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# An experimental test of the solemn oath in eliciting sincere preferences [*]

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**Abstract**

Hypothetical bias is the gap between the hypothetical willingness to pay and the real economic payment. Subjects may overstate or understate their willingness to pay due to strategic behaviour. This bias is common in contingent valuation studies. In this study, we attempt to use a commitment device to correct the bias, in order to elicit sincere preferences. We use a solemn oath in second-price auctions, using both induced valuations and homegrown valuations. Using a random effect panel data model, we draw three conclusions:

(1) there is a gap between subjects' bids and their true willingness to pay due to the violation of both the budget constraint and the participation constraint; (2) oaths in the induced value experiment can increase subjects' bids towards the induced value only given real monetary incentives; (3) oaths can modestly correct the hypothetical bias in the homegrown valuation experiment.

Keywords: Preference elicitation, Oath, Second-price auction, Induced-value experiment, Homegrown valuation

JEL Classification: C90, Q51, D44

"A promise is a promise. Lieutenant Dan." Forrest Gump (1994)

# 1 Introduction

Eliciting sincere preferences for environmental goods remains a challenge. The classic problem of hypothetical bias is that people overestimate their hypothetical willingness to pay for environmental goods (e.g. Bohm (1972); Bishop and Heberlein (1986);Murphy et al. (2005);Ehmke et al. (2008)). Jacquemet et al. (2013) propose using the social psychology theory of commitment to create a social context of truth-telling, showing that making commitments can induce people to keep their promises. They also argue that commitment is stronger if it is made freely, is publicly expressed, and has consequences for the subject. Jacquemet et al. (2013) asked one group of subjects to take a written oath freely before a second-price auction. They found that the oath-treatment group performed better than the hypothetical-treatment group and the monetary-incentives treatment group in an induced value experiment. They also found that the oath-treatment group bid higher than the monetary-incentives treatment group and bid lower than the hypothetical-

treatment group in a homegrown-value experiment (see also Jacquemet et al. (2017)).

Social psychologists studying commitment theory find that people tend to fulfil their commitments. Geller et al. (1989) found that safety belt use on a university campus was substantially increased by offering faculty, staff, and students buckle up pledge cards to sign and return. Wang and Katzev (1990) found that when subjects were asked to sign a pledge card to recycle paper, they recycled 47% more paper than before the treatment. Similar results are also found in economics research. Studies focusing on pre-experiment communication found that people can make credible promises in games (Ostrom et al. (1992);Ellingsen and Johannesson (2004)).

This study uses a second-price auction to test if the solemn oath can eliminate the hypothetical bias in eliciting preferences for environmental goods. We find that in the induced-value experiment, a solemn oath reduces the hypothetical bias, but the oath treatment is not perfectly demand-revealing. Real monetary incentives are perfectly demand-revealing both with and without the oath. In the homegrown value experiment, the oath reduces the hypothetical bias and helps correct the non-binding participation constraint problem. However, the effect is smaller than that found by Jacquemet et al. (2013).

Our paper contributes to the literature on oaths in environmental valuation by testing it in a cultural context less frequently studied in the literature. Economists are calling for more replication of experimental studies. Aarts et al. (2015) replicates studies in psychology and finds that approximately one-third to one-half of the original findings are also observed in replication studies. Maniadis et al. (2014) argue that some independent replications can greatly increase the chance the original study is true. Camerer et al. (2016)

make similar efforts to replicate studies in economics and find that approximately two-thirds of experiments studied yield results similar to the originals. The cornerstone of experimental science is replication (Fisher (1935)). Our study tests the solemn oath proposed by Jacquemet et al. (2013) in China. Some researchers have tested the effect of an oath script in other cultures such as the Netherlands and Spain with success (de Magistris and Pascucci (2014);Demagistris et al. (2013)). Chinese culture is different from European cultures , which may create different results for our study. Chinese society is more collective, while European societies are more individualistic (Kim and Markus (1999)). The effects of taking a solemn oath individually may be different for Chinese subjects than they are for European subjects. Our study differs from Carlsson et al. (2013), which uses a contingent valuation study in both China and Sweden. They find that an oath script lowers Chinese subjects' willingness to pay for climate change mitigation, compared with a hypothetical treatment. However, the effect of the oath is different for Chinese and Swedes. Our study uses a controlled lab experiment with induced value. This allows us to compare subjects' bids under the oath with their true preferences.

## 2  Experimental Design

This experiment follows Jacquemet et al. (2013) and uses a solemn oath as a commitment device to see whether subjects bid sincerely in a second-price auction. This is an ex-ante approach to correct both the hypothetical bias in a hypothetical survey and the downward bias in a real economic commitment auction. The experiment has two parts: an induced value auction and a homegrown value auction. Each part has four treatments: (1) baseline-

hypothetical, (2) oath, (3) monetary incentives, and (4) monetary incentives and oath . We recruit 72 student subjects, and each treatment has 18 subjects which are randomly divided into two groups. We conducted the experiments in March 2017 in the campus of Xian Jiaotong University, China. The experimental design and the main features of the experiments are summarized in table 1.

Table 1: Experiment Design

| Treatment | Experiment type | Rounds | Payment | Description |
|---|---|---|---|---|
| Baseline-hypothetical | IV | 9 | fixed participation fee | no commitment and no monetary incentives |
| | HG | 5 | fixed participation fee | |
| Monetary incentives | IV | 9 | fixed participation fee+accumulated earnings | real monetary incentives |
| | HG | 5 | fixed participation fee+earnings in the random drawn round | |
| Oath | IV | 9 | fixed participation fee | taking an oath |
| | HG | 5 | fixed participation fee | |
| Monetary incentives and oath | IV | 9 | fixed participation fee+accumulated earnings | taking an oath and real monetary incentives |
| | HG | 5 | fixed participation fee+earnings in the random drawn round | |

# 3 Induced Value (IV) Auction

## 3.1 Design of the IV experiment

Each treatment consists of two sessions. Each session has 9 bidders participating in 9 rounds. In all sessions, subjects are told that they will get a participation fee of 30 RMB. An on-campus job in Xi'an is usually paid 8 RMB per hour. The currency used for the auction is Experimental Currency Units (ECU), and 3 ECU=1 RMB. The induced value is the resale price. The profit of the winner equals the induced value minus the market clearing price.

In treatments with the oath, the experimenter asks each subject to voluntarily sign a solemn oath in a separate room before he or she participates in the experiment. Among the 18 participants for both the oath-only treatment and the oath-with-incentives treatment, all signed the oath except for one. Since the experiment is anonymous, we cannot exclude the data from our analysis. Figure 1 is a sample of the solemn oath. After subjects enter the lab, they are asked to randomly choose tables and sign the consent forms. The experimenter reads the instructions aloud, and all questions are addressed before the experiment starts. Subjects' earnings in the experiment equal the fixed payment of 30 RMB plus the accumulated earnings in each round in the monetary-incentives treatment.

西安交通大学
XI'AN JIAOTONG UNIVERSITY

宣 誓 书

**SOLEMN OATH**

我以自己的荣誉起誓，在整个实验中，我将

**I swear upon my honor that, during the whole experiment, I will:**

说真话并且在拍卖过程中提供诚实的答案。

**Tell the truth and always provide honest answers.**

西安交通大学
XI'AN JIAOTONG UNIVERSITY
签名 _____    日期 _____
**Signature**         **Date**

Figure 1: oath script

## 3.2 Results

*Result 1: taking a solemn oath reduces the hypothetical bias.*

*Support:* Figure 2 shows the total demand revelation, which is the ratio of the revealed total demand and the induced total demand. The closer the total demand revelation is to 1, the higher the total demand revelation. The demand revelation for the baseline is 1.46. Subjects bid 46% higher than their induced values on average, and there is a hypothetical bias. The demand revelation for treatments with monetary incentives and monetary
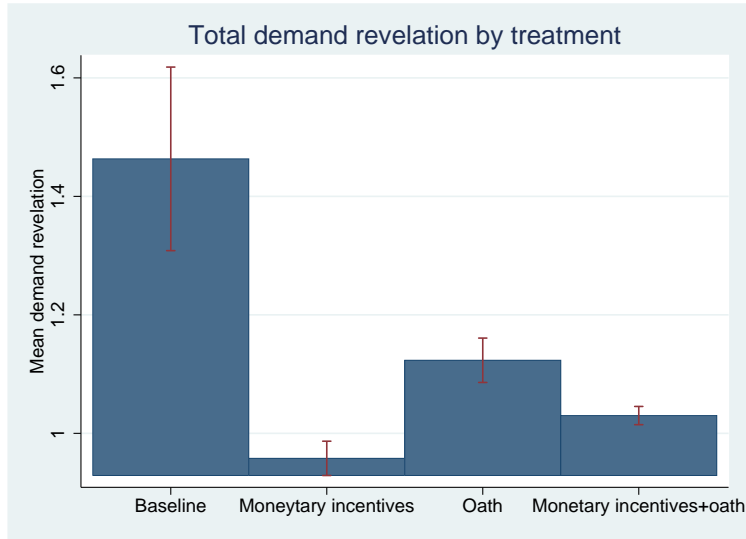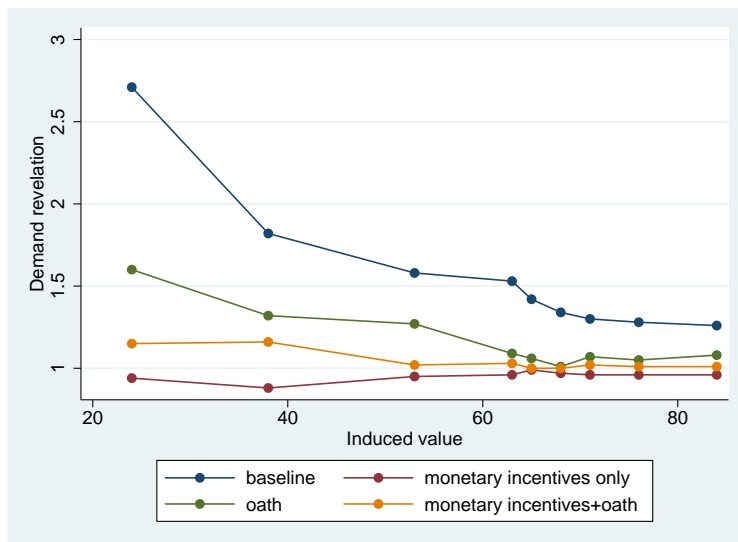
Figure 2: Total demand revelation



Figure 3: Demand revelation by induced value

incentives with oaths are 0.96 and 1.03 respectively. Subjects' bids are very close to their induced values on average. In the oath treatment, the demand revelation is 1.12. This evidence suggests that taking an oath can reduce the hypothetical bias.

Figure 3 shows the demand revelation by induced value. We can see the demand revelation increases with the induced value. This is because subjects overbid under the induced value to increase their chances of winning. When the induced value is 24, subjects in the oath treatment have better demand revelation (160%) than the baseline-hypothetical treatment (271%). Again, this suggests that taking an oath can mitigate hypothetical bias.

*Result 2: The monetary-incentives treatment is perfectly demand-revealing.*

*Support:* We use a random effect panel data model as follows to test the demand revelation.

$$b_{it}^* = \beta v_{it} + \alpha + \phi_t + \alpha_i + \epsilon_{it} \tag{1}$$

where $b_{it}^*$ is subject $i's$ bid in round $t$; $v_{it}$ is subject $i$'s induced value at round $t$; $\alpha$ is the constant; $\phi_t$ is the fixed round effect; $\alpha_i$ is the subject random effect, which follows the normal distribution with a mean of zero and a variance of $\delta_\alpha^2$. The estimation result is set forth in table 2.

We use the Wald test to study the demand revelation along the demand curve: $H_0 : \beta = 1, \alpha = 0, \phi_t = 0, \forall t$. The results reject the null hypothesis that the baseline ($p = 0.000$), the oath treatment ($p = 0.001$), and the treatment employing monetary incentives with oath ($p = 0.021$) are perfectly demand-revealing. The results fail to reject the null hypothesis that the monetary incentives are perfectly demand-revealing (p=0.283).

Table 2: IV bidding behavior: Individual random effect model estimation

| | Parameter estimation | | | |
|---|---|---|---|---|
| | Baseline-hypothetical | Monetary incentives | Oath | Monetary incentives+oath |
| $v_{it}$ | 0.691*** | 0.994*** | 0.797*** | 0.928*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Constant | 31.80*** | -4.03 | 21.34*** | 4.66*** |
| | (0.001) | (0.238) | (0.000) | (0.021) |
| Round Dummies | YES | YES | YES | YES |
| $\sigma_\mu$ | 30.17*** | 4.50*** | 9.03*** | 2.49*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| $\sigma_\epsilon$ | 19.85*** | 9.15*** | 12.90*** | 5.48*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Log-likelihood | -741.69 | -598.98 | -659.35 | -515.07 |

1) $P$ values in parentheses

2) $***p < 0.01, **p < 0.05, *p < 0.1$

# 4 Application: Homegrown valuation

## 4.1 Experiment design

In this experiment, subjects donate to a smog mitigation program initiated by the China Environmental Protection Foundation (CEPF). CEPF, the first non-profit organization in China dedicated to environmental protection, is an NGO which has a special consultative status with the UN's Economic and Social Council (ECOSOC). We auction a picture of Xi'an with a blue sky. The market price of this picture is almost zero, so the good itself will not affect the subjects' donation.

Before the experiment, the experimenter introduces CEPF's smog mitigation project. In this experiment, there are five auction rounds. Bids are restricted to between 0 and 80 RMB. If a subject wins the auction and the market price is larger than his or her experimental earnings, he or she must pay the prize by using out-of-pocket money . Each subject completes a survey about his or her socio-economic characteristics.

## 4.2 Results

*Result 3: Taking an oath increases subjects' bids relative to the monetary-incentives treatment and reduces subjects' bids relative to the baseline-hypothetical treatment. We conclude that taking an oath can modestly correct both the hypothetical bias and the non-binding budget constraint problem .*

*Support:* In the homegrown valuation experiment, the subjects' true preferences are unknown. We compare the number of zero bids and the number of bids which are larger than the experimental earnings.

Figure 4 is the cumulative distribution function of bids in the four treatments. We can see in the oath treatment, 22% of bids are lower than 40
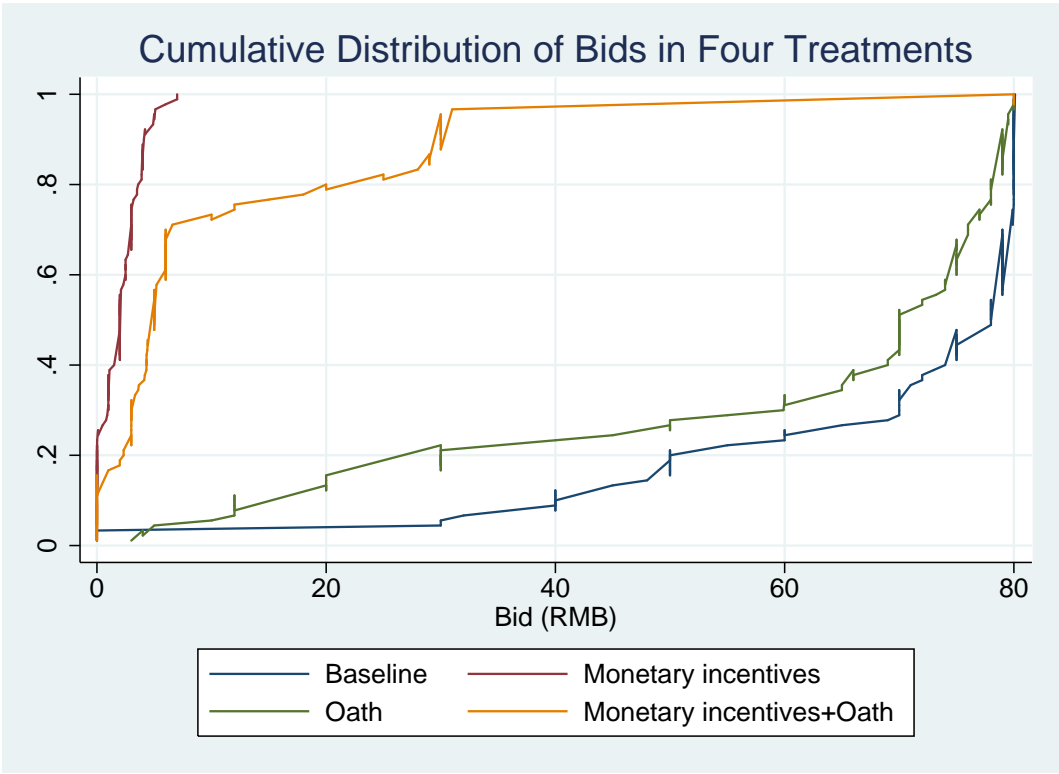
Figure 4: Cumulative Distribution Function of Bids in Four Treatments

RMB. 100% of bids in the monetary incentives treatment and 7% of bids in the baseline-hypothetical treatment are smaller than 40 RMB. The CDF of the oath treatment first order dominates the baseline-hypothetical treatment. The CDF of the monetary incentives treatment first order dominates the oath treatment. From the data, we also find that taking an oath reduces both the number of zero bids and the number of bids that are higher than the experimental earnings.

Using the Wilcoxon rank-sum test, we find that the oath-treatment bids are significantly smaller than those of the baseline treatment (p=0.010), but are significantly greater than the bids of the monetary-incentive treatment (p=0.000). Taking an oath can reduce the hypothetical bias and underbidding in the monetary-incentives treatment.

*Result 4: Gender and pollution information affect bidding behaviour.*

*Support:* We also collect individuals' socio-economic characteristics to study other factors that affect individuals' bids. We include age, gender, knowledge about CEPF, the level of knowledge about air quality index (AQI), and exposure to media coverage about air pollution. Gender and knowledge of CEPF are dummy variables. Our regression shows that females bid significantly higher than males. More information about AQI and media coverage of air pollution increases the subjects' bids.

# 5 Conclusion

Our findings show that the solemn oath has a modest effect in correcting the hypothetical bias in both the induced-value and the homegrown-valuation experiments. It can also mitigate the non-binding participation constraint problem. The effect of the oath in correcting biases in our study is not

as pronounced as it is in Jacquemet et al. (2013). This may be due to cultural differences. Western culture encourages individual expression and Chinese culture encourages community harmony (Kim and Markus (1999)). Individuals in China tend to conform more to social norms and bid more closely to others . The oath has a modest effect in changing individual behaviour in a competitive environment like the second-price auction.

Our study has a limited sample size, which may reduce the reliability of our findings. In addition, we use student subjects, which are less representative of the general population. We recommend future research and a larger and more diversified sample size to test the effect of the solemn oath in eliciting subjects' sincere preferences.

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