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Recency and projection biases in air quality valuation by Chinese residents☆

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HIGHLIGHTS

- Examine how recency and projection biases affect air quality valuation using responses to subjective well-being questions
- Valuation is higher for one-day improvement compared to one-year improvement in air quality
- These biases call into question the appropriate temporal scale when conducting air quality valuation studies
- Policymakers could exploit these biases to introduce more stringent policies during periods of intense air pollution

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ABSTRACT

We combine survey responses to subjective well-being (SWB) questions with air pollution data to recover Chinese residents' valuation of air quality improvements. Motivated by theoretical models of 'projection bias' and 'recency bias', we posit that one's SWB (and valuation) is affected disproportionately by more recent experiences with air pollution, even though long-term air pollution is more detrimental to one's actual well-being. Towards this end, we find that valuation for a unit improvement in $PM_{2.5}$ is twice as large when air quality on the day of survey is used as the explanatory variable compared to air quality averaged over a year. Our findings have far-reaching research and policy implications as they call into question the appropriate temporal scale of air quality conditions when conducting valuation studies or policy evaluations. Furthermore, our results imply that policymakers could conceivably exploit this behavioral bias to introduce more stringent air quality management policies when air quality is extremely poor.

1. Introduction

Air pollution is fast becoming a major public health challenge especially across the developing world. It is estimated that in 2012, 3.2 million or one in nine premature deaths in low- and middle-income countries were attributable to outdoor air pollution (WHO, 2014). Unfortunately, this challenge is projected to intensify as policymakers struggle to keep air quality from worsening (OECD, 2012). Nowhere is the problem of air pollution most prominent in China where decades of sterling economic growth were accompanied by corresponding deterioration in the environment (Z. Chen et al., 2013; Diao et al., 2009; Ebenstein et al., 2015; Huang et al., 2012; Wu et al., 2017). The Chinese government has been taking the fight to air pollution, but with varying degrees of success as they seek to improve air quality without sacrificing economic growth (Xie et al., 2016; Q. Zhang et al., 2012). One of the key ingredients that will aid policymakers in this battle of 'trade-offs' is the accurate valuation for air quality improvements. Access to such valuation will help decision-makers better weigh the benefits of reducing air pollution against its costs. Perhaps recognizing the urgent need for accurate valuation of air quality improvements, research on air quality valuation in China has increased in recent years. These studies can be generally categorized by the techniques in which valuation was elicited:

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stated preference (Dong and Zeng, 2018; Du and Mendelsohn, 2011; Hammitt and Zhou, 2006; Lin and Tan, 2017; Chuanwang Sun et al., 2016a; Chuanwang Sun et al., 2016b; Tan and Zhao, 2014; Tang and Zhang, 2016; G. Wang et al., 2016; H. Wang and Mullahy, 2006; K. Wang et al., 2015; X. Wang et al., 2006; Y. Wang and Zhang, 2009; Wei and Wu, 2017; Yu and Abler, 2010); property hedonic (D. Chen and Chen, 2017; Zheng et al., 2014; Zheng and Kahn, 2008; Zheng et al., 2010); averting expenditures (Barwick et al., 2017; Ito and Zhang, 2016; J. Zhang and Mu, 2017); happiness (Liu et al., 2018; X. Zhang et al., 2017); and migration (S. Chen et al., 2017; Freeman et al., 2017).

This study departs from the usual valuation techniques and instead uses subjective well-being or self-reported happiness to value air quality improvements. In conducting this study, we expand upon earlier works in two ways. First, air pollution, while undesirable, is often correlated with desirable attributes such as economic opportunities. This is especially true in developing countries where access to jobs are highly valued (Tan-Soo, 2017). Hence, valuation for clean air would be biased downwards if this confounding relationship is not controlled for. Towards this end, we use a wind-based instrumental variable to verify the direction of the confounding relationship and recover causal interpretation of willingness-to-pay for clean air. Second, this is one of the first studies to investigate empirically if valuation of air quality improvement is susceptible to projection or recency biases. From a welfare standpoint, it is obvious that one is better off with year-round improvement in air quality rather than just a month or a day of improvements. However, evidence from behavioral economics and psychology provide fodder to believe that one could possibly place a higher value for the shorter improvement than the longer-term improvement.

Using a household-level representative sample from China, we first find that the relationship between one's self-reported happiness and air quality is indeed confounded. We deploy an instrumental variable strategy by using upwind transmission of pollution to break this confounding relationship and derive unbiased valuation for clean air. Second, we unearth a previously undiscovered relationship between valuation and temporal scale of air pollution. Specifically, we find that the valuation for air quality improvements systematically decreases as we move from daily measures of air quality to annual averaged air quality. This is to say that individuals' valuation for air quality is most strongly influenced by their most recent experiences with air pollution. This finding provides new directions for future work in air quality valuation and insights in air quality management policies.

1.1. Literature review

The logic behind using happiness or well-being data to value air quality improvements is hinged on the assumption that subjective well-being or self-reported happiness is correlated with one's 'utility' or welfare. If we accept this assumption, then we could conceivably estimate an indirect utility function to recover marginal utilities or preference parameters. This technique contains elements of both revealed and stated preference methods. First, the stated preference portion is reflected by respondents' self-reporting of their happiness or well-being level. Second, the revealed preference portion is inferred by the researcher as we obtain air quality measures based on the respondents' residential locations. There is increasing popularity in using subjective well-being to value air quality because self-rated happiness questions are included in most social surveys and air quality information are relatively easier to obtain than before. This method also confers empirical advantage as the recovered marginal willingness-to-pay is a more comprehensive valuation for air quality improvements rather than a lower-bound estimate as seen in many revealed preference studies (Barwick et al., 2017; Ito and Zhang, 2016). In one of the earliest applications of subjective well-being data to air quality valuation, Welsch (2002) used a country-level survey and found that respondents from more polluted countries reported lower levels of happiness. The global average marginal willingness to pay (MWTP) was computed to be US$70 per kiloton of nitrogen dioxide. With the same approach, Welsch (2006) again used a country-level dataset to estimate valuation. The dataset in his second iteration included repeated observations for each country and thus he was able to control for time and spatially invariant factors. Many latter studies, such as Luechinger (2009) and Ferreira et al. (2013), used individual-level panel datasets.[1] As such, they could introduce individual fixed-effects to control for respondent-level heterogeneity. Luechinger (2009) further addressed the endogeneity of air pollution by using pollution from upwind locations as instrumental variable. He found that the MWTP for air quality in Germany is higher after instrumenting, suggesting positive confounding factor (e.g. positive correlation between air pollution and economic opportunities) between air pollution and happiness. Lastly, Levinson (2012) and X. Zhang et al. (2017) applied this method to individual cross-sectional data from the United States and China respectively. However, a key difference between these two studies and the others is that they used air quality on the day of the survey as opposed to an annual average used in other studies.

2. Theoretical model and empirical strategy

This paper is, to the best of our knowledge, one of the first studies to examine if air quality valuation is subjected to projection or recency biases. There are at least two reasons why we believe such a relationship exists. First, from microeconomics theory, the behavioral anomaly of 'projection bias' is formalized in an individual decision-making model (Loewenstein et al., 2003). This gist of 'projection bias' is that individuals project current conditions to their future selves. The canonical example to demonstrate projection bias is excessive grocery purchases on an empty stomach. Similarly, it is also possible that one might 'over' purchase air purifiers (or any other protective equipment) or in other words, have exceedingly high valuation for clean air during periods of bad air quality due to projection bias. Such tendencies have been observed with respect to over-purchase of winter clothing during periods of frigid conditions (Conlin et al., 2007). Recent studies by J. Zhang and Mu (2017) and Cong Sun et al. (2017) provided some evidence to support this hypothesis with respect to air pollution as they found that e-commerce sales of face-masks and air purifiers in China increased by multiple folds during days of severe air pollution. Second, the behavioral economics and psychology literature suggest the existence of 'recency bias', i.e. one's overall experience is much more affected by recent events. For example, Garbinsky et al. (2014) found that end moments of a culinary experience are more influential than the beginning moments in affecting experimental subjects' memory of the entire experience. Similarly, Redelmeier and Kahneman (1996) found that even though all patients incurred similar amount of pain in a colonoscopy examination, those who experienced less pain at the end of the procedure had a more favorable view of the entire examination compared to patients who experienced more pain at the end. In the case of air pollution, this could mean that a respondent reports lower level of happiness if the interview happens to be conducted on a day when air pollution is particularly high.

2.1. Theoretical model

We use a standard microeconomic model to demonstrate how air quality of different time-windows may affect a utility maximizing individual's valuations of air quality improvements. Adapting from Champ et al. (2003), we assume that an individual's utility is given by:

$$U = U(X, L, S) \tag{1}$$

$$S = S(\alpha, Z) \tag{2}$$

[1] It should be noted that Ferreira et al. (2013) stopped after estimating an indirect utility function and did not extend the analysis to value air quality.