Journal of Environmental Management 210 (2018) 51–70

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

Research article

Implicit individual discount rate in China: A contingent valuation study

Hua Wang [a], Jie He [b, *]

[a] Renmin University of China, China
[b] Département d'Économique and GRÉDI, Université de Sherbrooke, Canada

ARTICLE INFO

Article history:
Received 8 August 2017
Received in revised form
13 December 2017
Accepted 21 December 2017

Keywords:
Contingent valuation method
WTP
Discount rate
Payment schedules
Water
China

ABSTRACT

Two contingent valuation (CV) surveys were conducted in Kunming, China, to estimate households' willingness to pay (WTP) for the Panlong River rehabilitation project. The two surveys were conducted using the same procedures and questionnaires except for the payment schedule arrangements, which permitted a calculation of respondents' implicit discount rate. The surveys provided two estimates of WTP, one with a mean of 23 Yuan in monthly payment over 5 years and the other with a mean of 311 Yuan in a lump-sum payment that will cover all the expenses for a period of 5 years. The results produce an estimate of monthly discount rate of 7.6%–12.6% or annual discount rate of 141–315%. The estimates are higher than that reported from those studies conducted in the U.S., but are compatible with that of some other studies. This study also shows that both mean individual WTP and implicit individual discount rates are closely related to household demographic and economic characteristics and environment-related perceptions, as reported in the studies conducted in other countries.

1. Introduction

Many economic decisions involve outcomes that are temporally remote, which makes the use of discount rate necessary in calculation of present values of immediate and delayed costs and benefits. The concept of discounting was first proposed by Fisher (1930) and later derived axiomatically by Koopmans (1960) and Lancaster (1963). In the situation of perfect capital markets, based on the logic of opportunity cost, it is generally assumed that everyone behaves the same way at the margin since firms and individuals borrow or lend until their marginal rate of substitution between consumption today and consumption tomorrow is equal to the market interest rate. Consumers are mostly assumed to be consistent in their inter-temporal choice, which implies that the discount rate remains constant across situations and time.

Three different approaches are described in the literature to determine the implicit discount rate with micro-data. The first one is based on the revealed preference and uses the data of observable behavior/decision on different markets, where consumers face the tradeoffs between current and delayed future payment/income for durable goods (Hausman, 1979; Gately, 1980), credit card balance (Ausubel, 1991), and retirement regime (Warner and Pleeter, 2001). The second approach uses controlled laboratory experiments in which investigators create monetary incentives and invite participants to make choices between postponed/immediate payment/receipt. Their decisions are then used to infer their individual discount rate (Thaler, 1981; Loewenstein and Thaler, 1989; Benzion et al., 1989; Coller and Williamns, 1999; Harrison et al. 2000). The last approach is based on stated preference and the contingent valuation (CV) method. It uses the willingness to pay (WTP) questions to elicit the discount rates. Croker and Shogren (1993) calculated the discount rate based on the WTP of skiers for different length of wait times at ski resorts. Stevens et al. (1997) and Kovacs and Larson (2008) employed various temporal payment schedules in their WTP questions. The WTP estimated for these different payment schedules then allowed the investigators to impute the implicit discount rate.

These implicit discount rates, however, are significantly higher than the market based discount rate generally used in most of the cost–benefit analyses. Hausman (1979) studied the purchase and utilization decisions of US consumers of energy using durables. Based on the tradeoffs between purchase prices and delayed energy payments, he estimated an average consumer discount rate of about 25%. Gately (1980) compared the energy use and initial

* Corresponding author.
E-mail addresses: huawangbeijing@qq.com (H. Wang), Jie.He@USherbrooke.ca (J. He).

https://doi.org/10.1016/j.jenvman.2017.12.058
0301-4797/

purchase price of refrigerators and found that the implicit discount rate associated with purchase of cheaper and more energy-consuming models can be as high as 130–450%, according to the predicted future energy price. Stevens et al. (1997) reported weekly rates of 20–34% for movie passes, which represent annual rates of several thousand percentages. The consideration of the potentially excessively high transaction costs of borrowing money at the market rate for sporadic everyday purchases is a possible explanation (Ausubel, 1991). Another possible explanation is the monotonically negative correlation between the mean discount rate with respect to the length of time delay and the size of the involved payment, as reported by Thaler (1981), Benzion et al. (1989), Stevens et al. (1997), and Kim and Haab (2009). However, even in the context where people made tradeoffs between large amounts of immediate versus future income flow over a relatively long period, their behavior still implies relatively high discount rates. Warner and Pleeter (2001) used the military drawdown program of the early 1990s as a natural experiment. They found that although the before-tax break-even discount rate, which equated the present value of the annuity with the value of the lump-sum payment, to be between 17.5 and 19.8%, most of the separates still selected the lump-sum, which revealed individual discount rates ranging till 30%. Stevens et al. (1997), based on two payment schedules of annual payment for five years and lump-sum payment, reported annual discount rate ranging from 50 to 270% for an Atlantic salmon restoration project. Kovacs and Larson (2008) investigated four payment schedules (12 months, 48 months, 84 months, and 120 months) and found that the shorter the payment schedule, the higher the discount rate. They reported a discount rate of around 35% when using the information from all payment schedules proposed in their CV survey, with a 95% confidence interval ranging between 10% and 130%. Bond et al. (2009) used a split sample designs with three payment schedules: one, five and fifteen years, their results gave implicit discount rates arranging from 20% to 100%.

Another interesting finding observed in previous research is that implicit discount rates are specific to individuals. Hausman (1979) and Warner and Pleeter (2001), based on observed real choices, pointed out that the individual implicit discount rate varies with the respondents' socio-demographic characteristics (gender, age, education, income, family size, etc.). Harrison et al. (2000), based on controlled lab experiments, showed that it was reasonable to "assume constant discount rate for specific household types, but not the same rates across households." Croker and Shogren (1993) and Kovacs and Larson (2008), based on contingent valuation studies, also confirmed that the marginal rates of time preference showed high individual specificity.

We have not yet found studies to estimate the implicit individual discount rate for China in the current literature. We believe, however, that directly transferring the findings of other countries to China will be problematic, for the following reasons. First of all, China, as a developing country, has a per capita income that is significantly lower than that of the developed countries. Secondly, China's economic growth during the last decades has been the fastest in the world, which means that there exist investment opportunities with a higher rate of return. Both these reasons may motivate a higher implicit discount rate. Thirdly, China's economic system, although reformed towards a market style since 1980s, still presents various institutional weaknesses. In such a macroeconomic context, Chinese people may feel the necessity to reduce their time horizon in terms of investment and consumption, which may also influence their implicit individual discount rate. Finally, China's economic growth pattern shows great disparity across both regions and individuals. Considering the potential variations in the implicit discount rate associated with socio-demographic profiles, it will also be interesting to see whether the same changing pattern of discount rates also exists in China.

Our study uses two CV surveys to assess WTP for improvement of water quality in Panlong River and calculate the implicit discount rate of people living in Kunming City of Yunnan Province. Two different payment schedules (monthly payment for 5 years vs. a lump-sum payment) were randomly proposed in the WTP survey questions. With the use of multiple bound discrete choice (MBDC) WTP elicitation format and the two-stage estimation approach proposed by Wang and He (2011), the surveys also allowed us to calculate the discount rates specific to respondents with different socioeconomic profiles.

The paper is organized as follows. Section 2 presents the historical, current, and projected water quality in Panlong River and Lake Dianchi. Section 3 discusses the CV surveys used in this paper. The results are reported in Section 4. In Section 5, we report our findings about the implicit discount rates. Section 6 discusses policy implications and concludes.

2. Survey design

A CV study was conducted for the water quality improvement project in Panlong River of Kunming, Yunnan, China, in order to estimate the WTP and implicit discount rate. This study is part of the efforts of the World Bank in doing cost–benefit analyses of the Yunnan Urban Environmental Program in 2007. A good feature of these WTP surveys is that the hypothetical nature of CV surveys can be reduced since it was an actual investment project under preparation and respondents had the opportunity to understand the benefits associated with the project before answering the WTP questions.

The Panlong River is often considered the "Mother River" of Kunming City (Fig. 1); this is the only river that flows from north to south and passes through the entire Kunming City and is commissioned for supplying drinking water to the residents of Kunming City. Although the water in Panlong River is very clean before it flows into the city, it receives a large quantity of runoff from farmland, industrial wastewater, and municipal sewage without pre-treatment during its passage in Kunming; this runoff causes significant pollution of the river water and affects the river bank landscape. The extent of pollution in the downstream of Panlong River is most alarming up to the river mouth that opens into the Lake Dianchi (Fig. 2), also called "Sparkling Pearl of the Plateau," which is the sixth largest freshwater lake in China and is one of the most famous tourist sites in southern China.[1]

The CV surveys used in this paper were conducted in July 2007. Prior to the surveys, several focus group discussions were organized, where the project team consulted with various local community groups, including those working on the investment project, government officers, and local residents. Discussions were held focusing on the perceptions and attitudes towards the local economic and environmental situations, investment project, improvement of environmental quality, as well as possible methods of payments. A draft questionnaire was developed and finalized after three rounds of pre-tests.

In order to better present the project and the outcome, a package of visual aids was developed; examples of the visual aids used, including tables, pictures, and maps, are presented in Appendix 3. The maps show where and how those projects would be implemented; pictures and words are used to present water qualities and changes. A detailed description of the different grades of water quality (grade I to grade V or worse, Appendix 2) and their impacts

[1] More detailed introduction into Dianchi is given in Appendix 1.