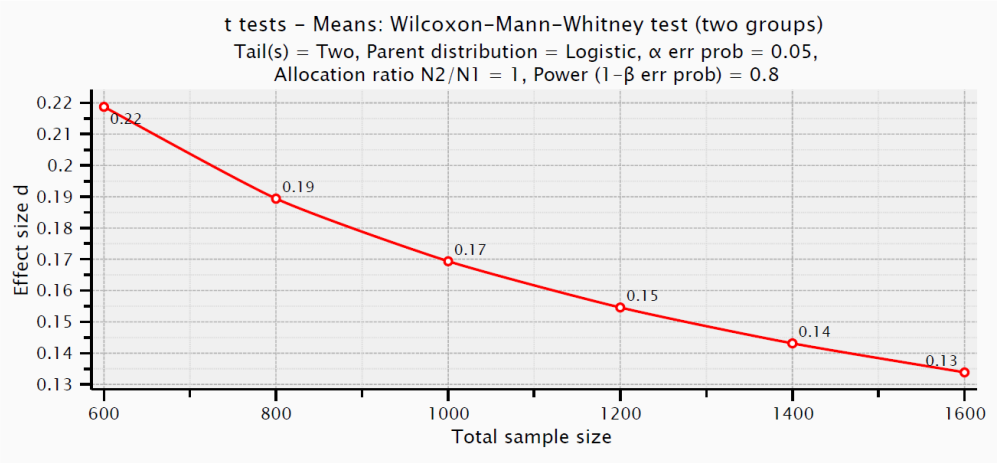

Figure 1: Minimum detectable effect size for the extensive margin of contributions to NGOs

assuming an extensive margin of 0.5 at baseline (50% of all respondents chose to donate) and a standard deviation of 0.5, the MDE would be an 8.5 percentage points change.

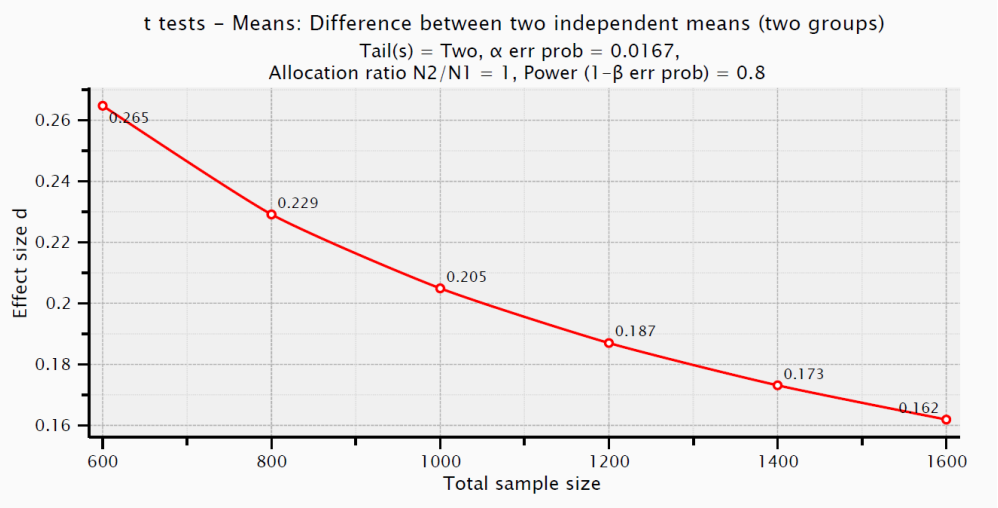

Figure 2: Minimum detectable effect size for secondary outcomes

Second, we consider the three secondary outcome variables for our auxiliary hypotheses. We adjust for multiple hypotheses testing using the Bonferroni correction as a strict method of p-value adjustment (Savin, 1984). Since we standardize our secondary outcome measures, we base the power analysis on a two-sided t-test with a normal parent distribution. Figure 2 illustrates the MDE for a varying total sample size with an adjusted $\alpha = 0.0167$ ($\alpha = 0.05$ adjusted for testing three hypotheses) and 80% power.

Again, considering a sample size of $N = 500$ per treatment arm (total sample size of $N = 1,000$ for the power calculation), we will be able to detect a small effect with an effect size around 0.2.

3 Study Design

3.1 Assignment to treatment

Participants will be randomly assigned to one of five groups following a Latin square design. Table 1 illustrates the treatment variation. To introduce exogenous variation in the perceived own relative income, we prime participants to think of a very rich (TH) or very poor (TL) household residing in the same state. Then, we ask participants to first guess the income decile of the mentioned household and then to guess their own. In a different treatment group (IC), we inform participants about their place in the income distribution in their state of residence according to official income data from 2019-2020 provided by the Indian Ministry of Labour. Additionally, we run a control treatment (no relative income manipulation) and a pure control treatment (no perceived relative income elicitation).

3.2 Incentives and data quality

Participation in the survey experiment is incentivized. In all groups, the compensation for completing the survey experiment is $2.50, including a fixed reward of $1.00 and a bonus of $1.50. Participants finishing the task will be guaranteed the fixed reward, and can choose to contribute any share of their bonus to a pro-environmental NGO. In the analysis, we will exclude participants who match any of the following criteria:

- Answering "No" when asked whether they have paid full attention to the survey and answered truthfully.
- More than 2 attempts per question in the comprehension questions of the reading and comprehension exercise (step 2 in Table 1).
- Nonsensical / automated answers to questions that allow for a free text input.

3.3 Attrition from the Sample

We do not expect any relevant level of attrition from the sample. While participants can end the participation in the survey experiment at any moment, they have a strong incentive to finish the survey as remuneration is conditional on full completion of the task. The attrition rate in our exploratory survey on sample characteristics was negligible.

Table 1: Survey experiment procedure and treatment variation

	PC	C	IC	TL	TH
1. Entry questionnaire	X	X	X	X	X
2. General and personalized air pollution info	X	X	X	X	X
3. Perception: prior relative own income		X	X		
4. Information on official statistics regarding own relative income			X		
5. Perception: posterior relative own income			X		
6. Perception: relative income of comparison group				X	X
7. Perception: own life years lost (LYL)	X	X	X	X	X
8. Perception: general own happiness and health	X	X	X	X	X
9. Revealed preference elicitation (contribution)	X	X	X	X	X
10. Stated support for public policies	X	X	X	X	X
11. Stated adoption of protective measures	X	X	X	X	X
12. Preferences for environmental justice	X	X	X	X	X
13. Preferences for redistribution	X	X	X	X	X
14. Preferences for economic equality	X	X	X	X	X
15. Altruism questions	X	X	X	X	X
16. Political party affiliation	X	X	X	X	X
17. Research purpose disclaimer	X	X	X	X	X
18. Relative income disclaimer				X	X

Notes: The table describes the experimental procedure and the treatment variation therein. PC = pure control, C = control, IC = income correction, TL = priming treatment with a low (poor) comparison, TH = priming treatment with a high (rich) comparison.

4 Implementation

4.1 Instruments

In all groups, participants complete an entry questionnaire and then receive general information on air pollution and its impacts on the economy and human health, as well as personalized information on average air pollution levels and the associated health costs in their state of residence. The treatment variation then implements different ways of eliciting and/or manipulating the participant's perceived relative income. After the treatment variation, we elicit revealed preferences for environmental quality in all groups and a number of stated outcome variables.

4.1.1 General and personalized air pollution information

Participants across all treatment groups receive general information about air pollution. This includes information on:

- The main sources of air pollution

- The measurement of air pollution
- The adverse effects on the economy
- Diseases and other health conditions caused by air pollution
- How the continuous exposure to $PM_{2.5}$ concentrations that exceed the WHO recommendation of 5 $\mu g/m^3$ in the annual average affects average life expectancy. In particular, every 10 $\mu g/m^3$ above the WHO recommendation lowers average life expectancy by about one year. The calculation of this life years lost (LYL) measure follows Ebenstein et al. (2016).

In addition, participants receive personalized information on the average annual pollution level in their state of residence, using data from Hammer et al. (2020). To give a tangible interpretation of this $PM_{2.5}$ value, we apply the conversion of $PM_{2.5}$ exposure to LYL to the state of residence of the participant and provide the information accordingly.

4.1.2 Elicitation and/or manipulation of perceived relative income

We implement different ways of eliciting and/or manipulating the participants' perceived relative annual household income.

- **Group 1 (Pure control – PC)**: In group PC, we neither elicit nor manipulate the perceived relative household income.
- **Group 2 (Control – C)**: In group C, we elicit the perceived relative household income of the participant.
- **Group 3 (Income correction – IC)**: In the IC group, we elicit the perceived relative household income of the participant in their state of residence and then inform participants about the state-specific income distribution in the 2019/2020 Periodic Labor Force Survey (PLFS) by the Indian Ministry of Statistics and Programme Implementation.
- **Group 4 (Treatment: low comparison group – TL)**: In the TL group, we first elicit the perceived relative income of a household with an annual income of 15,000 INR (ca. US $200, a very poor household) and then the perceived own relative household income of the participant.
- **Group 5 (Treatment: high comparison group – TH)**: In the TH group, we first elicit the perceived relative income of a household with an annual income of 1,00,00,000 INR (ca. US $130,000, a very rich household) and then the perceived relative household income of the participant.

In all groups (with the exception of PC), we use the following illustration to have participants think about an income distribution and indicate their own and the comparison household's (if in TL or TH) position:

"Assume the entire population living in your state is divided into 10 income groups, each with the same number of households. The figure below illustrates the 10 groups, ordered from left to right, from the poorest 10% to the richest 10%."

All Indian Households									
Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9	Group 10
10% poorest									**10% richest**

4.1.3 Elicitation of perceived health effects of air pollution

We elicit the perceived health effects of air pollution in two stages. First, we use the state-level average LYL value as a reference point and ask the respondent whether her own LYL due to air pollution is more, less, or the same as the state average. In case participants choose either more or less, participants are asked to specify their own LYL perception on a slider from zero to the state average (for those that chose "less") or on a slider from the state average to twice the state average (for those that chose "more").

4.1.4 Revealed preference elicitation

We observe revealed preferences for environmental quality by giving participants' the opportunity to voluntarily contribute any positive amount of their bonus remuneration of US $1.50 to an Indian NGO that leads air pollution reduction initiatives. Participants can choose among four different NGOs and the option "none". If an NGO is selected, participants can choose the desired amount on a slider from 0 to US $1.50.

4.1.5 Entry questionnaire and stated measures

In the entry questionnaire, participants in all groups are asked to provide demographic information (incl. the reported annual household income that is the reference point for the income correction in the IC group) and indicators useful to understand their health (existing conditions, smoking habit), and their baseline adoption of strategies against pollution exposure (such as the use of air purifiers).

Moreover, we collect several stated outcome variables including support for public policies, the intended adoption of protective measures against air pollution exposure, as

well as preferences for redistribution and environmental justice. We also elicit stated measures for general altruism, inequality aversion, and political orientation.

4.2 Data collection

Data collection is planned to start in May 2022 and will end when the targeted sample size is achieved. Participation is voluntary and anonymous.

5 Outcomes of Interest

5.1 Primary outcomes of interest

1. *Perceived relative income:*
   We directly elicit participants perceived income decile in their state of residence.
   Discrete variable, covering values from 1 to 10.

2. *Misperception of own relative income:*
   We derive a measure for misperceptions of own relative income by the difference between estimated true income decile and participants stated perceived income decile. The measure covers values from $-9 to 9$. The estimated true income decile based on the reported annual total household income in 2021. Answer categories of this question reflect income decile in the state of residence.
   Discrete variable, covering values from -9 to 9.

3. *Contribution to pro-environmental NGO*
   (a) Extensive margin: whether participants chose to contribute any amount to a pro-environmental NGO.
   Binary variable.
   (b) Intensive margin: the absolute size of the contribution.
   Continous variable, covering values from 0 to 1.50 USD.

5.2 Secondary outcomes of interest

1. *Perception of own number of life years lost due to air pollution exposure:*
   (a) 3-point measure: whether participants state they are losing more, the same, or less years of life than the average person in their state.
   Discrete variable, covering values -1, 0, 1.

(b) Perception of own life years lost due to air pollution.
Continuous variable. Respondents answering "less" can choose values between 0 and the state average. Respondents answering "more" can choose values between the state average and two times the state average.

(c) Relative difference between state average and perceived life-years-lost due to air pollution exposure:
Continuous variable, covering values from -1.00 to 1.00.

2. *Stated support for public policies*
We elicit support for the following public policies aimed at reducing air pollution on a 5 point Likert scale ("strongly oppose" ↔ "strongly support"):

- Ban on burning waste and agricultural residues
- Higher vehicle registration taxes and road taxes
- Higher fuel taxes
- Extension or introduction of days when vehicles are not allowed to drive

We standardize the response for all four policies to a mean of 0 and a standard deviation of 1 (see Kling et al., 2007) and accumulate them to form an index for support of public policies.

3. *Stated adoption of defensive measures*
We elicit the likelihood of current and future adoption of the following defensive measures against air pollution on a 5 point Likert scale ("not likely at all" ↔ "very likely"):

- Use an air purifier indoors
- Do preventive medical check-ups
- Change your commute route or time schedule to avoid high pollution areas
- Ventilate rooms frequently

Again, we standardize the response for all four defensive mechanisms to a mean of 0 and a standard deviation of 1 and accumulate them to form an index for intended adoption of defensive mechanisms.

4. *Happiness, life satisfaction, and general health*

(a) Happiness
We elicit current happiness on a 5 point Likert scale ("not likely at all" ↔

"very likely").
Discrete variable, covering values from 1 to 5.

(b) General life satisfaction
We also elicit current life satisfaction with a scale from 1 ("completely dissatisfied") to 10 ("completely satisfied")
Discrete variable, covering values from 1 to 10.

(c) General personal health status
We also elicit general personal health status with a Likert scale ("not likely at all" $\leftrightarrow$ "very likely").
Discrete variable, covering values from 1 to 5.

5.3 General preferences

In order to understand whether the treatment variation interacts with other important observable characteristics, we elicit a set of general preferences. While we do not consider them as outcomes of interest, we describe them in the following:

1. *Environmental justice*
We elicit preferences for environmental justice with two questions that consist of two opposing statements. Answers are collected on a scale from 1 ("I completely agree with the sentence on the left") to 7 ("I completely agree with the sentence on the right").

   (a) (LEFT:) *"Everyone should have equal access to protection measures against air pollution."*
   versus
   (RIGHT:) *"How much one is impacted by air pollution should depend mostly on how much effort she or he puts into reducing the impacts for themselves."*

   (b) (LEFT:) *"All people should put the same effort into reducing air pollution in their district."*
   versus
   (RIGHT:) *"People that are more wealthy should contribute more to reducing air pollution in their district."*

   We standardize the response for both variables to a mean of 0 and a standard deviation of 1 and accumulate them to form an index for preferences for environmental justice.

2. *Preferences for redistribution*
   We elicit preferences for redistribution with two questions that consist of two opposing statements. Answers are collected on a scale from 1 ("I completely agree with the sentence on the left") to 7 ("I completely agree with the sentence on the right").

   (a) (LEFT:) *"Incomes should be made more equal."*
   versus
   (RIGHT:) *"There should be greater incentives for individual effort."*

   (b) (LEFT:) *"Government should take more responsibility to ensure that everyone is provided for."*
   versus
   (RIGHT:) *"People should take more responsibility to provide for themselves."*

   We standardize the response for both variables to a mean of 0 and a standard deviation of 1 and accumulate them to form an index for preferences for redistribution.

3. *Preferences for inequality/inequality aversion*
   We elicit preferences for inequality with two statements where answers are measured on a Likert-scale from 1 ("Strongly agree") to 5 ("Strongly disagree"). The statements are:

   (a) *"The gap between the rich and the poor in India is too large"?*

   (b) *"It is the responsibility of the government to reduce the gap between the rich and the poor"?*

   We standardize the response for both variables to a mean of 0 and a standard deviation of 1 and accumulate them to form an index for inequality aversion.

4. *Altruism*
   We elicit altruism with separate questions:

   (a) Assume you won 1 lakh Indian rupees (1,00,000 INR) in a lottery. Considering your current situation, how much would you donate to a good cause?
   [Slider between 0 INR and 1,00,000 INR in steps of 10,000 INR.]

   (b) How do you assess your willingness to do good for others without expecting anything in return?
   [Likert scale from 1 ("completely unwilling") to 10 ("very willing")]

We standardize the response for both variables to a mean of 0 and a standard deviation of 1 and accumulate them to form an index for altruism.

5. *Political orientation:*
   We elicit political orientation with the following question:
   If an election was held today, which political party would you vote for?

   - Bharatiya Janata Party (BJP)
   - Indian National Congress (INC)
   - All India Trinamool Congress (AITC)
   - Communist Party of India (Marxist) (CPI(M))
   - Nationalist Congress Party (NCP)
   - Bahujan Samaj Party (BSP)
   - Communist Party of India (CPI)
   - National People's Party (NPP)
   - Other
   - I would not vote
   - Prefer not to say

6 Balance Testing

We will perform balance tests between the control groups and the three treatments IC, TH and TL respectively on the following variables.

7 Hypotheses and Testing

We introduce the following notation: Let I_i be the household's income decile and D_i be the revealed preference for environmental quality of for individual i. Also, let LYL_i be the health effect due to air pollution exposure, PP_i be the support for public policies, and DM_i be the adoption of defensive measures. Throughout, we denote state averages with the subscript s and perceived or stated measures with the superscript p. Treatment indicators are C (control), IC (income correction), TL (low/poor comparison), and TH (high/rich comparison) as described in Table 1.[1]

[1]For most of our hypothesis section, we omit the pure control group PC as it is only needed to test for an income framing effect, see section 7.2.5.

Table 2: Balance variables

Name	Definition
State	Set of state dummy variables
Rural	Dummy variable for rural residence
Age	Reported age
Female	Dummy variable for female participants
Education	Set of summy variables for each education level*
Household income	Reported annual household income in 2021
Household size	Number of people living in the household
Unemployed	Dummy variable indicating participants that are currently unemployed
Health risk index	Index variable of standardized equally weighted variables**
Past illnesses index	Dummy variables for a list of health conditions***

Notes: * Available levels: "no or only primary school", "secondary school", "vocational training or bachelor", "Masters degree or higher". ** The index will be based on answer to: "using a kerosene or gas lamp", "using dung cakes, wood, coal or kerosene for cooking", "cooking in the main living area", "not owning an air purifier", "not engaging in any defensive measures against air pollution at home", "exercising once per month or less", "smoking". *** The categories include: "allergies", "high blood pressure", "lung disease", "diabetes".

7.1 Main analysis: The effect of perceived relative income on revealed preferences for environmental quality

To answer RQ-1, we study the effect of a change in perceived relative income on revealed preferences for environmental quality D_i. Using the C, TH, and TL groups, we estimate:

$$D_i = \alpha_s + \delta \cdot I_i^p + X_i'\Gamma + \epsilon_i. \tag{1}$$

X_i is a vector of unbalanced observable characteristics and ϵ_i is an idiosyncratic error term. α_s are state fixed effects. Errors will be clustered at the state level.

We will use the random variation induced by the TL and TH treatments to instrument for perceived relative income and estimate Equation (1) with an instrumental variable approach. The first stage is given by:

$$I_i^p = \alpha_s + \theta_1 \cdot TL + \theta_2 \cdot TH + X_i'\Gamma + \varepsilon_i. \tag{2}$$

We will also run the reduced form model to estimate the impact of the treatment on stated and revealed preferences for environmental quality:

$$D_i = \alpha_s + \delta_1 \cdot TL_i + \delta_2 \cdot TH_i + X_i'\Gamma + \epsilon_i. \tag{3}$$

We formulate the following null hypothesis that we test with the two stage approach

outlined in equations (1) and (2):

Hypothesis 1 *On average, participants' perceived relative income does not affect revealed preferences for environmental quality, i.e.,*

$$\delta = 0.$$

Moreover, we will study the effect of the IC treatment on the revealed preference D_i. Using only the C and IC groups, we will estimate the following model,

$$D_i = \alpha_s + \beta \cdot IC_i + X_i'\Gamma + \epsilon_i \tag{4}$$

and formulate a null hypothesis that we test by estimating Equation (4):

Hypothesis 2 *On average, there is no effect of the income correction treatment on revealed preferences for environmental quality, i.e.,*

$$\beta = 0.$$

The sign of the relationship between a perceived income correction and revealed preferences is ex-ante ambiguous as positive and negative effects of the shift in perceived income may cancel out in the population average. We will run a heterogeneity analysis to study differences in revealed preferences between respondents corrected upwards, respondents corrected downwards, and those that had a correct perception to begin with: We estimate,

$$D_i = \alpha_s + \beta_1 \cdot IC_i^{\text{upwards}} + \beta_2 \cdot IC_i^{\text{downwards}} + \beta_3 \cdot IC_i^{\text{correct}} + X_i'\Gamma + \epsilon_i \tag{5}$$

and formulate the following null hypotheses that we test with equation (5):

Hypothesis 3 *On average, there is no effect on revealed preferences when correcting perceived income upwards, i.e.,* $\beta_1 = 0$.

Hypothesis 4 *On average, there is no effect on revealed preferences when correcting perceived income downwards, i.e.,* $\beta_2 = 0$.

Hypothesis 5 *On average, there is no effect on revealed preferences when perceived income is correct to begin with, i.e.,* $\beta_3 = 0$.

7.2 Auxiliary analysis

7.2.1 The effect of perceived relative income on perceived health effects of air pollution / stated support for public policy / intended adoption of defensive measures

To answer AQ-1, AQ-2, and AQ-3 we study the effect of a change in the perceived relative place in the income distribution on the perceived personal health effects of air pollution, on the stated support for public policy, and on the intended adoption of defensive measures against air pollution exposure. Letting y_i^p denote the respective outcome variable (LYL_i^p, PP_i^p, and DM_i^p) and using only the C, TH, and TL groups, we estimate:

$$y_i^p = \alpha_s + \gamma_1 \cdot I_i^p + X_i'\Gamma + \epsilon_i. \tag{6}$$

Equation (6) suffers from endogeneity issues, as both I_i^p and the respective outcome y_i^p could be explained by a series of omitted variables. Therefore, we use the priming treatment manipulation to capture exogenous variation in the perceived place in the income distribution and instrument I^p with the random assignment to the TL or TH group. The first stage will then be given by:

$$I_i^p = \alpha_s + \theta_1 \cdot TL + \theta_2 \cdot TH + X_i'\Gamma + \varepsilon_i. \tag{7}$$

We formulate a null hypothesis on the effect of perceived income on perceived health effects:

Hypothesis 6 *On average, participants' perceived income does not affect the perception of personal health impacts due to air pollution / stated support for public policies / intended adoption of defensive measures, i.e.,*

$$\gamma_1 = 0.$$

We test Hypothesis 6 for each of three outcome variables by running the two stage model described by equations (7) and (6). Standard errors will be corrected for multiple hypothesis testing.

Additionally, we will run a reduced form model to assess the impact of the priming treatments on the respective outcome y_i^p:

$$y_i^p = \alpha_s + \beta_1 \cdot TL + \beta_2 \cdot TH + X_i'\Gamma + \epsilon_i. \tag{8}$$

Moreover, we will study the effect of the IC treatment on LYL_i^p, PP_i^p, and DM_i^p. For this analysis, we will rely on the C and the IC groups. We will estimate the following model,

$$y_i^p = \alpha_s + \beta \cdot IC_i + X_i'\Gamma + \epsilon_i \tag{9}$$

and formulate a null hypothesis that we test by estimating equation (9):

Hypothesis 7 *On average, there is no effect of the income correction treatment on perceived health effects due to air pollution / stated support for public policies / intended adoption of defensive measures, i.e.,*

$$\beta = 0.$$

Equivalent to our analysis in Section 7.1, the sign of the relationship between a perceived income correction and the respective outcome y_i^p is ex-ante ambiguous as positive and negative effects of the shift in perceived income may cancel out in the population average. We will run a heterogeneity analysis to check differences in perceptions across respondents corrected upwards, respondents corrected downwards, and those that had a correct perception to begin with:

$$y_i^p = \alpha_s + \beta_1 \cdot IC_i^{\text{upwards}} + \beta_2 \cdot IC_i^{\text{downwards}} + \beta_3 \cdot IC_i^{\text{correct}} + X_i'\Gamma + \epsilon_i. \tag{10}$$

The estimated βs coefficients are expected to be biased due to omitted variables (endogeneity) but will nevertheless be useful for formulating policy implications. We formulate the following null hypotheses that we test with Equation (10) for each of the three outcome variables:

Hypothesis 8 *On average, there is no effect on perceived health outcomes due to air pollution / stated support for public policies / intended adoption of defensive measures when correcting perceived income upwards, i.e.,* $\beta_1 = 0$.

Hypothesis 9 *On average, there is no effect on perceived health outcomes due to air pollution / stated support for public policies / intended adoption of defensive measures when correcting perceived income downwards, i.e.,* $\beta_2 = 0$.

Hypothesis 10 *On average, there is no effect on perceived health outcomes due to air pollution / stated support for public policies / intended adoption of defensive measures when perceived income is correct to begin with, i.e.,* $\beta_3 = 0$.

7.2.2 Relative income perception at baseline

To address AQ-7, we test whether respondents' perception of the decile to which their own household belongs to in the state income distribution (I_i^p) corresponds to official statistics. For this purpose, groups C and IC form the baseline with unaffected apriori perceptions.[2] We test whether the relative income perception I_i^p of participants at baseline is different from their true relative income I_i as evaluated by comparing their reported income (during the entry questionnaire) to the representative income distribution in the PLFS.

Hypothesis 11 *On average, individuals at baseline perceive their own household's place in the state income distribution in line with official statistics, i.e.,*

$$|I_i^p - I_i| = 0.$$

We test Hypothesis 11 with a two-sided t-test.

7.2.3 Updating of relative income beliefs

After eliciting prior beliefs on the household's relative place in the state income distribution in the IC group, we inform participants of their household's position according to the PFLS. After informing them, we repeat the elicitation of the belief about the household's relative place in the state income distribution. To address AQ-8, we test whether the posterior relative income perception I_i^{pp} of participants is different from their prior I_i^p. Using only the IC group, we formulate a null hypothesis:

Hypothesis 12 *On average, there is no difference in prior and posterior beliefs about the household's place in the state income distribution, i.e.,*

$$|I_i^{pp} - I_i^p| = 0.$$

We test Hypothesis 12 with a two-sided t-test.

7.2.4 Priming treatment manipulation check

We aim to manipulate participants' place in the income distribution with the use of two comparison households (extremely rich or extremely poor). We expect that participants

[2]Participants in the income correction group receive an ex-post treatment as opposed to the apriori manipulation that is provided in the two priming treatment.

primed with the rich household perceive their own household to have a lower place in the income distribution compared to participants in the control group due to base rate fallacy. In contrast, we expect participants primed with the poor household to perceive their own household to have a higher place in the income distribution compared to participants in the control group.

To test AQ-9, we again pool the C and IC groups to form the baseline. To study treatment differences with respect to the perceived relative income, we use the following specification:

$$I_i^p = \alpha_s + \beta_1 \cdot TL_i + \beta_2 \cdot TH_i + X_i'\Gamma + \epsilon_i. \tag{11}$$

We formulate two null hypotheses on the effect of the priming treatments that will both be tested with equation (11):

Hypothesis 13 *On average, individuals in the low priming group have the same perception as individuals at baseline, i.e.,*

$$\beta_1 = 0$$

and

Hypothesis 14 *On average, individuals in the high comparison group have the same perception as individuals at baseline, i.e.,*

$$\beta_2 = 0.$$

7.2.5 Income priming effect

In all experiment groups, apart from PC, we elicit LYL_i^p after eliciting our I_i^p. This might prime participants with respect to a potentially existing relation between the two variables. To test for a potential priming effect, we can compar the LYL_i^p average between the C and PC group. Only using the C and PC groups, we estimate,

$$LYL_i^p = \alpha_s + \beta \cdot PC + X_i'\Gamma + \epsilon_i \tag{12}$$

and formulate a null hypothesis that we test with equation (12):

Hypothesis 15 *There is no framing effect of the perceived income elicitation on perceived health effects of air pollution, i.e.,*

$$\beta = 0.$$

8 Exploratory Analyses

Conditional on the analysis of our main hypotheses, we can conduct the following exploratory analysis.

Priming manipulation

We test the priming treatments' effect on perceived income, see Hypotheses 13 and 14. Conditional on rejecting one or both of the hypotheses, we will directly compare average perceived income in the two comparison treatments, *i.e.*, we will test whether $\beta_2 = \beta_3$ in equation (11).

Heterogeneous effects of income correction

In addition to testing Hypotheses 3, 4, and 5, we will examine whether being below (income groups 1 to 5) or above (income groups 6 to 10) the median of the state-specific income distribution explains further heterogeneity in equation (5) describing the effect on revealed preferences for environmental quality. Furthermore, we aim to conduct heterogeneity analyses with respect to the strength of the correction (*i.e.,* the number of income decile an individual is being corrected upwards or downwards).

The same rationale applies to the analysis of the income correction treatment effect described in Section 7.2.1.

Potential Channels

To have a better understanding about the channels through which the treatments affect outcomes, we test for potential heterogeneous treatment effects. In particular, we expect that the set of general preferences (as introduced in section 5.3) may explain variation in treatment effects across participants. Hence, we will separately interact the elicited general preferences with a set of treatment dummies.

Denoting a general preference variable or index as M^k, with $k \in \{1, 2, 3, 4, 5\}$ for each preference, we estimate:

$$D_i = \alpha_s + \delta_1 \cdot TL_i + \delta_2 \cdot TH_i + \delta_3 M_i^k + \delta_4 TL_i \times M_i^k + \delta_5 TH_i \times M_i^k + X_i'\Gamma + \epsilon_i. \quad (13)$$

The δ_4 and δ_5 coefficients will indicate whether the treatments effectiveness (of TL and TH respectively) varies with the strength of the elicited general preferences.

References

Ebenstein, A., Lavy, V., and Roth, S. (2016). The long-run economic consequences of high-stakes examinations: Evidence from transitory variation in pollution. *American Economic Journal: Applied Economics*, 8(4):36–65.

Hammer, M. S., van Donkelaar, A., Li, C., Lyapustin, A., Sayer, A. M., Hsu, N. C., Levy, R. C., Garay, M. J., Kalashnikova, O. V., Kahn, R. A., et al. (2020). Global estimates and long-term trends of fine particulate matter concentrations (1998–2018). *Environmental Science & Technology*, 54(13):7879–7890.

Kling, J. R., Liebman, J. B., and Katz, L. F. (2007). Experimental analysis of neighborhood effects. *Econometrica*, 75(1):83–119.

Savin, N. E. (1984). Multiple hypothesis testing. *Handbook of econometrics*, 2:827–879.