ECONOMIC STUDIES

DEPARTMENT OF ECONOMICS
SCHOOL OF BUSINESS, ECONOMICS AND LAW
UNIVERSITY OF GOTHENBURG
192

Environmental and Behavioral Economics - Applications to China

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ISBN 978-91-85169-51-1
ISSN 1651-4289 print
ISSN 1651-4297 online

Printed in Sweden,
Geson Hylte Tryck 2010

To my father and mother

Yanong and Ruyi

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Abstract

Paper 1: "The Effects of an Environmental Policy on Consumers – Lessons from the Chinese Plastic Bag Regulation." To reduce plastic bag litter, China introduced a nationwide regulation requiring all retailers to charge for plastic shopping bags on June 1, 2008. By using the policy implementation as a natural experiment and collecting individual-level data before and after the implementation, we investigate the impacts of the regulation on consumers' bag use. We find that the regulation implementation caused a 49% reduction in the use of new bags. Besides regulation enforcement, consumers' attitude toward the regulation and some consumers' socioeconomic characteristics also affected bag consumption. However, the regulation effects differ largely among consumer groups and among regions and shopping occasions.

Paper 2: "Can Stated Preference Methods Accurately Predict Responses to Environmental Policies? The Case of a Plastic Bag Regulation in China" investigates the validity of using stated preference (SP) estimates to predict policy effects on plastic bag consumption. Before implementation of a plastic bag regulation, when bags were still free of charge, we utilized an SP survey to elicit consumers' contingent bag consumption in certain possible pricing scenarios. Following implementation of the regulation mandating charging for bags, we conducted another survey to collect actual consumption information. We thus have unique data to compare stated and revealed consumption. The comparison results show that consumers' behavioral reactions to a policy change can be predicted reasonably well with SP techniques.

Paper 3: "Household Decision-making in Rural China: Using Experiments to Estimate the Influence of Spouses." Many economic decisions are made jointly within households. This raises the question about spouses' relative influence on joint decisions and the determinants of relative influence. Using a controlled experiment (on inter-temporal choice) we let each spouse make first individual decisions and then joint decisions with the other spouse. We use a random parameter probit model to measure the relative influence of spouses on joint decisions. In general, husbands have a stronger influence than wives. However, in richer

household and when the wife is older than the husband, we find a significantly stronger influence of the wife on joint decisions.

Paper 4: "Easy Come, Easy Go – The Role of Windfall Money in Lab and Field Experiments" investigates the influence of windfall and earned endowment on behavior by conducting a dictator game, where the recipient is a charity organization, in exactly the same way in the laboratory and in the field. We find subjects donate more in both environments if the endowment is a windfall gain. Thus, windfall money is important not only in a lab environment. However, although the experimental design was intended to control for all other effects except environment, we still find differences in behavior between the lab and the field for both windfall and earned endowment. This points to the importance of discussing the environment when interpreting both laboratory and field experiment results as well as of conducting replication studies.

Paper 5: "Windfall vs. Earned Money in the Laboratory: Do They Affect the Behavior of Men and Women Differently?" experimentally investigates how windfall and earned endowments affect behavior differently between genders using a dictator game. In line with previous studies, we find that windfall endowments significantly increase the amount donated. The impact of moving from earned to windfall endowment on behavior is larger for females, yet the gender difference is statistically insignificant. Thus, we do not find evidence that the change in how the endowment is obtained in a laboratory experiment affects male and female behavior differently.

Key words: charitable giving; China; contingent behavior; dictator game; experiment; earned endowment; external validity; field experiment; gender; household decision-making; laboratory experiment; litter; market-based policy; natural experiment; plastic bags; random parameter model; relative influence; revealed behavior; spouses; stated preference; time preferences; windfall money

JEL classification: C91, C93, D10, D12, D64, Q53, Q58

Acknowledgements

Though I can still clearly remember the time when I had just arrived and still do not feel quite done with my work here, the time has already come for me to wrap up my thoughts on what I have accomplished during my years of studying in Sweden. Looking back, when I first came here, I did not have a clear idea about what I would pursue. I just wanted to spend a few years abroad to gain experiences. Four years and three months in Gothenburg finally made me think like an economist and clearly know where I should go in the future.

I have learned a lot from taking courses, conducting field studies, as well as writing this thesis. I have grown in the midst of all these things and am happy to have overcome all the challenges I have encountered. More importantly, I have also experienced a completely different life with distinguished people during my journey. All the experiences have deeply influenced my way of living and will continue to affect me for the rest of my life.

Without a doubt, my deepest appreciation goes to Qian Weng, my dearest classmate, friend, teacher, support, love, and wife. She has been alongside me throughout the ten years that have passed since I left home. Without her company, encouragement, and influence, I would never have had the ambition to pursue a Masters degree, not to mention to become a PhD. Qian is such a pretty woman, and she never stops giving me unflinching encouragement, the warmest comfort, lenient toleration, and endless help during my life in China and Sweden to pursue this little yellow book. We have spent, enjoyed, and endured all the good and bad times together. With her, life becomes more enjoyable and much easier.

My heartfelt appreciation goes to my two supervisors and co-authors Fredrik Carlsson and Peter Martinsson. I clearly remember the first lunch meeting we had in September 2007 to discuss the idea of our first project. Both of them enriched the idea with interesting thoughts and they then became my supervisors. I have felt trust from both of them since the very beginning, which has encouraged me to explore the wonderful world of economic research in my own ways. I could always knock on their doors and ask for whatever help I needed. Fredrik always gave me very quick, specific, and invaluable advice on all my academic work, which kept me going in the right direction. He also gave me personal suggestions about how to manage my career and warm comfort when I got stuck at some point in the PhD study. He never refused my questions or impatiently ordered me to go to the textbooks no matter how basic my questions were. Peter has always been supportive and constructively criticizing. He could always easily figure out the essence of my questions and then make excellent comments or suggest solutions with his intellectual skills and all-round considerations, a trait that has been invaluable in shaping each piece of my work. Without you two, my yellow book would never have been finished.

Great thanks also go to my other two co-authors, Ping Qin and Matthias Sutter. Ping is not only my co-author, but also my very good friend. I have learned a lot from her about academia, careers, and life. Our discussion on possible ways to pursue research, our attempts to understand Swedish-Chinese cultural differences, and our efforts to adapt to life here are things I will never forget. I hope our friendship and collaboration will continue in the same fashion. Collaborating with Matthias is a great honor and has benefited me a lot. His expertise, insight, and experiences during our collaboration not only brought great inspiration to improve my research, but also made me consider research from a referee’s viewpoint. All that he has shown me can hardly be learned from anyone else.

A special “thank you” goes to Yazhen Gong and Jintao Xu, who have acted as a “beacon of light” in my life, driving me to academia. I am grateful to Yazhen for encouraging me to apply for the undergraduate program and masters program in Beijing, and also the PhD program here, as well as for all the help and guidance over all the years since middle school. Jintao has given me persistent advice and support on my work and my career since my masters studies and has also made my study as a PhD student here possible.

Several scholars have shared their wisdom and experiences to help me drastically improve my work. Jiegen Wei is my best friend and mentor in Sweden. He has never hesitated to offer his expertise or share his knowledge to help me figure out every single question I have raised. Måns Söderbom has always kept an open door for me. His proficiency in econometrics has inspired me to strive toward a deeper understanding of econometric methods. Olof Johansson-Stenman, Katarina Nordblom, and Jesper Stage have always been ready to receive me at their offices and I have had many meaningful discussions with them about both research ideas and difficulties in my work. Martin Dufwenberg has offered critical yet very useful comments that have helped me improve my work. Michael Hanemann and Peter Berck have given me invaluable suggestions and inspiration during the exchange semester I spent at the University of California, Berkeley. Mitesh Kataria, Gunnar Köhlin, and Amrish Patel provided insightful comments at my final seminars.

I am very happy to have become friends with everyone in my cohort, Yonas Alem, Clara Villegas, Pham Khanh Nam, Kofi Vondolia, Conny Wollbrant, Måns Nerman, Eyerusalem Siba, and Andreas Kotsadam. Yonas, Clara, Nam, and Kofi, I will especially never forget the time we spent together when taking courses, discussing assignments, sharing life in general.

I am very fortune to have made the choice to come to Gothenburg and spend my life with colleagues and friends who are always warm, friendly, and helpful. I would like to express my sincere gratitude to people at the Environment Economics Unit: Thomas Sterner, Anders Ekbom, Daniel Slunge, Olof Drakenberg, Elina Lampi, Martine Visser, Karin Backteman, Jessica Coria, Håkan Eggert, Magnus Hennlock, Karin Jonson, Åsa Lofgren, Persson Martin, César Emelie, Gunilla Wingqvist, Ida Hellmark, Xiaojun Yang, Haileselassie Medhin, Jorge Bonilla, Claudine Uwera, Simon Wagura, and Hailemariam Teklewold. Funding from the Swedish International Development Cooperation Agency (Sida) through EEU has enabled me to come to Sweden, to conduct field studies in China, and to complete my PhD. I am grateful to Sida for its great vision regarding this capacity building program.

I am also indebted to colleagues and friends at the Department of Economics. Renato Aguilar, Lennart Hjalmarsson, Lennart Flood, Ola Olsson, Dick Durevall, Johan Stennek, Joakim Westerlund, Hong Wu, Elias Tsakas, Roger Wahlberg, Arne Bigsten, Jinghai Zheng, Jianhua Zhang, Marcela Ibanez, Miguel Quiroga, Pelle Ahlerup, Johan Lönnroth, Sven Tengstam, Florin Maican, Constantin Belu, Annika Lindskog, Andreea Mitrut, Cristinana Manescu, Patel Amrish, Oleg Shchetinin, Michele Valsecchi, Kristina Mohlin, Lisa Andersson, and Anna Nordén. Thank you all! I would also like to extend my gratitude to the teachers and friends at the Beijer Institute of Ecological Economics at the Royal Swedish Academy of Sciences when I took a course there, and at the Department of Agricultural and Resource Economics at the University of California, Berkeley when I was a visiting scholar there.

I would also like to thank Elizabeth Földi, Eva-Lena Neth-Johansson, Gerd Georgsson, Jeanette Saldjoughi, Katarina Renström, Åsa Adin, and Yuanyuan Yi for their great administrative support. Elizabeth has always been patient and helpful. Without all her enthusiasm and help, I would not have had such a smooth and wonderful stay in Sweden. You are the one who inspired me to look at the world and my country from different angles. I will never forget the discussion with you about culture, politics and life in both Sweden and China. I am indebted to my English editor, Debbie Axlid, and English teacher, Mimi Möller. Their help has greatly improved my written and oral English.

I also indebted to my Chinese friends for great support: Yu Duan, Xun Mo, Song Gao, Jie Sun, Xuanying Ma, Gen Wang, Tong Ning, and Mian Liu. Yu, thank you for always being supportive over the past years. Xun, you have always been my number one think tank when I have encountered problems. Song, I truly cherish having shared so many life experiences with you ever since we were kids. Jie, I will never forget all the insights and inspiration from you whenever I need.

I would also like to acknowledge all the field work team members from Guizhou University, Beijing Forestry University, Peking University, and several other universities. The thesis could never have been completed without your hard work and strong support with data collection. I would also like to thank Gen Wang, Yu Duan, Xun Mo, Taizhou He, Xin Huo, Yue Zhang, Hongtao Chen, Li Gan, Ze Yu, and Aili Yao for providing various assistance before and during the field studies.

Finally, but most importantly, my parents, Yanong He and Ruyi Gan, have dreamed and continue to dream of great opportunities for me, opportunities that they have never had or even dreamed of ever having. Your love and encouragement have always been a driving force for me to keep moving forward. I know how proud and happy you are for me to become a

PhD. This thesis is dedicated to you! Although I am the only child in my family, the extremely nice environment in the extended family makes me never feel lonely. Great thanks go to my grandfathers, grandmothers, uncles, aunts, and cousins. They have been a great source of pride, strength, hope, and resilience throughout my life. This thesis is also dedicated to all of you!

Haoran He

Gothenburg, Sweden

August 25th, 2010

Summary of the thesis

Stated preference methods and laboratory experiments are two important tools for economists to gain knowledge and insights about human behavior. However, the reliability of both these methods is questioned, e.g., to what extent stated preference methods can accurately predict actual human behavior. All papers in this thesis use stated preference methods and/or experiments to investigate individual or household behavior in various contexts. Three of the five papers in particular test the validity of these methods. What follows is a brief introduction to all these papers.

This thesis consists of five separate yet related papers. They fall into four fields of economics: environmental economics, behavioral economics, experimental economics, and development economics. Four papers (papers 2, 3, 4, and 5) aim to contribute to methodological development, while one paper (paper 1) is an empirical analysis of a specific issue. All papers use methods of experimental economics in one way or another, and with or without survey methods, to study issues such as the impact of environmental policy (paper 1), the accuracy of predicted policy effects (paper 2), household decision-making (paper 3), and the impacts of heterogeneous conditions in laboratory and field experiments (papers 4 and 5). To this end, laboratory experiments, field experiments, and natural experiments are used.

Paper 1:

The Effects of an Environmental Policy on Consumers – Lessons from the Chinese Plastic Bag Regulation

Retailers in China spent more than 24 billion Chinese yuan per year on plastic bags (Zhang, 2008). As a result of mass usage, plastic litter composed of plastic bags constitutes 3-5% of the total landfill solid waste (Chinese National Development and Reform Commission, 2008b), and plastic bag litter has also become a common problem across continents and countries due to high visibility and very slow decomposition. China, as the number one plastic

bag consuming country, introduced a nationwide regulation requiring all retailers to charge for plastic shopping bags on June 1, 2008 in an attempt to reduce plastic bag litter.

This paper focuses on the impacts of the environmental policy on plastic bag use by using individual-level data from surveys conducted with consumers both before and after the implementation of the regulation. We not only concentrate on the number of plastic bags consumed, but also consider other aspects of bag use such as efficiency of bag use, reuse of bags, and use of substitutes. In addition, we try to understand in more detail the impacts of the regulation on different groups of people, at different locations and on different shopping occasions. Since the regulation was not perfectly enforced, we also investigate the influence of enforcement variation on people's bag consumption behavior.

Our findings show that Chinese consumers in the two surveyed cities have reduced their overall plastic bag consumption by 49%. We also find that, regulation enforcement, consumers' attitude toward the regulation, and some socioeconomic characteristics have significant effects on the bag consumption. Apart from bag consumption, the plastic bag regulation also shifted various other aspects of bag use behavior toward more efficient use, more reuse of plastic bags, and more use of substitutes. Nevertheless, the effects of the regulation differ largely among groups of consumers and among places. The resulting information is intended to help policymakers better understand the role of the regulation for short-term plastic shopping bag reduction and to suggest possible ways of generating further improvements.

Paper 2:

Can Stated Preference Methods Accurately Predict Responses to Environmental Policies? The Case of a Plastic Bag Regulation in China

In an attempt to reduce plastic bag litter, China introduced a nationwide regulation on June 1, 2008, prohibiting free provision of plastic bags and requiring all retailers to mark the price of the bags clearly and not attach the cost to that of other items. The price of the plastic bags can be set by individual shops, yet at a level no less than the acquisition cost (Chinese Ministry of Commerce *et al.*, 2008; Chinese National Development and Reform Commission, 2008a). Similar market-based plastic bag regulations have been implemented in several countries such as Ireland (Convery *et al.*, 2007) and South Africa (Hasson *et al.*, 2007).

By using the policy implementation as a natural experiment, we collected individual-level data before and after the implementation. Before implementation of a plastic bag regulation, when bags were still free of charge, we utilized a stated preference survey to elicit consumers' stated contingent bag consumption in certain possible pricing scenarios. Following implementation of the regulation mandating charging for bags, we conducted another survey to collect actual consumption information. We thus have unique data to compare stated and revealed consumption. The first goal of this article is to investigate whether there exists a discrepancy between predicted, i.e., stated contingent behavior, and actual revealed behavior related to the environmental policy change. The second goal is to address what factors, if any, influence the direction and magnitude of the potential gap.

The comparison results show that consumers' behavioral reactions to a policy change can be predicted reasonably well with stated preference survey methods. In line with the findings in List and Gallet (2001), the private good nature and the respondents' familiarity with the bags may contribute to the accurate prediction based on our stated preference technique. In addition, regulation enforcement plays a crucial role in determining the validity of our stated preference prediction since the actual enforcement differed largely from that in the hypothetical scenario in the *ex-ante* survey.

Paper 3:

Household Decision-making in Rural China: Using Experiments to Estimate the Influence of Spouses

Many important economic decisions are made by households, implying joint rather than individual decisions. For example, decisions regarding labor supply, savings, and investments are often made jointly within the household. This implies that such decisions are a function of the preferences of household members and the relative influence of each household member on the joint decisions. However, it is not straightforward to measure the relative influence of spouses on joint decisions and it is by definition difficult to obtain field data on preferences/choices of the spouses and the joint household decisions. A recently developed approach is to use experiments or survey methods to study household decision making, since they allow for collection of data for both individual and joint decisions under controlled conditions. This approach has been used to study household decision making in many different domains, such as risk taking (Bateman and Munro, 2005; Iversen et al., 2006; Munro et al., 2008; de Palma et al., 2010), consumption choices (Arora and Allenby, 1999; Browning and Chiappori, 1998), behavior in social dilemma situations (Cochard et al., 2010), and stated preferences (Quiggin, 1998; Dosman and Adamowicz, 2006; Strand, 2007; Beharry-Borg et al., 2009).

We conduct a high-stake artefactual field experiment (Harrison and List, 2004) with poor, rural households in southwestern China. The experimental task is to make inter-temporal decisions in which spouses have to choose between earlier but smaller rewards and later but higher rewards. Both the husband and wife in a household participate in the experiment. First they make individual choices independently, and thus reveal their individual time preferences. After that, they make joint choices in the exact same experiment. We apply a random parameter modeling approach to estimate the relative influence of the husband and the wife on the joint decisions. In the final part of the analysis, we estimate a truncated regression model where the relative influence is explained by a number of individual and household characteristics.

We find that husbands have a stronger influence on household decisions than do wives, which corresponds to the traditional Chinese norm. Our estimations reveal that in 90% of households, joint household decisions are influenced more by the husband's individual time preferences than by the wife's. Across our 93 households, we find relatively small variation in the relative influences, suggesting that the spouses' relative influences are persistent. Despite the small variation, we find several factors that have significant effects on the spouses' relative strength in influencing the joint decisions. In richer households, the relative influence shifts significantly in favor of the wife's time preferences. This is a clear indication that (increasing) wealth improves the relative power of women in households. Moreover, we find that wives have more influence on their household's joint decisions if they are older than their husbands. Finally, wives have more power in households where they are mainly in charge of small investment decisions.

Paper 4:

Easy Come, Easy Go – The Role of Windfall Money in Lab and Field Experiments

Laboratory experiments are an important tool to gain various economic insights that cannot easily be obtained using market data or field experiment data, although differences between the laboratory and the field make it difficult to generalize findings from the laboratory setting. A growing number of experimental studies focus on reducing the differences by for example using non-standard subject pools and having subjects earn an endowment. An important reason for the increased use of non-windfall gain is the intent to mimic the setting outside the lab, where almost all incomes are earned rather than obtained as windfalls.

In this paper, we analyze the behavioral effects of conducting experiments in the lab and the field, and in particular we investigate the role of windfall and non-windfall money in the lab and the field. To do this, we conduct a dictator game experiment with a charity organization as the recipient (see, e.g., Eckel and Grossman, 1996) and use a 2×2 experimental design. In our experiments, we keep all other factors, such as stake, selection of subjects, and choice sets and time horizons of the experiment, constant and only vary windfall gain and whether the experiment is conducted in the lab or in the field. Our design allows us to make two important comparisons. First, we can investigate the effect of windfall gain in the lab and in the field. Second, we can make an overall comparison between the lab and the field conditional on the way the endowment is received and earned.

Our findings suggest a strong effect of windfall gains on donation amounts in both the lab and the field. Subjects donate more if the endowment is a windfall gain. Thus, windfall money is important not only in a lab environment. However, even for earned endowment, there is a significant difference in behavior between the lab and the field. Although the experimental design was intended to control for all other effects except environment, we still find differences. This points to the importance of discussing the environment when interpreting both laboratory and field experimental results, as well as of conducting replication studies.

Paper 5:

Windfall vs. Earned Money in the Laboratory: Do They Affect the Behavior of Men and Women Differently?

A key component of laboratory experiments is that subjects are monetarily rewarded and that the rewards are linked to their actions. In most experiments, subjects receive an endowment as a windfall gain, and then make their decisions using the endowment, while in some cases subjects have to earn their endowment to be used in the experiment. In experiments involving issues such as altruism, fairness, or pro-social behavior, it is possible that how the endowment is obtained affects subject behavior. Using dictator games, a number of studies suggest that subjects behave differently when the endowment is earned as compared to received as a windfall (see, e.g., Cherry et al., 2002; Oxoby and Spraggon, 2008; Reinstein and Riener, 2009). Moreover, women are found to be more altruistic, and contribute more in dictator games (see, e.g., Croson and Gneezy, 2009; Eckel and Grossman, 1998; Engel, 2010). Therefore, a relevant question with respect to laboratory experimental design is whether the gender difference in behavior is also present when the endowment is changed from a windfall gain to earned money.

The objective of this paper is to investigate gender differences in donations in a dictator game when the endowment is either a windfall gain or earned using a between sample design.

In our dictator game experiment, we use a charitable organization as the recipient. We use a 2×2 experimental design, where the two dimensions are how the endowment is received (windfall or earned) and the gender of the subjects.

Our results provide evidence that earning the endowment has a strong impact on reduction in contribution. Moreover, we find that the impact of different endowments is larger for women, although the gender difference is statistically insignificant.

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Paper 1

The Effects of an Environmental Policy on Consumers - Lessons from the Chinese Plastic Bag Regulation

Haoran He[*,†]

Abstract

To reduce plastic bag litter, China introduced a nationwide regulation requiring all retailers to charge for plastic shopping bags on June 1, 2008. By using the policy implementation as a natural experiment and collecting individual-level data before and after the implementation, we investigate the impacts of the regulation on consumers' bag use. We find that the regulation implementation caused a 49% reduction in the use of new bags. Besides regulation enforcement, consumers' attitude toward the regulation and some consumers' socioeconomic characteristics also affected bag consumption. However, the regulation effects differ largely among consumer groups and among regions and shopping occasions.

Key words: China; litter; market-based policy; natural experiment; plastic bag

JEL classification: Q53, Q58

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Acknowledgements: I would like to thank Peter Berck, Fredrik Carlsson, Mitesh Kataria, Peter Martinsson, Thomas Sterner, Jiegen Wei, Qian Weng, and seminar participants at Peking University, Chinese Academy of Sciences and the University of Gothenburg for extremely helpful discussions and comments on this paper. I am also grateful to the field work support team from Guizhou University and Peking University. All errors and omissions remain the sole responsibility of the author. Financial support from Swedish International Development Cooperation Agency (Sida) to the Environmental Economics Unit at the University of Gothenburg is gratefully acknowledged.

1. Introduction

Plastic bag litter has become a common problem across continents and countries, waterways and oceans. Many countries and cities around the globe are now taking actions against the use of plastic bags in an attempt to reduce litter and pollution. However, previous experience has taught that unless the correct instruments are chosen and enforced effectively and persistently, plastic bag litter control will not be successful. China, the number one consumer of plastic bags in the world, has joined the list of countries that are taking action against the use of plastic bags by banning thin, free plastic shopping bags. In June 2008, a market-based regulation that forces shops to charge for the use of these bags was implemented. Accordingly, it is of interest to analyze to what extent the market-based environmental policy, intended to influence all citizens who use plastic bags, actually affects people's behavior and to analyze the factors affecting the influence of the policy. This paper focuses on these issues by relying on individual-level data from surveys conducted with consumers both before and after the implementation of the regulation. In addition, we try to understand in more detail the impacts of the regulation on different groups of people and at different locations and shopping occasions. Since the regulation has failed to be perfectly enforced, i.e., some shops still provide the bags for free, it is also of interest to investigate the influence of enforcement variation on people's bag consumption behavior. The resulting information is intended to help policymakers better understand the role of the regulation for short-term plastic shopping bag[1] reduction and to suggest possible ways to further improve the regulation.

A number of studies have analyzed the effects of various market-based environmental policy instruments such as charge systems, tradable permits, market friction reductions, and government subsidy reductions (see, e.g., OECD, 2001; Stavins, 2002; and Sterner, 2003[2]). Although policy impacts can be more adequately analyzed with detailed – both *ex-ante* and *ex-post* – socioeconomic and environmental data

[1] In the remainder of this paper, "plastic shopping bag" is abbreviated as "plastic bags" or "bags" in most places.

[2] For detailed information about each policy instrument and its effects, see the specific chapters of the books.

(Briassoulis, 2001), the impacts of environmental policy instruments have rarely been assessed by using detailed information from both before and after a policy change. In the present paper, we use this regulation implementation as a naturally occurring opportunity to make a detailed analysis of the impacts of the regulation by conducting surveys both before and after the regulation implementation.

The *ex-ante* survey was conducted one month before the implementation date, when most citizens were well aware of the news of the forthcoming regulation.[3] Hence, the questions in our questionnaire could be easily understood by the respondents.[4] In the *ex-ante* survey, we collected information about consumer characteristics and plastic bag use situations. The *ex-post* survey was conducted about four months after the regulation was implemented so that citizens had time to adjust to the regulation. Both surveys were conducted in the same shops at the same time of day and with the same questionnaire, but some complementary questions about the enforcement of the regulation in the respondent's home community were asked in the *ex-post* survey. During the period in which the two surveys were conducted, there was no other major economic change or any relevant action or campaign with respect to the use of plastic bags[5] in China. It is therefore reasonable to assume that any change in behavior regarding plastic bag use was clearly due to the implementation of the regulation.[6] Furthermore, the same two surveys were conducted in different regions in order to identify possible regional differences in the behavior change due to the regulation. By analyzing and comparing the results from

[3] At the time of the pre-policy survey, more than 80% of the respondents in the survey reported that they already knew about the regulation.

[4] We interviewed both consumers and shop managers about whether they had noticed any changes in plastic bag use behavior that could be linked to the news of the forthcoming regulation. No change was reported, which is consistent with evidence from supermarkets' formal records that bag consumption did not change until the regulation had been implemented (see, e.g., Figure 1 in Section 5).

[5] Promotion of reduced plastic bag use occurred before June 2008 when the regulation had not yet been implemented.

[6] This can be seen in Figure 1 in Section 5 that the monthly consumption of regulation-targeted bags remained constant during the two periods before and after the regulation implementation, respectively. A drastic drop in the monthly consumption of the targeted bags can only be seen in connection with the implementation of the regulation.

the surveys, we are able to analyze whether there were any clear effects of the regulation.

Regarding litter control, consumers' environmental-friendly intentions and behaviors are affected by individual demographics as well as by internal and external motivators. The primary incentive for individuals to use plastic bags is simply that they are the cheapest alternative for carrying goods home from stores. Market-based policies have the potential to provide incentives for consumers to adopt better technologies into their daily lives since, by using product-charging instruments (also called "advanced disposal fees") such as charging for plastic bags, it always pays off for consumers to use a bit less if another sufficiently low-cost method of doing so is available.[7] Moreover, along with the policy implementation, a clear signal that plastic bag litter is environmentally harmful was sent out via information campaigns with the charging of the bags (Convery *et al*., 2007). This signal and the bag pricing *per se* could shift consumers' external environments and reference points of plastic bag consumption. Therefore, the information together with a small price added to the bags has the potential to generate a considerable reduction of bag consumption.

The remainder of the paper proceeds as follows: Section 2 presents the background of the regulation and Section 3 introduces the survey design. Section 4 discusses the methodology used and Section 5 describes the data. The results are reported in Section 6 and Section 7 concludes the paper.

2. Background of international actions and China's regulation

2.1. International actions against the use of plastic bags

Many countries and cities around the globe are taking actions and/or are implementing policies against the use of plastic bags with the motivation of reducing litter and pollution (e.g., Bangladesh, China, California, Denmark, Hong Kong, Kenya, Ireland, South Africa,

[7] Taylor (2000) summarizes policy incentives that can be used to minimize waste. For other examples, see Geller *et al.*, 1973; Downing and White, 1986; Pearce and Turner, 1993; Carr-Harris, 1996; Ackerman, 1997; and Manuel *et al.*, 2007.

Rwanda, Tanzania, and the UK). For example, the Bangladesh government banned the use of plastic bags in its capital Dhaka in 2002 and Rwanda prohibited the use of plastic bags by shoppers in 2006. Denmark imposed a tax of 22 DKK per kilogram of plastic bags on retailers in 1994, which has since cut plastic bag usage by 66% (Danish EPA, 1999). In contrast to imposing a tax on retailers as in the case of Denmark, in March 2002 Ireland introduced a product tax of €0.15 per plastic bag levied on consumers, which has led to a 90% reduction in bag use. In July 2007, the Irish government further increased the environmental levy on plastic bags to €0.22 per bag in order to maintain its impact[8] (Irish Department of the Environment, Heritage & Local Government, 2007). The success in terms of substantially reducing the use and the associated gains in the form of reduced litter and a more attractive landscape in Ireland has attracted considerable international interest (Convery *et al*., 2007). However, the seemingly similar legislation implemented in South Africa in 2003 witnessed a gradual rebound in plastic bag consumption after showing an initially significant reduction (Hasson *et al*., 2007).

2.2. China's regulation of plastic bags

Plastic bags, with the advantages of being lightweight, strong, waterproof, and seemingly free of charge, have been ubiquitous for several decades in China ever since they were introduced as a way of promoting sales in the early 1980s. Although plastic bags have been provided for free, they have not been without costs. Before the regulation, retailers in China spent more than 24 billion Chinese yuan per year on plastic bags (Zhang, 2008). This was passed on to consumers through higher prices of other goods. While supermarkets have consumed 25% of all plastic bags, department stores, roadside stores, open markets and all other retailers have consumed the remaining 75% (Wang, 2008). As a result of mass usage, plastic litter composed of plastic bags constitutes 3-5% of the total

[8] Surveys provided by the Irish Central Statistics Office indicate that the levy caused yearly plastic bag per capita usage to decrease overnight from an estimated 328 bags to only 21 in 2002. More than 90% of the reduction remained in 2003. However, survey data indicate that plastic bag usage rose to 30 bags per capita during 2006.

landfill solid waste (Chinese National Development and Reform Commission, 2008b). These buried plastic bags may last for 500-1,000 years in landfills (Friends of the Earth Scotland, 2005).

Since the late 1990s, local governments in a few cities and provinces have introduced policies with the intention of limiting or even eradicating the use of plastic bags. However, most regional policies aimed at reducing plastic bag use have become useless paperwork after implementation or have not even reached practical enforcement. It was not until early 2008 that, as an effort to host a “Green” Olympic Games, the Ministry of Commerce, the National Development and Reform Commission, and the State Administration for Industry and Commerce jointly published the nationwide byelaw *The Administrative Byelaw for Non-free Use of Plastic Shopping Bags in Retailer Situations*. The administrative byelaw (the regulation) has been in effect since June 1, 2008. The key feature of the regulation is that free provision of plastic bags is prohibited in all supermarkets, stores and all other retailers across the country (excluding plastic bags used for separating foods and other products for hygiene and food safety purposes). All shops are instructed to mark the price of the plastic bags clearly and to not attach the cost to that of other items. The price of the plastic bags can be set by individual shops, yet at a level no less than the acquisition cost (Chinese Ministry of Commerce *et al.*, 2008; Chinese National Development and Reform Commission, 2008a).

Consumption of a bag has two costs: the first is the cost of acquisition including production and transportation costs and the second is the negative external effect on the environment due to disposal of the bag. The regulation, however, only requires charging for the acquisition cost but excludes the social cost. This is partially because, before enacting the formal regulation, a draft was announced in early 2008 for the purpose of collecting public opinions and comments. A considerable number of complaints were made that charging for plastic bags was a disguised form of price markup, increasing shopping costs and therefore hurting all citizens. Therefore, a compromise from the original environment-protection purpose of the regulation had to be made while still leaving space for its further adjustment. It is also noteworthy that due to the fiercely competitive Chinese retail trade environment, a substantial fraction of shops have enforced the regulation incompletely, i.e., only charging for some of all the provided bags, or even none. Therefore, consumers still obtain a considerable proportion of the total number of bags for free.

3. Survey design

The policy change on June 1, 2008 is used in order to compare plastic bag use behaviors obtained by the two surveys *ex-ante* and *ex-post*. The *ex-ante* survey was conducted from late April to early May of 2008, and the *ex-ante* survey was conducted from October to November of 2008. For both surveys, the two most frequently visited types of shops were chosen since these shops account for a considerable fraction of citizens' daily plastic bag consumption (Wang, 2008). Intercept surveys were conducted when consumers exited the shops and a between-subject design was used. The advantage of using an intercept survey with a between-subjects design is that it avoids the "recall effect" that would follow from using the same subjects in both surveys. Therefore, both surveys needed to be conducted *ex-ante* and *ex-post* in the same shops at the same time of day in order to receive responses from comparable respondents from the same sample pool. The two surveys investigated individual consumers' current plastic bag use behaviors before and after the implementation, respectively. Since the regulation was not perfectly enforced, the *ex-post* survey also collected information about the percentage of individual consumers' paid-for bags out of their total bags as an index of regulation enforcement in their community after the implementation.

Since we are interested in analyzing the impacts of the regulation on the use of plastic bags, we designed a series of questions to capture the different aspects of the use.[9] In order to obtain measures of the consumption of new plastic bags[10] at the individual level, we investigated the number of new bags used in a one week period since it is

[9] All surveys were answered by individual respondents based on their personal situation; yet, an individual's bag use behavior could be somehow related to the situations of his/her family.

[10] The term "new plastic bags" means the first time the plastic bags are used. After the first time, the bags are not "new."

expected to be relatively stable across weeks, and we also recorded the number of new bags used during the surveyed shopping trip since it is easily observed. We further investigated three other aspects of bag use that could also be affected by the regulation: new bag use, bag reuse, and use of substitutes. Regarding the general bag reuse situation, we recorded respondents' average proportion of bags being reused and their average number of reuse times. Moreover, we designed a systematic way to find out the information about how consumers use new plastic bags and substitutes used during the surveyed shopping trip. First, we collected information about the number of new plastic bags used and the weight of the goods in the new plastic bags during the current shopping trip. We then calculated each respondent's average weight of goods per new bag as a measure of new bag use efficiency. Second, we recorded each respondent's total expenditure for all goods and the expenditure for goods carried in containers other than plastic bags during the same shopping trip. Substitute use is then quantified by the ratio of the two expenditures[11]. In this study, we are also interested in the factors, excluding the regulation *per se,* that could affect the use of plastic bags and the impacts of the regulation on different groups of people. The first group of factors includes what people think about the regulation and how difficult it is for them to reduce or to dispose of their use of the plastic bags. The second group of factors concerns respondents' socioeconomic characteristics since bag use behavior might be influenced by respondents' lifestyles and other specific conditions. Last but not least, in order to obtain a representative sample and to detect potential differences in bag consumption behavior, we conducted the surveys at different times of day, on different shopping occasions, and in different regions.

We conducted two parallel surveys in the two cities Beijing and Guiyang in order to detect any possible regional discrepancy. Beijing is the capital and one of the most developed metropolitan areas in China, and Guiyang is a medium-sized city located in one of the most undeveloped provinces. We conducted surveys in the two most frequently visited types of shops, namely supermarkets and open markets, in order to see whether

[11] The proportion of expenditure is a more neutral measurement of substitute use level than the proportion of weight. This is because the expenditure for goods is much less correlated with the means of carrying them than the weight of goods is.

there are differences between people shopping in different types of shops. Consumers who shop in supermarkets are generally considered to have higher income and a higher standard of living than those who shop in open markets. We chose three main residential areas in each city and included one large supermarket and one large open market from each of these areas. Furthermore, since shopping behavior may differ depending on the day of the week and on the time of day,[12] our surveys cover both regular weekdays and weekends/public holidays as well as the three main shopping rush hours, namely early morning, noon/early afternoon, and late afternoon/early evening. As presented in Table 1, we attempted to distribute our samples evenly in each of the dimensions so that we could detect possible behavioral effects among these situations and obtain a sample representing urban consumers in China.

<Table 1 to be here>

The sampling procedure of interviews was exactly the same: Every third shopper who exited the shop[13] was approached by the enumerators and asked if s/he would like to participate in a survey that would last a few minutes. If the selected customer refused to participate, the enumerator approached the very next shopper. If this person agreed to participate, then the enumerator would complete the survey and proceed to the next third shopper. We ended up with 3,074 interviewed respondents[14]. The most commonly stated reason for refusing to participate was lack of time.

4. Methodology

In order to analyze the impact of the regulation on the use of plastic bags for different

[12] The potential differences in bag use depending on time of day could be generated by unobserved factors such as the differences in the complex characteristics of consumers, the differences in goods purchased, etc.

[13] If more than one shopper exited at the same time, the enumerators always counted them from left to right in order to select the “third” subject.

[14] In total, we asked about 4,000 in order to obtain the 3,074 respondents. We discard 18 observations considered as outliers since these respondents consumed an extremely high number of new plastic bags and lack representativeness of the bag use behavior for normal citizens.

groups of people, we use econometric models. The dependent variable in the first model is the individual consumer's number of new bags used per week, while the independent variable vector $\boldsymbol{X}$ has several components, i.e., $\boldsymbol{X} = (\boldsymbol{X_0}, \boldsymbol{X_i}, \boldsymbol{X_j}, \boldsymbol{X_m}, \boldsymbol{X_n}, \boldsymbol{X_r})$. $\boldsymbol{X_i}$ is the key variable "implementation of regulation," while all the other variables take the role of controls in this study: $\boldsymbol{X_j}$ denotes consumers' self-reported percentage of paid-for plastic bags out of their total bag consumption[15], which captures the enforcement of the regulation; $\boldsymbol{X_m}$ expresses the variables regarding consumers' knowledge of the policy and inconvenience of not using plastic bags provided by shops, etc.; $\boldsymbol{X_n}$ denotes the socioeconomic variables of the respondents and their families; $\boldsymbol{X_r}$ denotes variables controlling for bag use behavior shifts due to regional discrepancy, market type difference, weekday or weekend, and time of day. We take the first element $\boldsymbol{X_0}$ as a constant. We will explain all variables in detail in the next sub-section.

The dependent variable number of new plastic bags used has a count data structure, i.e., taking only nonnegative integral values. Therefore, we apply Negative Binomial regression models (Cameron and Trivedi, 1986 and Greene, 2003) to deal with the structure.[16] The present study mainly focuses on the results from Negative Binomial regression models but still reports the results from OLS and Tobit regression models in the appendix for comparison.[17] In the second model, we take the number of new bags used during the surveyed shopping trip instead of the number of new bags used per week as dependent variable and estimate using the same model specifications and the same

[15] The percentage of paid-for bags is set to be zero for all observations from the *ex-ante* survey since no shops charged for plastic bags then.

[16] Since the Poisson variance assumption does not hold for the dependent variable due to over-dispersion, i.e., the variance exceeds the mean, the Poisson regression model is not an appropriate method.

[17] OLS models are used to analyze the data as a benchmark. In addition, since a fraction of respondents do not use new plastic bags in our sample, Tobit models (Wooldridge, 2002) can also be applied to deal with the censored structure of the data. However, since zero-bag users accounts for only 6% of the sample, using a Tobit model does not offer any significant benefits as compared to an OLS model while suffers strict assumptions. In addition, the comparisons of the distributions between the true value of the dependent variable and its predicted values from OLS, Tobit and Negative Binomial models respectively suggest that the Negative Binomial model fits the data best.

independent variables as in the first model.[18]

Since the regulation increased the cost of using plastic bags, it is expected to have decreased bag consumption. Experiences from other countries show that whether the regulation can, and if so how it will, succeed in ensuring a reduction in plastic bag consumption depends on (1) people's environmental protection consciousness which maintains their positive attitude toward the reduction and (2) the support of its enforcement from all relevant administrative departments (Convery *et al.*, 2007). That is to say, the reduction in plastic bag use is likely to be positively correlated with positive attitudes toward the regulation and with regulation enforcement. As for the socioeconomic variables, it is possible that more educated people with a relatively high degree of concern for the environment use relatively few bags and that males consume more bags than females since they are less likely than females to bring other bags with them. It is also possible that higher income and having a larger family is linked to using more bags. Regarding the regional and shop type dummies, since various factors associated with the dummies could affect people's plastic bag use behavior in different ways, the net effect is not straightforward.

We note that the effects of some influencing variables on plastic bag use could differ between before and after the regulation implementation. For example, older people may be more sensitive to the price change thereby reducing their plastic bags more than younger ones following regulation implementation. Therefore, in some of our models, we add interaction variables, i.e., variables interacted with the regulation implementation dummy. The coefficients of the interaction variables enable us to analyze the differences in impacts of the regulation on different groups of people with different characteristics as well as in different locations and different shopping occasions.

Moreover, since we are interested in understanding the extra effects of the regulation

[18] The variable of bag price at the current surveyed shops is not included in the main models since the purpose of this research is to investigate the overall effects of the regulation unconditional on the prices set by individual shops. Yet, it is also interesting to explain the bag consumption during the surveyed shopping trip with further incorporating the bag price variable.

on bag consumption reduction if enforced perfectly, we make comparisons between the true value of bag consumption under imperfect regulation enforcement and the predicted values of bag consumption from a Negative Binomial model under perfect enforcement. The comparisons were conducted in the following steps: First, we estimated a Negative Binomial regression model of weekly bag consumption using only the *ex-post* survey data. Hence, we did not include the dummy variable "implementation of regulation" and its interaction variables in this model. Second, based on the estimation results, we calculated the predicted value of the dependent variable using parameters estimated from the model yet conditional on the regulation being enforced perfectly, i.e., the enforcement variable "percentage of paid-for bags" for every observation is equal to 100%. Third, we performed non-parametric tests to compare the predicted value of the number of new bags used per week under perfect enforcement with the true value of number of new bags used under imperfect enforcement. If the test results suggest that the predicted value of bag consumption is larger than the true value, then tighter enforcement will reduce more bag consumption.

5. The data

5.1. Reduction in plastic bag consumption

As previously discussed, we included several measures of the use of plastic bags in order to capture different aspects of the response to the regulation. Table 2 summarizes the situation both *ex-ante* and *ex-post* the implementation.

Regarding the general use of plastic bags, it can be observed that before the regulation was implemented, respondents, on average, used 21 plastic bags per week with each bag being reused about 0.7 times. After the regulation, nearly half of all new bags were saved with the sizeable increase in reuse by 0.6 times to 1.3 times. As for the bag use behavior during the surveyed shopping trip, the probability that respondents used at least one new plastic bag when shopping decreases dramatically from 99% to 56%. The average number of new bags used decreases by 64%, from 3.0 to 1.1 bags. The average weight of goods per new plastic bag increases by about 50%, from 1.3 to 1.9 kilograms. The proportion of total goods (measured in terms of expenditure) not held in plastic bags increases from less than 7% to more than 41%. The values of all these variables differ largely between the *ex-ante* survey and the *ex-post* survey, and the differences in the mean of all variables are highly significant in terms of the t-test or the proportional test[19] as the corresponding p-values show in Table 2. A clear tendency of a reduction in the consumption of new plastic bags due to implementation is seen. In addition, the regulation also affects the way consumers use plastic bags: first, the new bags are used to hold more goods than before; second, the bags are reused more frequently than before; third, more substitutes are used, meaning that more goods are placed in containers other than plastic bags.

<Table 2 to be here>

Furthermore, we collected information about shops' monthly sales income and consumption of two types of plastic bags[20] in 2007 and 2008 from all surveyed supermarkets in Guiyang. The results are shown in Figure 1. No seasonal effects can be detected from the trends of free plastic bags and paid-for plastic bags, although the trend of sales income reflects weak seasonal variation.[21] Across the two-year period, the trend of sales income remains nearly flat, although apparent variances appear with sales income peaks occurring in the months that include main festivals.[22] The consumption trend of the free plastic bags also kept stable across the 24 months, although with some variation. Nevertheless, paid-for plastic bag consumption experienced a drastic decrease directly after the regulation implementation in June 2008. The average number of paid-for bags

[19] The variable with proportion data is tested by a proportional test; the remaining variables are tested by t-tests.

[20] One type of plastic bag is that sold right after the regulation implementation; the other type is the one still provided for free even after regulation implementation, i.e., the one used to separate foods and other products for hygiene and food safety purposes.

[21] The sales income seems to be higher in the winter than in the summer and nearly the same in the spring and the autumn. We conducted the two surveys in the spring and in the autumn, respectively.

[22] For example, a sales explosion occurred in January 2008 simply because, due to tradition, people bought lots of food to prepare for the celebration of China's most important festival, the Chinese Spring Festival.

consumed monthly fell from around one million to 0.2 million, while it stayed stable during the separate periods of both before and after the implementation. Compared to the bag consumption in April 2008, bag use decreased by 79% in the Guiyang supermarkets in November and December 2008. It is worth noting that the counterpart data from our survey reflects that the reduction in use of new plastic bags equals 75%, which corresponds well with the percentage reduction indicated by the sales records of the surveyed supermarkets in Guiyang.

<Figure 1 to be here>

5.2. Descriptive statistics

Factors other than the implementation of the regulation may also influence plastic bag use. These potential influential factors are presented in Table 3.

The first set of variables reflects individuals' support of the regulation and the inconvenience of not using plastic bags provided by shops. In the survey, we measured the first two variables on a five-level scale from "low" to "high." As shown in Table 3, more than 80% of the respondents present a positive attitude toward the regulation although the supportive attitude generally went down after experiencing the impacts of the implementation. The stated actual inconvenience caused by no longer using plastic bags provided by shops is greater than the respondents thought beforehand. Four months after the regulation was implemented, the percentage of new plastic bags consumed that were actually paid for, rather than obtained for free, is only 42% on average, reflecting that the enforcement effort is far from satisfying. After the regulation, the average bag price weighted by the surveyed subjects is 0.21 yuan in all surveyed shops and 0.33 yuan if only the surveyed shops that charged for bags are included. The subject-weighted average bag price is 0.37 and 0.30 yuan in the Beijing and Guiyang surveyed shops that charged for bags, respectively.

The socioeconomic characteristics of the respondents and their families constitute the second set of variables that affect the use of plastic bags. Considering the pooled data of both surveys, the mean age of all respondents is 41, and about 45% are male. A "businessman" dummy is created to control for the effect of this particular profession on weekly bag use: respondents running their own business, such as a restaurant or a grocery store, may shop not only for themselves or their own families but also for all their customers, thereby consuming many more plastic bags than the average. About 10% of respondents belong to this profession, nearly 20% are registered as rural residents, and one-fifth are members of the Communist Party[23]. The average years of schooling and the average monthly income of the sample are 12.7 years and 2,200 Chinese yuan, respectively, while the average family size is nearly three persons. It is worth noting that the differences in mean of these characteristics between the sample from the *ex-ante* survey and from the *ex-post* survey are small in a quantitative sense. However, the differences in the mean or the distribution of some of the characteristics are significant in terms of the t-test, the proportional test or the Wilcoxon-Mann-Whitney test[24] partially due to the large sample.

<Table 3 to be here>

6. Econometric results

Econometric analysis is applied to estimate the effects of the aforementioned factors on the number of new plastic bags used per week and during the surveyed shopping trip, especially the effects of the regulation implementation. As mentioned before, interaction variables are included in some of the models. Table 4 reports regression results from two different specifications of Negative Binomial regression models, with and without interaction variables, concentrating on the effects on the number of the bags used per week. In both models, the dummies are included to control for weekdays and

[23] At the end of 2008, nearly 70% of the party members were urban residents (Organization Department of the Central Committee of the Communist Party of China, 2009) and in China, the urban population is smaller than the rural population. Our data therefore shows a larger fraction of party members in urban populations than the gross fraction of party members in the whole population.

[24] Variables with ranked data are tested by Wilcoxon-Mann-Whitney tests.

weekends/holidays and the time of day the survey was conducted. We begin by looking at the models without interaction variables.

<Table 4 to be here>

The results of the first Negative Binomial model are presented in Column [2]. Only the main variables *per se* are included in this model. The results show that, controlling for other socioeconomic characteristics, regulation implementation has a strong impact on the use of new plastic bags: people on average use 12.5 fewer new bags per week following the regulation implementation. The results from this model also suggest that several control variables significantly influence the number of new plastic bags consumed per week. Nevertheless, the regulation has a quantitatively much larger influence than any other single factor.

Since the impacts of several influencing variables on bag consumption could differ from before to after the regulation implementation, our analysis mainly focuses on the results of the second Negative Binomial model in Column [3]. This model further incorporates interaction variables that are the regulation implementation dummy interacted with all the variables of interest[25] respectively, in order to capture the impacts of the regulation on different groups of people and on different places and shopping occasions.

Before the implementation, respondents with a one level higher feeling of inconvenience on average consume 0.4 more new plastic bags per week. Males on average consume 1.2 more new bags per week, while people with one more year of education use 0.5 fewer new bags weekly. One additional family member increases 0.7 new bags consumed weekly. As for the bag consumption of shoppers surveyed in different types of shops and in different regions, the shoppers surveyed in supermarkets use three fewer new plastic bags per week than those in open markets. Respondents from the less developed regional city Guiyang consume 2.7 more new bags weekly than

[25] The only exception is the variable "percentage of paid-for bags." Since the "percentage of paid-for bags" is set to be zero for all the observations from the *ex-ante* survey, its interaction variable is equivalent to itself, thereby turning out to be perfect collinear.

respondents from the most developed capital Beijing.

After the implementation, for every 10 percentage point more paid-for plastic bags out of their total bag consumption, respondents use 0.2 fewer new bags weekly. It can be seen that the interaction variables interacting with attitude, age, supermarket dummy, and Guiyang dummy are significant, which indicates different reactions to the regulation. Specifically, respondents with a one level higher supportive attitude toward the regulation and those with a one year increase in age consume 1.2 and 0.1 fewer new bags per week, respectively, after regulation implementation, although neither of these factors plays a role in bag consumption before implementation. In addition to the three fewer bags used by people surveyed in supermarkets than by those surveyed in open markets before the regulation implementation, the former group use 2.2 fewer new bags per week than the latter group after implementation. Moreover, people in Guiyang consume 2.6 more new bags than those in Beijing *ex-ante*, while this consumption difference increases to 13.3 new bags *ex-post*. All of the above mentioned marginal effects are significant at the 5% level or better. From the models shown above, the sizes of the marginal effects reflect that the regulation exerts a large impact on reduction of weekly plastic bag use.[26]

As for the effects of the regulation implementation and other factors on the number of new bags used during the surveyed shopping trip, Table 5 reports the results from Negative Binomial regression models. The same independent variables as before are included in the models. The results demonstrate that the regulation has similar effects on per shopping trip bag consumption as compared to the effects on weekly bag consumption.[27] Consumers on average use 2.3 fewer new bags during one shopping trip

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[26] The marginal effects from OLS and Tobit models are reported in Table A1 in the appendix. Comparing the regression results between OLS and Negative Binomial models and between the Tobit and Negative Binomial models, the significant variables are almost the same. The marginal effects of all the significant variables maintain the same sign, and their magnitude differences are small across various models. The small variations in the marginal effect estimates of most variables suggest robustness of our results.

[27] The estimation results from OLS and Tobit model are reported in Table A2, which tells the similar story as shown by the Negative Binomial model. Moreover, the results of the regression models further incorporating the variable of bag prices are shown in Table A3. Unsurprisingly, the marginal effects of the

following the regulation implementation. Many interaction variables are significant, indicating that the effects of the regulation on per shopping trip bag consumption differ among different groups of people. Consumers with a stronger supportive attitude, older consumers, party members, and people surveyed in supermarkets are more affected by the regulation, while consumers with a stronger inconvenience feeling, males, consumers registered as rural residents, and consumers in Guiyang are more likely to stick to their previous bag use habit.

<Table 5 to be here>

Using the comparison approach introduced at the end of Section 4, Table 6 displays the descriptive statistics of the true and the predicted values of the number of new bags used per week after regulation implementation, under imperfect and perfect regulation enforcement, respectively. It can be seen that consumers would further reduce their consumption by more than one new bag per week if the regulation was enforced perfectly, and this further reduction is highly significant in terms of t-test and Wilcoxon-Mann-Whitney test results.[28] The comparison above confirms that the regulation would be even more effective on bag use reduction if the regulation enforcement was more effective.

<Table 6 to be here>

7. Conclusions and lessons

In recent years, an increasing number of countries have enacted various regulations to limit the use of plastic bags. Similar plastic bag control policies that appear successful in some countries, e.g., Denmark and Ireland, have turned out to be far from successful in others, e.g., South Africa and Kenya (Hasson *et al*., 2007; Clean Up the World, 2008). Hence, when China implemented a regulation requiring shops to charge consumers for

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price variables demonstrate that bag consumption during a certain shopping trip decreases with the bag price increase in the shops.

[28] The regression results of the corresponding Negative Binomial model are presented in Table A4. The statistical test results are shown in Table A5.

plastic bags, we took the opportunity to conduct surveys both *ex-ante* and *ex-post* regulation implementation. Our findings show that Chinese consumers in the two surveyed cities reduced their overall plastic bag consumption by 49% and their bag consumption during the surveyed single shopping trip in supermarkets or open markets by 64% from the first to the second survey. This indicates that a potential success in plastic bag litter control measure is occurring in China – the country with the largest consumption of plastic bags in the world. Apart from bag consumption, the plastic bag regulation also shifted various other aspects of bag use behavior toward more efficient use, more reuse of plastic bags, and more use of substitutes. The influence of the regulation differs substantially across different groups of people and different locations. This information can be used to further improve the regulation.

Citizens' attitudes toward the policy indeed play a significant role in reducing the number of bags used after regulation implementation, which is consistent with the experience from Ireland (Convery *et al.*, 2007). Since plastic bags are still easily affordable following the new regulation, it is important to strengthen and maintain people's supportive attitudes toward the regulation in order to keep the degree of reduction in bag use. People surveyed in open markets and people in Guiyang consumed more bags than those in supermarkets and those in Beijing before the regulation implementation, and the differences were further enlarged after the regulation. Apart from the fact that people shopping in supermarkets and living in Beijing could be more environmentally conscious, the better dissemination of information and enforcement of the regulation in these places could be the main driving forces behind the differences. Our results further show that the regulation would reduce bag consumption to an even higher degree if it were enforced more effectively. Generally speaking, the improvements such as better enforcement and nationwide information dissemination would be more easily achieved if the government were to take over the charging duty from the shops by levying a plastic bag tax directly on consumers and requiring the shops to collect the levy.

It is noteworthy that the results of the paper reveal only the short-term effects of the regulation and cannot simply be generalized to conclude anything about the long-term effects. Using monetary incentive tools alone to achieve a long-run impact on pollution control could be unreliable: The effects of increases in shopping costs at the margin become weaker for consumers as time passes. After the first feelings of resistance, which are provoked by the additional expenditure, consumers become accustomed to what they were initially upset about (East and Hogg, 2000). This may be found to be particularly true with goods, such as plastic bags, that can be classified as daily consumption commodities and add only marginally to the total shopping bill. The changed pattern of consumption following plastic bag legislation in South Africa shows that the initially significant consumption reduction in plastic bags gradually rebounded (Hasson *et al.*, 2007). Therefore, the current success in terms of bag use reduction should only be considered a trigger; any future reduction depends on the long-run enforcement efforts of the regulation. Further adjustments, such as adding the negative environmental cost of the bags into the price, persistent information campaigns to maintain people's environmental concerns, and enhancing enforcement at various locations and shopping occasions, may need to be adopted.

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Tables and Figures

Table 1. The time and spatial distribution of the observations in both surveys

Survey period	Beijing		Guiyang		All regions and shops
	supermarket	open market	supermarket	open market	
07:30-11:00	227	202	276	285	990
12:00-15:00	195	194	349	272	1010
17:30-20:00	202	190	276	406	1074
All periods	624	586	901	963	3074

Note: The three periods are the main shopping hours of the shops.

Table 2. Descriptive statistics of variables defining the relevant plastic bag use behaviors

Bag use behavior variables	Description	Before policy			After policy			P-value
		Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	
Self-reported behavior of plastic bag use in general								
Number of new plastic bags per week	= number of new plastic bags respondent uses per week (bag)	1039	20.923	18.221	2035	10.678	14.501	0.000[a]
Bag actual reuse time	= product of the average reuse proportion and average reuse time (time)	1039	0.746	0.642	2035	1.275	1.289	0.000[a]
Measurable behavior of plastic bag use during the surveyed shopping trip								
Use new bags or not	= 1 if respondent used new plastic bag during the surveyed shopping trip; =0 otherwise	1039	0.987	0.111	2035	0.564	0.496	0.000[b]
Number of new plastic bags used	= number of new plastic bags respondent uses during the surveyed shopping trip (bag)	1039	3.013	1.996	2035	1.079	2.159	0.000[a]
Average weight per new bag[c]	= respondent's average weight of goods in one new plastic bag during the surveyed shopping trip (Kg/bag)	1026	1.284	1.197	1148	1.877	2.101	0.000[a]
Expenditure percentage of goods not held in plastic bags	= respondent's percentage of total expenditure not held in plastic bag during the surveyed shopping trip (%)	1039	6.683	19.643	2035	41.260	45.305	0.000[a]

Notes: 1. [a] indicates it is from a t-test; [b] indicates it is from a proportional test; [c] This variable is only for the respondents who use new plastic bags at the time of shopping;

2. At the times of the surveys, 6.98 Chinese Yuan Renminbi = 1 USD (May 2008) and 6.85 Chinese Yuan Renminbi = 1 USD (November 2008).

Table 3. Definitions and descriptive statistics of variables used in econometric analyses

Variable	Description	Before policy			After policy			P-value	Before & after policy		
		Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.		Obs.	Mean	Std. Dev.
Supportive attitude	= respondent's support level of policy on a 1-5 scale, where 1 is does not support at all and 5 is strongly supports	1039	4.459	0.930	2035	4.069	1.067	0.000 [c]	3074	4.201	1.039
Inconvenience of not using plastic bags	= respondent's perception of inconvenience level without plastic bags on a 1-5 scale, where 1 is not inconvenient at all and 5 is very inconvenient	1039	2.740	1.375	2035	3.000	1.221	0.000 [c]	3074	2.912	1.281
Percentage of paid-for bags	= percentage of number of paid-for bags out of the total number of consumed plastic bags (%)	1039	0.000	0.000	2035	42.251	32.924	0.000 [a]	3074	27.970	33.422
Bag price in the current shop	= price of one bag in the shop of the surveyed shopping trip (yuan/bag)	1039	0.000	0.000	2035	0.206	0.168	0.000 [b]	3074	0.136	0.168
Age	= age of respondent (years)	1039	42.858	16.535	2035	40.620	16.894	0.001 [a]	3074	41.376	16.804
Male	= 1 if respondent is a male	1039	0.417	0.493	2035	0.460	0.499	0.021 [b]	3074	0.446	0.497
Businessman	= 1 if respondent works in sales or own business	1039	0.090	0.287	2035	0.099	0.298	0.460 [b]	3074	0.096	0.295
Rural register	= 1 if respondent is registered as a rural resident	1039	0.180	0.384	2035	0.201	0.401	0.154 [b]	3074	0.194	0.396
Education years	= respondent's years of schooling (years)	1039	12.398	3.242	2035	12.815	3.269	0.001 [a]	3074	12.674	3.266
Monthly income	= respondent's net monthly income divided by 1,000 (thousand yuan)	1039	2.178	1.674	2035	2.215	1.688	0.559 [a]	3074	2.203	1.683
Party member	= 1 if respondent is a communist party member	1039	0.226	0.419	2035	0.188	0.391	0.012 [b]	3074	0.201	0.401
Family size	= number of family members living in the respondent's household (persons)	1039	2.876	1.311	2035	2.975	1.457	0.065 [a]	3074	2.941	1.410

Notes: 1. [a] indicates it is from a t-test; [b] indicates it is from a proportional test; [c] indicates it is from a Wilcoxon-Mann-Whitney test;
2. At the time of the surveys, 6.98 Chinese Yuan Renminbi = 1 USD (May 2008) and 6.85 Chinese Yuan Renminbi = 1 USD (November 2008).

Table 4. Regression results from negative binomial models regarding weekly bag consumption

Model specification	[1] Negative binomial model 1 without interaction variables	[2] Negative binomial model 2 with interaction variables
Dependent variable	Number of new plastic bags per week	
	Mar. Eff.	Mar. Eff.
After policy implementation	-12.495 (14.88)***	-7.528 (1.68)*
Supportive attitude	-1.277 (6.37)***	-0.197 (0.56)
Inconvenience of not using plastic bags	0.420 (2.54)**	0.432 (1.68)*
Percentage of paid-for bags	-0.034 (4.18)***	-0.018 (2.28)***
Age	-0.002 (0.14)	0.040 (1.61)
Male	1.681 (4.08)***	1.239 (1.91)*
Businessman	2.463 (2.99)***	2.061 (1.57)
Rural register	0.704 (1.19)	0.476 (0.49)
Education years	-0.499 (6.53)***	-0.453 (3.75)***
Monthly income	0.582 (4.30)***	0.347 (1.55)
Party member	-0.614 (1.23)	-0.206 (0.26)
Family size	0.492 (3.41)***	0.733 (2.75)***
Supermarket	-4.559 (10.94)***	-2.990 (4.75)***
Guiyang	8.076 (18.44)***	2.681 (4.03)***
Attitude*After policy imple.		-1.204 (2.89)***
Inconvenience*After policy imple.		0.418 (1.29)
Age*After policy imple.		-0.068 (2.30)**
Male*After policy imple.		0.459 (0.56)
Businiessman*After policy imple.		0.895 (0.60)
Rural register*After policy imple.		0.997 (0.81)
Eduyear*After policy imple.		-0.051 (0.34)
Income*After policy imple.		0.065 (0.23)
Party member*After policy imple.		-0.234 (0.24)
Family size*After policy imple.		-0.506 (1.62)
Supermarket*After policy imple.		-2.238 (3.00)***
Guiyang*After policy imple.		10.694 (9.83)***
Dummies for weekdays and weekends/holidays	Yes	Yes
Dummies for time of day conducting survey	Yes	Yes
No. of Obs.	3074	3074
Pseudo R-square	0.051	0.06
Prob > chi2	0	0

Notes: 1. Absolute value of t or z statistics in parentheses;

2. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5. Regression results from negative binomial models regarding bag consumption during the surveyed shopping trip

Model specification	[1] Negative binomial model 1 without interaction variables	[2] Negative binomial model 2 with interaction variables
Dependent variable	Number of new plastic bags during the surveyed shopping trip	
	Mar. Eff.	Mar. Eff.
After policy implementation	-2.315 (19.49)***	-1.036 (2.03)**
Supportive attitude	-0.105 (4.26)***	0.038 (1.14)
Inconvenience of not using plastic bags	0.049 (2.45)***	0.020 (0.86)
Percentage of paid-for bags	0.003 (2.38)***	0.004 (3.73)***
Age	-0.007 (3.73)***	0.001 (0.26)
Male	0.140 (2.76)***	-0.051 (0.86)
Businessman	0.004 (0.05)	0.034 (0.31)
Rural register	-0.009 (0.13)	-0.239 (3.01)***
Education years	0.009 (1.00)***	0.007 (0.59)
Monthly income	0.056 (3.64)***	0.016 (0.80)
Party member	-0.165 (2.72)***	-0.017 (0.24)
Family size	0.027 (1.55)	0.035 (1.60)
Supermarket	-1.014 (18.94)***	-0.397 (6.75)***
Guiyang	0.231 (4.40)***	-0.091 (1.44)
Attitude*After policy imple.		-0.192 (4.4)***
Inconvenience*After policy imple.		0.104 (2.92)***
Age*After policy imple.		-0.017 (5.1)***
Male*After policy imple.		0.320 (3.33)***
Businiessman*After policy imple.		-0.021 (0.14)
Rural register*After policy imple.		0.555 (3.43)***
Eduyear*After policy imple.		0.020 (1.22)
Income*After policy imple.		0.026 (0.96)
Party member*After policy imple.		-0.262 (2.65)***
Family size*After policy imple.		-0.033 (1.08)
Supermarket*After policy imple.		-1.004 (13.83)***
Guiyang*After policy imple.		0.746 (6.84)***
Dummies for weekdays and weekends/holidays	Yes	Yes
Dummies for time of day conducting survey	Yes	Yes
No. of Obs.	3074	3074
Adjusted/pseudo R-square	0.118	0.151
Prob > chi2	0.000	0.000

Notes: 1. Absolute value of t or z statistics in parentheses;

2. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6. Descriptive statistics of the true value and predicted value of the number of new plastic bags per week after regulation implementation

	No. of Obs.	Mean	Std. Dev.
True weekly bag consumption under imperfect enforcement (Q^{T}_{imperf})	2035	10.678	14.501
Predicted weekly bag consumption by NB model under perfect enforcement ($Q^{P\_NB}_{perf}$)	2035	9.644	6.461

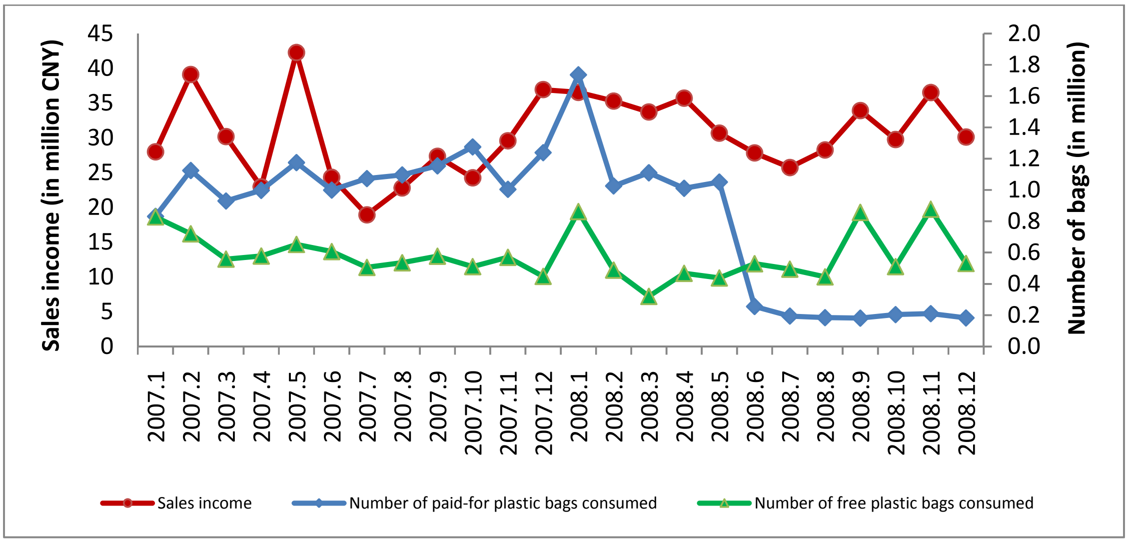

Figure 1. The sales income and the number of consumed plastic bags at the sampled supermarkets in Guiyang

Appendix. Tables

Table A1. Regression results from OLS and Tobit models regarding weekly bag consumption

Model specification	[1] OLS model 1 without interaction variable	[2] OLS model 2 with interaction variables	[3] Tobit model 1 without interaction variable	[4] Tobit model 2 with interaction variables
Dependent variable	Number of new plastic bags per week			
	M.E./Coef.	M.E./Coef.	Mar. Eff.	Mar. Eff.
After policy implementation	-10.716 (-14.75)***	-6.907 (-1.33)	-10.207 (-15.48)***	-6.724 (-1.47)
Supportive attitude	-1.168 (-4.25)***	-0.238 (-0.46)	-1.123 (-4.81)***	-0.190 (-0.43)
Inconvenience of not using plastic bags	0.475 (2.12)**	0.703 (1.87)*	0.456 (2.40)**	0.582 (1.84)*
Percentage of paid-for bags	-0.026 (-2.47)**	-0.027 (-2.52)**	-0.019 (-2.17)**	-0.019 (-2.07)**
Age	-0.015 (-0.73)	0.041 (1.17)	-0.028 (-1.64)	0.036 (1.20)
Male	1.519 (2.74)***	2.354 (2.48)**	1.518 (3.21)***	1.900 (2.36)**
Businessman	4.131 (4.23)***	4.235 (2.47)**	3.309 (3.76)***	3.481 (2.25)**
Rural register	0.836 (1.10)	0.917 (0.67)	0.858 (1.31)	0.794 (0.68)
Education years	-0.647 (-6.49)***	-0.929 (-5.28)***	-0.505 (-5.92)***	-0.755 (-5.10)***
Monthly income	0.567 (3.21)***	0.416 (1.30)	0.498 (3.31)***	0.351 (1.31)
Party member	0.196 (0.28)	0.635 (0.54)	0.080 (0.13)	0.467 (0.47)
Family size	0.485 (2.54)**	0.881 (2.41)**	0.380 (2.34)**	0.725 (2.36)**
Supermarket	-5.008 (-9.13)***	-5.331 (-5.76)***	-4.487 (-9.63)***	-4.328 (-5.58)***
Guiyang	7.473 (12.63)***	5.216 (5.15)***	6.972 (14.51)***	4.214 (5.10)***
Attitude*After policy imple.		-1.231 (-2.01)**		-1.212 (-2.34)**
Inconvenience*After policy imple.		-0.082 (-0.17)		0.137 (0.34)
Age*After policy imple.		-0.086 (-2.03)**		-0.100 (-2.78)***
Male*After policy imple.		-1.300 (-1.11)		-0.669 (-0.68)
Businiessman*After policy imple.		0.035 (0.02)		0.040 (0.02)
Rural register*After policy imple.		0.229 (0.14)		0.460 (0.33)
Eduyear*After policy imple.		0.423 (1.98)**		0.385 (2.13)**
Income*After policy imple.		0.195 (0.51)		0.162 (0.50)
Party member*After policy imple.		-0.587 (-0.40)		-0.488 (-0.40)
Family size*After policy imple.		-0.596 (-1.39)		-0.543 (-1.50)
Supermarket*After policy imple.		0.509 (0.44)		-0.256 (-0.26)
Guiyang*After policy imple.		3.244 (2.59)***		4.440 (4.12)***
Dummies for weekdays and weekends/holidays	Yes	Yes	Yes	Yes
Dummies for time of day conducting survey	Yes	Yes	Yes	Yes
No. of Obs.	3074	3074	3074	3074
Adjusted/Pseudo R-square	0.220	0.226	0.034	0.037
Prob > chi2	0.000	0.000	0.000	0.000

Notes: 1. Absolute value of t or z statistics in parentheses;
2. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A2. Regression results from OLS and Tobit models regarding bag consumption during the surveyed shopping trip

Model specification	[1] OLS model 1 without interaction variables	[2] OLS model 2 with interaction variables	[3] Tobit model 1 without interaction variables	[4] Tobit model 2 with interaction variables
Dependent variable	Number of new plastic bags during the surveyed shopping trip			
	M.E./Coef.	M.E./Coef.	Mar. Eff.	Mar. Eff.
After policy implementation	-2.132 (21.26)***	-1.109 (1.56)	-2.472 (23.53)***	-1.123 (1.68)*
Supportive attitude	-0.092 (2.43)**	0.083 (1.17)	-0.113 (3.38)***	0.056 (0.97)
Inconvenience of not using plastic bags	0.052 (1.67)***	0.048 (0.94)	0.061 (2.22)**	0.034 (0.80)
Percentage of paid-for bags	0.002 (1.51)	0.003 (1.76)*	0.004 (3.25)***	0.006 (4.05)***
Age	-0.007 (2.44)***	-0.000 (0.04)	-0.012 (4.65)***	0.001 (0.24)
Male	0.126 (1.64)	-0.112 (0.86)	0.147 (2.17)***	-0.089 (0.83)
Businessman	0.038 (0.28)	0.073 (0.31)	-0.040 (0.34)	0.050 (0.26)
Rural register	-0.090 (0.86)	-0.548 (2.92)***	0.019 (0.20)	-0.351 (2.47)**
Education years	0.014 (1.04)	0.019 (0.79)	0.016 (1.29)	0.014 (0.71)
Monthly income	0.058 (2.38)***	0.036 (0.83)	0.069 (3.23)***	0.023 (0.65)
Party member	-0.173 (1.77)*	-0.022 (0.13)	-0.198 (2.36)***	-0.025 (0.19)
Family size	0.042 (1.59)	0.089 (1.78)*	0.027 (1.15)	0.060 (1.46)
Supermarket	-1.081 (14.28)***	-0.930 (7.33)	-1.142 (16.99)***	-0.612 (5.88)***
Guiyang	0.216 (2.64)***	-0.223 (1.61)	0.374 (5.26)***	-0.129 (1.13)
Attitude*After policy imple.		-0.224 (2.67)***		-0.223 (3.16)***
Inconvenience*After policy imple.		0.049 (0.76)		0.105 (1.91)*
Age*After policy imple.		-0.010 (1.72)*		-0.022 (4.43)***
Male*After policy imple.		0.320 (1.99)**		0.338 (2.38)***
Businiessman*After policy imple.		0.023 (0.08)		-0.067 (0.29)
Rural register*After policy imple.		0.692 (3.06)***		0.660 (3.04)***
Eduyear*After policy imple.		-0.005 (0.18)		0.013 (0.52)
Income*After policy imple.		0.010 (0.20)		0.040 (0.92)
Party member*After policy imple.		-0.230 (1.15)		-0.274 (1.71)*
Family size*After policy imple.		-0.082 (1.39)		-0.067 (1.35)
Supermarket*After policy imple.		-0.194 (1.23)		-0.846 (6.98)***
Guiyang*After policy imple.		0.672 (3.90)***		0.898 (5.87)***
Dummies for weekdays and weekends/holidays	Yes	Yes	Yes	Yes
Dummies for time of day conducting survey	Yes	Yes	Yes	Yes
No. of Obs.	3074	3074	3074	3074
Adjusted/pseudo R-square	0.225	0.240	0.088	0.104
Prob > chi2	0.000	0.000	0.000	0.000

Notes: 1. Absolute value of t or z statistics in parentheses;

2. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A3. Regression results from negative binomial, OLS and Tobit models regarding bag consumption during the surveyed shopping trip with price information

Model specification	[1] Negative binomial model 1 without interaction variables	[2] Negative binomial model 2 with interaction variables	[3] OLS model 1 without interaction variables	[4] OLS model 2 with interaction variables	[5] Tobit model 1 without interaction variables	[6] Tobit model 2 with interaction variables
Dependent variable	Number of new plastic bags during the surveyed shopping trip					
	Mar. Eff.	Mar. Eff.	M.E./Coef.	M.E./Coef.	Mar. Eff.	Mar. Eff.
After policy implementation	-1.489 (14.02)***	-0.826 (1.71)***	-1.789 (14.76)***	-0.899 (1.26)	-1.872 (15.45)***	-0.873 (1.33)
Bag price in the current shop	-3.305 (14.02)***	-1.557 (4.83)***	-1.760 (5.00)***	-1.582 (3.66)***	-2.913 (9.13)***	-1.882 (4.58)***
Supportive attitude	-0.084 (3.64)***	0.037 (1.13)	-0.084 (2.21)***	0.083 (1.16)	-0.099 (2.97)***	0.056 (0.96)
Inconvenience of not using plastic bags	0.049 (2.62)***	0.020 (0.85)	0.055 (1.78)***	0.048 (0.93)	0.066 (2.43)***	0.033 (0.79)
Percentage of paid-for bags	0.006 (5.36)***	0.005 (4.4)	0.003 (2.21)***	0.003 (2.06)***	0.006 (4.79)***	0.006 (4.44)***
Age	-0.006 (3.35)***	0.001 (0.26)	-0.006 (2.25)***	-0.000 (0.03)	-0.011 (4.43)***	0.001 (0.25)
Male	0.120 (2.55)***	-0.051 (0.87)	0.124 (1.63)	-0.112 (0.86)	0.140 (2.08)***	-0.090 (0.84)
Businessman	-0.004 (0.05)	0.035 (0.32)	0.027 (0.20)	0.074 (0.32)	-0.056 (0.49)	0.052 (0.27)
Rural register	-0.004 (0.06)	-0.238 (3.01)***	-0.083 (0.79)	-0.548 (2.92)***	0.036 (0.38)	-0.350 (2.47)***
Education years	0.014 (1.65)	0.007 (0.59)	0.017 (1.21)	0.019 (0.79)	0.020 (1.64)	0.014 (0.72)
Monthly income	0.037 (2.60)	0.015 (0.80)	0.050 (2.04)***	0.036 (0.82)	0.056 (2.64)***	0.023 (0.64)
Party member	-0.141 (2.49)***	-0.018 (0.25)	-0.167 (1.71)***	-0.022 (0.14)	-0.187 (2.24)***	-0.025 (0.20)
Family size	0.040 (2.41)***	0.035 (1.61)	0.050 (1.90)***	0.090 (1.79)***	0.040 (1.70)***	0.060 (1.47)
Supermarket	-0.581 (10.33)***	-0.396 (6.75)***	-0.825 (9.05)***	-0.930 (7.34)***	-0.733 (9.08)***	-0.611 (5.89)***
Guiyang	0.010 (0.19)	-0.091 (1.44)	0.055 (0.63)	-0.223 (1.61)	0.134 (1.75)***	-0.130 (1.13)
Attitude*After policy imple.		-0.193 (4.44)***		-0.223 (2.65)***		-0.221 (3.13)***
Inconvenience*After policy imple.		0.106 (2.98)***		0.050 (0.78)		0.107 (1.94)***
Age*After policy imple.		-0.016 (4.85)***		-0.009 (1.62)		-0.022 (4.29)***
Male*After policy imple.		0.329 (3.42)***		0.332 (2.07)***		0.346 (2.43)***
Businiessman*After policy imple.		-0.028 (0.20)		0.005 (0.02)		-0.083 (0.35)
Rural register*After policy imple.		0.564 (3.47)***		0.703 (3.11)***		0.677 (3.11)***
Eduyear*After policy imple.		0.023 (1.45)		-0.004 (0.12)		0.016 (0.62)
Income*After policy imple.		0.022 (0.81)		0.005 (0.09)		0.036 (0.81)
Party member*After policy imple.		-0.262 (2.64)***		-0.226 (1.13)		-0.269 (1.67)***
Family size*After policy imple.		-0.027 (0.87)		-0.075 (1.28)		-0.060 (1.21)
Supermarket*After policy imple.		-0.679 (6.55)***		0.160 (0.86)		-0.434 (2.74)***
Guiyang*After policy imple.		0.469 (4.04)***		0.441 (2.41)***		0.607 (3.70)***
Dummies for weekdays and weekends/holidays	Yes	Yes	Yes	Yes	Yes	Yes
Dummies for time of day conducting survey	Yes	Yes	Yes	Yes	Yes	Yes
No. of Obs.	3074	3074	3074	3074	3074	3074
Adjusted/pseudo R-square	0.135	0.153	0.231	0.243	0.095	0.105
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000

Notes: 1. Absolute value of t or z statistics in parentheses;
2. * significant at 10%; ** significant at 5%; *** significant at 1%.

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Table A4. Regression results from the negative binomial model regarding weekly bag consumption after regulation implementation

Model specification	Negative binomial model
Dependent variable	Number of new plastic bags per week
	Mar. Eff.
Supportive attitude	-1.044 (5.76)***
Inconvenience of not using plastic bags	0.626 (3.88)***
Percentage of paid-for bags	-0.015 (2.31)**
Age	-0.023 (1.7)*
Male	1.234 (3.13)***
Businessman	2.412 (2.96)***
Rural register	1.180 (2.02)**
Education years	-0.360 (4.94)***
Monthly income	0.315 (2.43)**
Party member	-0.282 (0.57)
Family size	0.169 (1.30)
Holiday or weekend	-1.312 (3.44)***
Noon	-1.949 (4.42)***
Afternoon	-0.825 (1.77)*
Supermarket	-4.069 (9.74)***
Guiyang	8.314 (20.97)***
Dummies for weekdays and weekends/holidays	Yes
Dummies for time of day conducting survey	Yes
No. of Obs.	2035
Adjusted/pseudo R-square	0.057
Prob > chi2	0.000

Notes: 1. Absolute value of z statistics in parentheses;

2. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table A5. The results of statistical tests of the further reduction

Null hypothesis	$Q^{T}_{imperf} = Q^{P\_NB}_{perf}$
Differences in mean consumption	1.034
t-test (p-value)	0.000
Rank-sum test (p-value)	0.000
No. of Obs: Q^{A} / Q^{P}	2035/2035

Note: Q^{T}_{imperf} denotes the true weekly bag consumption under imperfect enforcement; $Q^{P\_NB}_{perf}$ denotes the predicted weekly bag consumption by the NB model under perfect enforcement

Paper 2

Can Stated Preference Methods Accurately Predict Responses to Environmental Policies?
The Case of a Plastic Bag Regulation in China

Haoran He[*,†]

Abstract

This study investigates the validity of using stated preference (SP) estimates to predict policy effects on plastic bag consumption. Before implementation of a plastic bag regulation, when bags were still free of charge, we utilized an SP survey to elicit consumers' contingent bag consumption in certain possible pricing scenarios. Following implementation of the regulation mandating charging for bags, we conducted another survey to collect actual consumption information. We thus have unique data to compare stated and revealed consumption. The comparison results show that consumers' behavioral reactions to a policy change can be predicted reasonably well with SP techniques.

Key word: China; contingent behavior; external validity; plastic bags; revealed behavior; stated preference

JEL classification: C93, D12, Q53

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Acknowledgements: I would like to thank Fredrik Carlsson, Michael Hanemann, Mitesh Kataria, Peter Martinsson, Jiegen Wei, Qian Weng, and seminar participants at Peking University and the University of Gothenburg for extremely helpful discussions and comments on this paper. I am also grateful to the field work support team from Guizhou University and Peking University. All errors and omissions remain the sole responsibility of the author. Financial support from Swedish International Development Cooperation Agency (Sida) to the Environmental Economics Unit at the University of Gothenburg is gratefully acknowledged.

1. Introduction

The designs of many important economic policies – e.g., tax policies, price policies, migration policies, and even social security policies – often rely on their expected effects. Accurately predicting potential effects of policies, therefore, is important since implementing improper policies is costly, and it is often difficult to adjust policies after they have been implemented. Thus, the validity of predicted policy effects is an important area of research. The more accurately policy effects can be predicted *ex-ante*, the easier it is to design policies or to select them from a large number of available alternatives.

If similar policies have been implemented elsewhere, one can forecast the effects of a policy based on past experiences. However, if a policy is new or if the experiences from previous policies are inadequate, there are two main alternatives to predict the effects of the policy: survey methods and experimental methods. Survey methods, with merits of describing the situation closest to reality and obtaining direct reactions from subjects in the field, are the most common methods for investigating the potential effects of policies. However, the question of the external validity of survey estimates remains. On the other hand, experimental methods, despite usually providing better incentives for subjects to reveal preferences by mirroring policy change situations in experimental environments, also have their shortcomings. For example, field experiments, if not too difficult to be applied, may suffer problems such as high time demand and/or large expenses (Burtless, 1995), and lab experiments may suffer more serious external validity problems due to difficulties in creating consistent test conditions for many policies (Levitt and List, 2007). Although lessons have been learned from a number of studies concerning the external validity of these methods, very few studies have examined the prediction accuracy by making use of a real policy change. In the present paper, we conducted two rounds of surveys in the *ex-ante* and *ex-post* counterpart situations created by implementation of an environmental regulation regarding plastic bag consumption in China. The aims of this article are (1) to investigate the possible discrepancy between predicted, i.e., stated contingent behaviors elicited from a pre-policy survey, and actual behavior revealed by a follow-up survey after the policy was implemented and (2) to address what factors influence the direction and magnitude of the potential bias.

Similar market-based plastic bag regulations have been implemented in several countries, with mixed results. The policies have achieved success in reducing plastic bag consumption in developed countries such as Denmark (Danish EPA, 1999) and Ireland (Convery *et al*., 2007); while seemingly similar policies have rapidly lost effectiveness in developing countries like South Africa (Hasson *et al*., 2007). In June 2008, the Chinese government implemented a nationwide environmental regulation against the use of plastic shopping bags[1]. The key feature of the regulation is to force all shops to charge for plastic bags, and each shop can set the price of the bags at a level no less than their own acquisition costs (Chinese Ministry of Commerce *et al*., 2008; Chinese National Development and Reform Commission, 2008). There were no major economic changes or relevant actions or publicity campaigns with respect to the use of plastic bags[2] during the period between our two surveys, so the changes in behavior were clearly due to the new regulation.[3] We used a stated preference (SP) method in the *ex-ante* survey to elicit consumers' contingent behavior of plastic bag consumption, and then recorded their actual revealed behaviors using the *ex-post* survey.[4] Then we compared the two behaviors and analyzed the external validity of the SP survey estimates.

Due to the difficulties of finding opportunities to conduct tests using real policy changes, very few studies investigate the prediction validity of SP estimates by predicting

[1] In the remainder of this paper, "plastic shopping bag" is abbreviated to "plastic bags" or "bags" in most places.

[2] Public campaigning for the reduction of plastic bag use occurred before June 2008 when the regulation had not yet been implemented.

[3] We obtained detailed information about monthly sales income and plastic bag consumption from half of the supermarkets where the surveys were conducted during a two year period from January 2007 to December 2008. The data demonstrates invariability of monthly free plastic bag consumption and monthly sales income, while the consumption of plastic bags dwindled drastically immediately after the regulation implementation with stable consumption both before and after the implementation. From the supermarket data, we do not find seasonal effects in the plastic bag consumption. For more information, see He (2010).

[4] Apart from reducing the number of plastic bags consumed, the regulation also changed other types of behavior related to plastic bag use, such as carrying more goods in each plastic bag, more reuse of the bags, and use of more substitutes. It is worth noting that the reduction in plastic bag consumption is part of the confound effects of the regulation. This discussion is beyond the scope of the present study; for more details, see He (2009).

effects of a real policy change.[5] Instead, the main criteria used to test the validity of SP predictions are built on results from revealed preference (RP) methods[6] or experimental methods. As for the comparisons between SP and RP results, e.g., Carson *et al*. (1996) provide a meta-analysis of 83 studies of quasi-public goods containing 616 comparisons between results from SP and RP methods. They find that, on average, SP methods provide lower estimates than do RP methods. Nevertheless, since estimates from RP techniques measure the desired quantity but still with error,[7] the reliability of using the RP estimates as criteria to determine the validity of SP estimates could be problematic. In recent years, experimental estimates and real market data have increasingly been used to serve as comparison criteria for SP estimates. Shogren *et al*. (1999) in a natural field experiment compare the mail survey and lab experimental estimates with the actual consumer purchase of irradiated chicken, which had recently appeared on the market. They find a significantly higher level of acceptance of the irradiated chicken in both the survey and the lab estimations than in the real retail market, and that the estimates of consumers' choices are closer to the real behavior in the market when the prices are higher. Similarly, Lusk *et al*. (2006) find that more moralistic and pro-social preferences are stated in a framed field experiment than in a natural field experiment's real-world setting regarding antibiotic-friendly pork consumption. On the other hand, Chang *et al*. (2009) examine the accuracy of estimates from three preference elicitation methods (hypothetical choices, non-hypothetical choices, and non-hypothetical rankings) for environmentally-friendly consumer goods and organic food and find that estimates from all methods show a high level of external validity. It is worth noting that most previous studies concerning external validity have used goods that were new to consumers, and the researchers have tried to provide the new items a prominent shelf position or even an introduction to the good or a reminder in their positions, which is likely to attracting consumers' attention and therefore induce more purchases. Additionally, since the comparison criteria in previous

[5] The only study we are aware of is Lampi and Orth (2009). The authors examine the validity of SP estimates by examining the change in composition of museum visitors and by making use of a real public policy change,

[6] Revealed preference methods refer to the hedonic pricing method, the recreation demand and travel cost method, the averting behavior method, the cost of illness method, etc.

[7] For more detailed discussions, see, e.g., Mitchell and Carson (1989) and Carson *et al.* (1996).

studies are usually market shares in a single grocery store during a relatively short period, the criteria could be made more reliable by obtaining data from a wide range of time frames and situations.

There are two main explanations for the possible discrepancy between predicted behavior stated in surveys and subsequent actual behavior. The first explanation is respondents' uncertainty about their preferences due to, e.g., unfamiliarity with the situation they are being asked about *ex-ante*. Gradual learning later on can thus lead the respondents to display different preferences. The second explanation is respondents' strategic behavior aiming at somehow influencing the policy. For example, a respondent could intentionally state systematically biased preferences regarding the value or the consumption of the goods or services when asked *ex-ante*. The design of this study tries to take into account the aforementioned two sources of possible prediction bias. By utilizing a well-known everyday good, the surveyed respondents were already familiar with the good. We conducted the *ex-ante* SP survey close to the regulation implementation date when most of consumers were well aware of the forthcoming policy and its content. This made the respondents more likely to state their real preference to the given policy change rather than to present strategic answers in an effort to influence the policy. Our goal with the design is to diminish the possible discrepancy between the predicted and actual behavior. In addition, the consumption decisions were made by a wide range of ordinary citizens in various types of shops with substantial variations in major demographic variables. We use a publicly known environmentally-harmful good so that we can further take respondents' incentives to perform more pro-socially into account, an incentive present in many SP studies.

In addition to noting the potential advantages of using a naturally occurring policy change as a tool, it is also important to note the disparities between our study and standard SP studies. First, based on plastic bag pricing information, we investigated consumers' contingent behavior at three likely prices but did not randomize their presenting order in the hypothetical scenario. Second, since the bags are likely to be necessary goods for people, this study considers the number of bags consumed rather than willingness to pay for them. Third, while most SP studies push respondents to make choices regarding a policy change that is new to them, respondents in this study, well-informed about the forthcoming policy before being involved in the survey, might have already thought about how to respond. Despite the discrepancies, our study at least captures the difference between hypothetically stated responses without monetary payoff and actual revealed consumption behavior with real costs in real market situations.

Overall, our findings suggest an accurate prediction of the survey SP method, which enhances confidence in forecasting potential policy effects with survey methods. The remainder of the paper proceeds as follows: Section 2 introduces the experimental design and the econometric model and Section 3 discusses the data. The results are reported in Section 4 and Section 5 concludes the paper.

2. Methodology

2.1. Experimental design

With a between-subject design, intercept surveys were conducted at the exit of shops, both *ex-ante* and *ex-post* the policy change. Both surveys needed to be conducted in the same shops and during the same time of day in order to obtain comparable samples. In addition to it being easier to recruit different subjects from the same sample pool than to recruit the same subjects for both surveys conducted at different time, another advantage of using a between-subjects design is that it avoids correlation of the answers from using the same subjects in both surveys.

The *ex-ante* survey was conducted one month before the implementation when most citizens were well aware of the forthcoming regulation. Thus, the questions in our survey could be easily understood and handled by the subjects.[8] In the *ex-ante* survey, apart from collecting the information about subjects' characteristics and their actual consumption of

[8] At the time of the *ex-ante* survey, more than 80% of the subjects in the survey reported they knew about the regulation before the survey. However, we interviewed both consumers and shop managers about whether behavioral changes with respect to plastic bag use appeared after dissemination of the news of the forthcoming regulation, and none of the interviewees reported that any change had occurred, which is consistent with the evidence from the supermarkets' formal record. For more details, see He (2009).

plastic bags at zero price, a series of valuation questions[9] were asked to elicit consumers' contingent behavior with respect to plastic bag consumption at certain hypothetical prices contingent on perfect enforcement of the regulation.[10] Figure 1 shows the structure of the questions.

<Figure 1 to be here>

In the *ex-ante* SP survey, rather than directly asking about the respondents' predicted bag consumption, we focused on investigating their free bag consumption and predicted reduction behavior given certain prices with perfect regulation enforcement, and then calculated the predicted bag consumption. Since the regulation allows the individual shops to set their own prices for plastic bags, yet at a level no lower than the acquisition cost, it was too difficult to forecast accurate prices for the plastic bags in the shops before the regulation. We set the predicted most likely average price to 0.5 Chinese Yuan Renminbi (yuan) per bag in consultation with experts in plastic bag manufacturing, retail trade, and the government sector.[11] We expected that there would be some price variation occurring in the market after the implementation due to the price being set by individual shops. We therefore included another two possible prices, 0.3 and 1 yuan, in order to cover the effects of a wider range of price fluctuation on bag consumption. Specifically, beginning with giving the main hypothetical price 0.5 yuan, the enumerators asked the subjects to choose among three options, "the same use," "reduce use," and "stop use." If the option "reduce use" was chosen, the specific percentage reduction range needed to be answered. Based on the responses to the main hypothetical price, one or both of the two other price options were asked.

[9] See Appendix 2 for the questions asked in the *ex-ante* survey questionnaire.

[10] Although we understood that perfect enforcement of the regulation would be highly unlikely, we kept the perfect enforcement condition throughout the valuation questions for simplicity of cognition reasons. We then asked detailed questions about the actual regulation enforcement faced by each respondent in the *ex-post* survey so that we would be able to control for differences in the enforcement of the regulation.

[11] We considered all the information we had before the regulation when the *ex-ante* survey was about to be conducted, such as the cost of plastic materials for making plastic bags, the cost of transporting the bags, implementation preparation by the government sector, retailers' attitude toward cooperating with the enforcement and towards profiting from the charging, and other relevant information we had at that time.

Given the structure of the questions, subjects could make 11 possible patterns of choices. Two of the choices are inconsistent and are marked with crosses in Figure 1. All subjects first gave their responses to the major price of 0.5 yuan, while fewer subjects then responded to the 0.3 yuan price and even fewer responded to the 1 yuan price. However, bearing in mind that plastic bag demand is non-decreasing in price,[12] we can complement many responses at the non-answered prices and construct a more complete dataset by utilizing the following two deduction rules: First, when a higher price was given, if a subject answered that she would consume the same amount of plastic bags as before when the price was zero, we deduce that she would also consume the same amount at lower prices. Second, if a subject answered that she would stop using plastic bags when a certain price was given, we deduce that she would also stop using the bags at higher prices.

The *ex-post* survey was conducted about four or five months after the regulation implementation in order to make sure that citizens had enough time to adjust to the regulation. In the *ex-post* survey, we collected information about the average price of paid-for plastic bags faced by subjects and about subjects' bag consumption and socioeconomic characteristics.[13] The survey was conducted in the same shops during the same daily time periods as in the *ex-ante* survey. After the implementation, two of the three hypothetical prices turned out to be the common plastic bag average prices faced by consumers while the price of 1 yuan has rarely been faced. Therefore, only the 0.3 and 0.5 yuan prices are applied for the tests in this paper. As expected, the actual enforcement is not perfect and varies across regions, residential areas, and types of shops. In order to control for the variation in enforcement, we recorded extra information about each subject's percentage of paid-for bags out of her total number of consumed plastic bags. We further recorded each subject's actual percentage reduction in bag consumption in the shops that charged for bags, as compared to their consumption when these shops

[12] The third most common choice pattern in Table 4 below demonstrates the negative correlation between plastic bag consumption and price.

[13] See Appendix 2 for the questions asked in the *ex-post* survey questionnaire.

provided bags for free[14]. We then can use the extra information to adjust the actual plastic bag consumption under imperfect enforcement into a measure of consumption under the assumption that all shops charging for bags by using the methods presented in Section 2.2.

2.2. Hypothesis

The main purpose of this study is to compare consumers' pre-regulation predicted consumption behavior with their actual consumption afterwards; therefore, we have the null hypothesis that consumers' predicted bag consumption is equal to their actual bag consumption. In order to test this hypothesis, we need to have the following information: their predicted consumption ($\boldsymbol{Q_p^P}$) of plastic bags under certain hypothetical prices before regulation implementation, and their actual consumption ($\boldsymbol{Q_p^A}$) of plastic bags when were faced with the same but real prices after the implementation. In the *ex-ante* survey, given a certain price (e.g., $\boldsymbol{p=0.5}$ yuan) in the hypothetical scenario with perfect enforcement "if all shops charge for plastic bags," we elicited the *ex-ante* predicted total bag consumption ($\boldsymbol{Q_{p=0.5}^{P\_total}}$). Since in the hypothetical scenario all bags are charged for a price, the predicted free bag consumption ($\boldsymbol{Q_{p=0.5}^{P\_free}}$) is zero and the predicted total bag consumption is equal to the predicted paid-for bag consumption ($\boldsymbol{Q_{p=0.5}^{P\_paid}}$).

$$\boldsymbol{Q_{p=0.5}^{P\_total}} = \boldsymbol{Q_{p=0.5}^{P\_paid}} + \boldsymbol{Q_{p=0.5}^{P\_free}} = \boldsymbol{Q_{p=0.5}^{P\_paid}} + \boldsymbol{0} = \boldsymbol{Q_{p=0.5}^{P\_paid}} \tag{1}$$

In the *ex-post* survey, we recorded the actual total bag consumption. Given the complex situation of regulation enforcement afterwards, we need to adjust the *ex-post*

[14] For example, a consumer's weekly bag consumption was 100 free bags before the regulation and 20 paid-for bags and 60 free bags afterwards since some shops did not enforce the regulation. Therefore, the consumer's actual percentage reduction in the shops that charged for bags is 50% (= bag consumption reduction / (free bag consumption *ex-ante* - free bag consumption *ex-post*) = 20 / (100 - 60)).

actual total bag consumption $(\boldsymbol{Q_{p=0.5}^{A\_total}})$ by taking the imperfect enforcement into account. We obtain the *ex-post* adjusted actual total bag consumption $(\boldsymbol{Q_{p=0.5}^{A\_adjusted\ total}})$ through the following procedure:

Since the regulation failed to be perfectly enforced, i.e., some shops still provided the bags for free after the implementation, the *ex-post* actual total bag consumption is equal to the sum of the *ex-post* actual paid-for bag consumption bought at average price ***p*** $(\boldsymbol{Q_{p=0.5}^{A\_paid}})$ and the *ex-post* actual free bag consumption $(\boldsymbol{Q_{p=0.5}^{A\_free}})$.

$$\boldsymbol{Q_{p=0.5}^{A\_total} = Q_{p=0.5}^{A\_paid} + Q_{p=0.5}^{A\_free}} \tag{2}$$

As mentioned in Section 2.1, we recorded individual consumers' percentage of paid-for bags out of total bag consumption. This enables us to identify both of the components of the *ex-post* actual total bag consumption.

$$\boldsymbol{Q_{p=0.5}^{A\_paid} = Q_{p=0.5}^{A\_total} * \textit{percentage of paid-for bags}} \tag{3}$$

$$\boldsymbol{Q_{p=0.5}^{A\_free} = Q_{p=0.5}^{A\_total} * \textit{(1 - percentage of paid-for bags)}} \tag{4}$$

In general, consumers would only use some (but not all) of the free bags if they were required to pay for them. Since we recorded individual consumers' actual percentage reduction in bag consumption in the shops that charged for bags (***actual percentage reduction from p=0 to p=0.5***), we can adjust the *ex-post* actual free bag consumption in the shops that did not charge for bags to the *ex-post* actual free to paid-for bag consumption ($\boldsymbol{Q_{p=0.5}^{A\_free\ to\ paid}}$).[15]

$$\boldsymbol{Q_{p=0.5}^{A\_free\ to\ paid}} = \boldsymbol{Q_{p=0.5}^{A\_free}} \textbf{\textit{ * (1 - actual percentage reduction from p=0 to p=0.5)}} \quad (5)$$

Then we can estimate the *ex-post* adjusted actual total bag consumption ($\boldsymbol{Q_{p=0.5}^{A\_adjusted\ total}}$) conditional on all shops charging for plastic bags.

$$\boldsymbol{Q_{p=0.5}^{A\_adjusted\ total}} = \boldsymbol{Q_{p=0.5}^{A\_paid}} + \boldsymbol{Q_{p=0.5}^{A\_free\ to\ paid}} \quad (6)$$

Therefore, by taking the imperfect enforcement into account, we can finally construct the null hypothesis of the validity test under the circumstance of perfect enforcement: the *ex-post* adjusted actual total bag consumption is equal to the *ex-ante* predicted total bag consumption at the same 0.5 yuan price.

Hypothesis: ***H0:*** $\boldsymbol{Q_{p=0.5}^{A\_adjusted\ total}} = \boldsymbol{Q_{p=0.5}^{P\_total}}$ (7)

Statistical tests will be performed for the hypothesis at each of the 0.3 and 0.5 yuan prices, respectively. It is worth noting that the *ex-post* adjusted actual total bag consumption used in the hypothesis includes the component *ex-post* actual free to paid-

[15] An underlying assumption is imposed for the adjustment of the *ex-post* actual free bag consumption, i.e., if shops that still provide free bags start to charge for bags at the same average prices as the shops that have already been charging, the percentage reduction in bag consumption in the former shops is the same as the actual percentage reduction in bag consumption in the latter shops.

for bag consumption ($\boldsymbol{Q_p^{A\_free\ to\ paid}}$) that is a product of the subjects' actual total bag consumption per week multiplying two fractions[16], which could be a noisy measurement. We therefore conduct multivariate tests with different types of controls of the regulation enforcement to circumvent difficulties associated with the statistical tests.

2.3. Experimental procedures

We want to control for the possibility that customers who are in different cities or areas and who typically shop at different shops and at different times of day are systematically different. We therefore conducted two parallel surveys in two cities, Beijing and Guiyang. While Beijing is the capital and one of the most developed metropolitan areas in China, Guiyang is a medium-sized city located in one of the most underdeveloped provinces. We conducted surveys in the two most frequently visited types of shops, i.e., supermarkets and open markets. Consumers shopping at supermarkets are generally considered to have a higher income and standard of living than those shopping in open markets. Three main residential areas in each city were chosen, and the surveys were conducted in one large supermarket and one large open market in each area. Furthermore, we conducted the surveys on both weekdays and weekends/public holidays, and at three times of day, i.e., morning, noon/early afternoon, and late afternoon/early evening. As presented in Table 1, we attempted to distribute our observations evenly across the dimensions in order to obtain representative and comparable samples.

<Table 1 to be here>

The sampling procedure of interviews was carried out as follows: Every third shopper that exited the shop[17] was approached by the enumerators and asked if she would

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[16] That is, the *ex-post* actual free to paid-for bag consumption is a fraction of the *ex-post* actual free bag consumption that is a fraction of the *ex-post* actual total bag consumption. Due to the impossibility of accurately forecasting the *ex-post* policy enforcement situation, this is the best measurement we can find given the complexity of the *ex-post* enforcement situation.

[17] If more than one person exited at a time, the enumerators always counted them from left to right in order to select the "third" subject.

like to participate in a survey that would last a few minutes. If the selected consumer refused to participate, the enumerator approached the very next shopper. If this person agreed to participate, then the enumerator completed the survey and then proceeded to the next "third" shopper. We ended up with 3,074 interviewed respondents[18]. The most commonly stated reason for refusing to participate was lack of time. We believe that the sample selection bias (if any) can be cancelled out by the use of the between-survey comparisons.

2.4. Multivariate testing: econometric method

In order to test the validity of consumers' predicted consumption as compared to their actual revealed consumption while controlling for other influential factors, we use econometric models. In the first type of multivariate test, we estimate a model including both the *ex-ante* and the *ex-post* subjects who faced the same hypothetical or actual prices. Accordingly, the dependent variable refers to the combination of both the *ex-ante* predicted total number of new plastic bags used per week at certain hypothetical prices ($\boldsymbol{Q_p^{P\_total}}$) and the *ex-post* self-reported actual total number of new plastic bags used per week ($\boldsymbol{Q_p^{A\_total}}$) at the same but real prices. It is worth noting that $\boldsymbol{Q_p^{P\_total}}$ is continuous since it is a fraction of a consumer's *ex-ante* actual total bag consumption per week. The dummy variable "actual price" is included to identify whether or not the subjects faced actual prices. Since a proportion of subjects did not using new plastic bags, we apply a Tobit model (Wooldridge, 2002).

$$\boldsymbol{Q^{*}= X\beta + \varepsilon, \quad Q = max\ (0, Q^{*}),} \tag{8}$$

[18] In total, we asked about four thousand customers to obtain the 3074 respondents. Moreover, we discard 18 observations considered as outliers since these respondents consumed an extremely high number of new plastic bags per week.

where the dependent variable Q^* denotes the combination of the predicted and actual total bag consumption per week at the same hypothetical or real prices,[19] and the independent variable vector $\boldsymbol{X}$ has several components, i.e., $\boldsymbol{X} = (\boldsymbol{X_0}, \boldsymbol{X_i}, \boldsymbol{X_j}, \boldsymbol{X_m}, \boldsymbol{X_n}, \boldsymbol{X_r})$. The independent variable $\boldsymbol{X_i}$ refers to the key dummy variable "actual price," while the others act as controls in the multivariate tests: $\boldsymbol{X_j}$ denotes consumers' self-reported percentage of paid-for plastic bags out of their total bag consumption[20], which is capturing the enforcement of the regulation; $\boldsymbol{X_m}$ expresses the variables regarding consumers' cognition of the policy and of not using plastic bags provided by shops; $\boldsymbol{X_n}$ refers to the socioeconomic variables of the respondents and their families; and $\boldsymbol{X_r}$ denotes variables used to control bag use behavior shifts due to regional discrepancy, market type difference, weekday/weekend, and time of day. We take the first element $\boldsymbol{X_0}$ to be unity. We will explain all the variables in detail in the next section.

In the second type of multivariate test, we use another adjustment approach to consider the imperfect regulation enforcement: We replace the *ex-post* actual total number of new plastic bags used per week ($\boldsymbol{Q_p^{A\_total}}$) with the *ex-post* adjusted actual total number of new plastic bags used per week ($\boldsymbol{Q_p^{A\_adjusted\ total}}$) as a part of the dependent variable. Therefore, we insert the control of the imperfect regulation enforcement directly into the dependent variable. We still keep the predicted total number of new plastic bags used per week at the same hypothetical prices ($\boldsymbol{Q_p^{P\_total}}$) in the dependent variable. We then estimate a similar Tobit model except that we do not contain the regulation enforcement variable in the model since we have corrected the imperfect enforcement in the dependent variable.

In both tests, we control for other factors that could affect subjects' plastic bag consumption. The coefficients of the "actual price" dummy variables indicate the extra effect of the actual price on the number of plastic bags consumed, as compared to the effect of the same hypothetical price. If the impact of actual prices on consumption is the

[19] However, we only observe Q^* when Q^* is equal to or greater than zero. Therefore, Q is used to refer to the observed number of new plastic bags used per week.

[20] As mentioned, the percentage of paid-for bags is given to be 100% in the hypothetical scenario for all the subjects participating in the *ex-ante* survey.

same as that of hypothetical prices, i.e., if consumers at a real price actually consume what they predicted they would consume at the same hypothetical price in the *ex-ante* SP survey, then the coefficient of the variable should not be significantly different from zero; otherwise, the coefficient should be significantly positive (negative) if consumers underestimate (overestimate) their actual consumption of plastic bags after the regulation. The same models are applied for the 0.3 and 0.5 yuan prices.

3. The data

3.1. Descriptive statistics of characteristics

The descriptive statistics of potentially influential factors are presented in Table 2, sorted by different sub-groups of the sample. Column [1] shows the information for the 1,025 subjects from the *ex-ante* survey who faced the hypothetical prices 0.3 and 0.5 yuan. The figures in Columns [2] and [3] reflect the information for the 1,595 and 337 subjects from the *ex-post* survey who faced the average actual prices 0.3 or 0.5 yuan, respectively. Column [4] summarizes the statistics for all observations from both surveys.

Following implementation, only slightly more than 40 percent of the bags are paid for, which indicates an unsatisfying imperfect enforcement of the regulation. All the other variables vary much less dramatically across different groups of the sample. The proportion of subjects who knew about the regulation increased from 89% before the implementation to more than 98% after the implementation, and the perceived inconvenience of not using plastic bags also slightly increased. However, the subjects' understanding of the regulation's environmental purpose, their supportive attitude toward the regulation, their perceived effectiveness of the regulation, and their perceived seriousness of the environmental problem go down from *ex-ante* to *ex-post* the implementation. The *ex-ante* subjects' average understanding of the indissolubility of plastic bags is worse than the *ex-post* ones' who faced the 0.3 yuan actual price yet is better than the *ex-post* ones' who faced the 0.5 yuan actual price.

Regarding subjects' and their families' socioeconomic characteristics, the mean age of all subjects is 41 years and about 44% of the subjects are male. Around 10% of the subjects work in sales or run their own business, nearly 20% are registered as rural residents, and one-fifth are Communist Party members[21]. The average years of schooling and monthly income in the sample are 12.7 years and 2,200 Chinese yuan respectively, while the average family size is nearly three persons. The mean of most variables shifts from the *ex-ante* sub-sample to the two *ex-post* sub-samples. More exactly, the proportions of males, businessmen, rural residents, years of schooling, and family size increase, while the mean age and the proportion of party members decrease. The *ex-ante* subjects' average monthly income is higher than the *ex-post* ones' who faced the 0.3 yuan actual price yet is lower than the *ex-post* ones' who faced the 0.5 yuan actual price.

As shown in the last two columns in Table 2, the differences in the mean of many variables between the sub-samples in Columns [1] and [2] and between the sub-samples in Columns [1] and [3] are significant in terms of t-tests, proportional tests, and Wilcoxon-Mann-Whitley tests[22], respectively. The small standard error of the variables generated by the large sample may contribute to the significance of the differences. These differences between the sub-samples suggest a need for applying econometric analysis to control for these variables in order to achieve clearer comparisons.

<Table 2 to be here>

3.2. Predicted reactions to hypothetical prices

In the valuation part of the *ex-ante* survey, there were a total of 11 response patterns, and none of the total 1,039 subjects fell into the two inconsistent response patterns. Only 14 out of the 1,039 subjects made the inconsistent choices that they would consume more

[21] Since nearly 70% of the party members were urban residents as late as in 2008 (Organization Department of the Central Committee of the Communist Party of China, 2009) and the urban population is smaller than the rural population, this urban survey data shows a larger fraction of party members than the fraction of party members in the whole Chinese population.

[22] Variables with ranked data are tested by Wilcoxon-Mann-Whitney tests.

plastic bags at a higher bag price, or *vice versa*.[23] In this study, we report the results based on the remaining 1,025 consistent subjects. Only two out of the 1,025 subjects do not use plastic bags at all. Table 3 shows the three most common reaction patterns. Together, they account for more than 82% of the total subjects. All the three reaction patterns indicate a quantitatively large reduction in bag consumption given perfect enforcement of the regulation.

<Table 3 to be here>

In the *ex-ante* survey, the hypothetical price started at 0.5 yuan and then the price of 0.3 and/or 1 yuan was given depending on the answer given. Consequently, all 1,025 subjects responded to 0.5 yuan, 955 subjects responded to 0.3 yuan, and only 633 responded to 1 yuan. By using the deduction rules introduced in Section 2.1, we can complete the choices for all 1,025 subjects at the 0.3 yuan price. However, we can only complete the choices for 989 subjects at the 1 yuan price. In theory, it is impossible to complement the remaining 36 subjects' choices at the 1 yuan price since these subjects chose "reduce use" at the 0.5 yuan price and "the same use" at the 0.3 yuan price. In the remaining analysis, we will use this completed dataset with 1025, 1025, and 989 observations at the 0.5, 0.3, and 1 yuan price, respectively.

Table 4 reports the frequency and cumulative percent of subjects choosing certain contingent behaviors. The data indicates a clear trend that subjects believe they would indeed cut down more on plastic bag consumption the higher the price: as the price increases from zero to 0.3, 0.5, and 1 yuan, an increasing number of consumers choose to either reduce their bag consumption more or stop using plastic bags. The proportion of subjects who stated they would stop using bags increases to 27.4%, 34.7%, and 64.1%, at 0.3, 0.5, and 1 yuan, respectively, while the proportions of subjects who stated they would stick to the same use are 10.7%, 6.8%, and 3.1%, at 0.3, 0.5, and 1 yuan, respectively. Consequently, given perfect enforcement of the regulation in the *ex-ante* hypothetical scenario, the percentage reduction in total bag consumption can be calculated as 63.2%, 70.5% and 88.3% at 0.3, 0.5, and 1 yuan, respectively.

[23] The tiny fraction of inconsistent responses demonstrates the seriousness of subjects' answers to the questions in the questionnaire.

<Table 4 to be here>

Before the regulation, we collected consumers' actual total bag consumption at zero price ($\boldsymbol{Q_{p=0}^{A\_total}}$). Figure 2 shows the distribution of the number of plastic bags used per week from the *ex-ante* survey when the bags were still free. Based on this information, we can estimate the predicted total bag consumption by using the predicted reduction.

<Figure 2 to be here>

3.3. Predicted consumption vs. actual consumption

In the *ex-post* survey, the number of subjects who do not use plastic bags is 188 out of the total 2,035 subjects[24], reflecting that the regulation results in a considerable proportion of consumers not using plastic bags at all. Due to the highly competitive retail trade environment in China, shops adjusted their prices of plastic bags downwards. The actual price of a new plastic bag turns out to vary from 0.2 to 0.6 yuan depending on region, residential area, and type of shop, and also on the size and quality of the bags. In the supermarkets and open markets where the surveys were conducted, 99% of the reported bag prices ranged from 0.3 to 0.5 yuan. Looking at all shops in the two survey cities, the most common average prices are also around 0.3 or 0.5 yuan, but very rarely close to 1 yuan. Therefore, only the cases of the 0.3 and 0.5 yuan prices were investigated in the *ex-post* survey. Figure 3 shows the distribution of the number of plastic bags used per week from the *ex-post* survey when shops charged for the bags.

<Figure 3 to be here>

Table 5 shows the statistics of the predicted and actual weekly plastic bag consumption from the *ex-ante* and *ex-post* surveys. Before the regulation, the mean actual total consumption of free new bags is about 21 per week. When the hypothetical price is

[24] We conducted the *ex-post* survey with a larger sample size because each subject was only able to face one average actual price after regulation implementation. In the *ex-ante* survey, subjects could state hypothetical consumption at several prices.

increased from zero to 0.3, 0.5, and 1 yuan, subjects predicted that their mean total bag consumption would shrink from 21 bags per week to 7.8, 6.4, and 2.8 bags per week respectively, which describes an obvious reduction tendency induced by the regulation. After the regulation, the mean actual total consumption turns out to be 11.4 and 7.8 bags per week corresponding to the 0.3 and 0.5 yuan average prices, respectively. The actual reactions to certain prices seem to be less dramatic than the *ex-ante* survey subjects thought they would be. This is because the direct comparison ignores the imperfect enforcement. Nevertheless, this comparison serves as a conservative benchmark since a consumer's actual total bag consumption under perfect enforcement cannot be larger than her actual total bag consumption under imperfect enforcement. On the other hand, if we take subjects' percentage of paid-for bags into consideration, the mean consumed number of paid-for new bags per week turns out to be only 4.1 and 3.4 bags at the 0.3 and 0.5 yuan prices, respectively. It is clear that the remaining 7.2 and 4.4 new bags per week obtained for free still account for a major part of the actual total bag consumption after the regulation. If we ignore the free bag consumption and only compare the consumption of paid-for new bags with the predicted consumption of new bags, this acts as the opposite boundary of a consumer's least total bag consumption in reality after the regulation. By utilizing subjects' percentage of actual reduction in bag consumption in shops that have charged for bags, we can convert the number of bags obtained for free into the number of paid-for bags as shown in Section 2.2. Finally, the adjusted actual total number of new bags consumed per week turns out to be, on average, 9.0 and 6.2 bags respectively. The figures in the last column represent the proportion of zero-bag users in each case.

<Table 5 to be here>

4. Results

4.1. Statistical tests

Table 6 reports the results from statistical tests of the hypothesis shown in Section 2.2 for both the 0.3 and the 0.5 yuan price. For each hypothesis, we conduct a t-test for mean differences as well as a Wilcoxon rank-sum test of equality of distributions for actual and predicted number of bags consumed per week at the same prices. Furthermore, we perform a proportional test of the hypothesis of equal shares of zero-bag users and perform t-tests and rank-sum tests for actual and predicted number of bags consumed per week conditional on excluding the zero-bag users.

<Table 6 to be here>

The results show that we can reject the null hypothesis that the actual total bag consumption is equal to the predicted total bag consumption at the 0.3 yuan price, while the difference is fairly small if taking the total bag reduction into consideration.[25] In the 0.3 yuan case, the mean actual total bag consumption is significantly higher than the mean predicted bag consumption, and this is largely explained by the large difference in the proportion of subjects not using plastic bags at all. The proportion of subjects not using plastic bags is significantly lower in the real market setting than in the hypothetical scenario for both prices. If the zero-bag users are removed, the difference in the number of plastic bags consumed turns out to be smaller and insignificant in terms of a t-test, yet remains significant in terms of a rank-sum test. Consequently, at the 0.3 yuan price, the major reason for the bag consumption difference is the larger share of zero-bag users in the hypothetical scenario. That is, a considerable fraction of the subjects stated that they would completely stop using plastic bags if all shops began enforcing the regulation as stated in the hypothetical scenario of the *ex-ante* survey. Yet, under the *ex-post* real circumstance of imperfect enforcement, the fraction of subjects who actually stop consuming bags is significantly smaller than the fraction of subjects stating no bag consumption in the *ex-ante* survey.

For the 0.5 yuan case, however, the mean adjusted actual total bag consumption and the mean predicted total bag consumption are essentially the same. The proportion of subjects not using plastic bags is still significantly lower when they were faced with a real market situation than when they were faced with a hypothetical scenario. Interestingly, if we take out the zero-bag users, the difference for the 0.5 yuan case turns out to be larger

[25] The mean adjusted actual total bag reduction per week is approximately 11.966 (= 20.937 - 8.971); thus, the over-prediction in bag reduction equals around 9.5% (≈ 1.141 / 11.966).

and significant in terms of both a t-test and a rank-sum test. That is because if we remove the zero-bag users in this case, the mean adjusted actual total bag consumption becomes even lower than the mean predicted total bag consumption.

In line with the findings of Shogren *et al*. (1999), the predicted bag consumption is closer to the actual bag consumption at the higher price of 0.5 yuan than at the lower price of 0.3 yuan.[26] There are two factors that could explain this. First, under the higher price of 0.5 yuan, subjects are likely to take the price more seriously than under the lower price of 0.3 yuan when making predictions. Second, 0.3 yuan is the second price given, and is therefore less likely to be taken as seriously as the first one when predicted.[27]

The results from the statistical tests demonstrate that consumers predicted their future bag consumption reasonably well, although there was a small bias of under-prediction of bag consumption for the lower price. However, the results above may not be reliable since they do not control for other influential factors that vary across the two surveys. This should be kept in mind when viewing the above statistical test results. In order to make clearer comparisons between the stated and the revealed bag consumption behaviors, econometric analysis is needed to control for factors that may potentially affect plastic bag consumption.

4.2. Econometric analysis

In the econometric analysis, multivariate tests are used to estimate the possible difference between predicted and actual consumption while controlling for other influential factors. The coefficient of the dummy "actual price" indicates the potential discrepancy. We proceed to compute the marginal effects on the expected number of new bags per week based on the regression results of Tobit models with and without controlling for the regulation enforcement. Table 7 reports marginal effects for the regressions of the first

[26] We perform a t-test for the two differences in mean bag consumption at the 0.3 and 0.5 yuan prices in Table 6, and find that the difference between the two differences is significant from zero.

[27] Since we did not randomize the order of the hypothetical prices, it is not possible to test the "order effect."

type of tests for the 0.3 and 0.5 yuan prices.[28] For simplicity, Table 7 does not include the estimated parameters of the control dummies that control for time of day and location of conducting the survey.

<Table 7 to be here>

In Columns [1] and [3] in Table 7, the regression models do not include the enforcement variable to control for the crucial influential factor of regulation enforcement in the regressions. Not surprisingly, despite controlling for other factors, the marginal effect of the actual price dummy reflects that people consume 2 and 1.5 more bags at the price of 0.3 and 0.5 yuan, respectively, when they face the actual prices as compared to when they face the hypothetical ones. Columns [2] and [4] report the multivariate test results generated by including the "percentage of paid-for bags" variable to capture the variation in the actual enforcement of the regulation. After correcting for the influence of the bags still obtained for free, the marginal effects of actual price dummy variables now turn out to be insignificant at both prices, showing that the fraction of bags obtained for free essentially has explanatory power on the number of new bags used per week. The models, which control for the degree of regulation enforcement and other factors, suggest that the effects of paying the actual prices on consumers' actual bag consumption do not differ from the effects of paying the same hypothetical prices on their predicted bag consumption. So, we cannot reject the hypothesis of equal predicted and actual bag consumption at the same hypothetical and actual prices. In other words, the *ex-ante* contingent behavior valuation provides accurate estimates of citizens' actual consumption behavior at both 0.3 and 0.5 yuan. Moreover, still-free provision of plastic bags in some shops and especially in some open markets is the key explanation for the underestimation of consumption, which is found in the multivariate tests without control for enforcement.

A substantial number of other factors are shown to significantly influence plastic bag consumption at both prices. Almost all the other influential variables stay the same in terms of direction, magnitude, and significance across the different specifications of the models. Since the main interest of the paper is to test the consumers' prediction ability by

[28] We use the post-estimation command in STATA to calculate the variance inflation factor (VIF) for the counterpart OLS models, and do not find any evidence of multicollinearity problems.

using the SP survey method and since including other variables is mainly for control purpose rather than interpretation purposes, we will not provide a detailed discussion of the impacts of other variables.[29] Additionally, although we have tried to add interaction variables, i.e., various socioeconomic characteristics and treatment dummies interacted with the actual price dummy, respectively, we do not find any particular sub-groups of consumers with persistently better or worse prediction ability than others across prices.[30]

The results of the second type of tests, with the adjusted actual bag consumption as a part of the dependent variable, are reported in Table A1 in the appendix. The results in these models are similar to those from models in the first type of tests discussed above. The coefficients of the "actual price" dummies are not significantly different from zero. Again, controlling for degree of regulation enforcement and other influential factors, we cannot reject the hypothesis of equal predicted and actual consumption of plastic bags at the two hypothetical and actual prices.

5. Discussion and conclusions

A fundamental question for researchers working with SP elicitation methods is whether stated values accurately correspond to consumer behavior in real-world situations. In this paper, by conducting a large-scale survey using consumers in a real market setting, we investigate the possible bias between consumers' shifts in stated and actual consumption of a private good following implementation of an environmental regulation. Our results suggest that, regarding an everyday private good, estimates from a SP survey method are reasonably accurate predictors of actual consumer behavior in a real setting. While our findings cannot confirm external validity of all SP survey techniques, they do shed some light on the idea that pre-policy evaluation prediction provides a close approximation of the actual effects in a real setting.

[29] A detailed analysis of the influential variables and the impact of the regulation is provided by He (2009).

[30] We perform likelihood ratio tests for the null of joint insignificance of the interaction variables in the models, and we cannot reject the null hypothesis. Therefore, interaction variables are not included in the models presented in this paper.

As far as we know, nearly all previous studies on the validity of SP estimates have been conducted in western countries. However, the developing country context may influence the accuracy of predictions of SP estimates in one way or another. In this case, the fact that Chinese consumers may care less about the environmental harmfulness of plastic bags[31] may contribute to the accurate prediction of their plastic bag consumption. That is, as compared to consumers in developed countries, Chinese consumers may have less incentive to behavior pro-environmentally in the *ex-ante* SP survey regarding the hypothetical scenario.

There are additional important lessons to learn: First, in line with the findings in List and Gallet (2001), the private good nature and the respondents' familiarity with the bags may contribute to the accurate prediction based on our SP technique. Second, regulation enforcement plays a crucial role in determining the validity of our SP prediction since the actual enforcement differed largely from that in the hypothetical scenario in the *ex-ante* survey. Third, given 0.5 yuan is the best prediction of the expected price of a regular plastic bag, we mainly focused on this price and set it as the initial hypothetical price in the *ex-ante* SP survey. In the fiercely competitive Chinese retail trade sector, unfortunately, a substantial fraction of shops adjusted their bag prices downwards from the initial 0.5 yuan to prices below 0.5 yuan shortly after the regulation went into effect. The study would have benefited from a design allowing us to take the unexpected price adjustment into consideration, e.g., randomizing the appearance order of prices in the *ex-ante* SP survey.

The findings of this paper provide evidence for the reliability of SP estimates predicting policy effects on consumer behavior in the context of everyday private goods. Whether or not our findings can be extended to other types of goods and policies is an empirical question that hopefully can be answered by future research.

[31] For example, only half of the subjects in our survey understand that indissolubility of plastic bags is the main environmental harmfulness of the bags.

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Table 1. The time and spatial distribution of the observations in both surveys

Survey period	Beijing		Guiyang		All regions and shops
	supermarket	open market	supermarket	open market	
07:30-11:00	227	202	276	285	990
12:00-15:00	195	194	349	272	1010
17:30-20:00	202	190	276	406	1074
All periods	624	586	901	963	3074

Notes: The three periods are the main shopping hours of the shops.

Table 2. Definitions and descriptive statistics of variables used in the analysis

Variable	Description	*Ex-ante*	*Ex-post*				
		Hypo. price of 0.3 and 0.5 yuan [1]	Actual price of 0.3 yuan [2]	Actual price of 0.5 yuan [3]	All subjects pooled [4]	P-value of tests between Columns [1] and [2]	P-value of tests between Columns [1] and [3]
Actual price	= 1 if subject faces the actual price	0.000	1.000	1.000	0.653	0.000[b]	0.000[b]
Percentage of paid-for bags	= percentage of all consumed bags that are paid-for bags	100.000	42.533	46.914	62.952	0.000[a]	0.000[a]
Know regulation	= 1 if subject knows about the regulation before participating in survey	0.890	0.987	0.958	0.950	0.000[b]	0.000[b]
Understanding of regulation's purpose	= subject's perception of the regulation purpose on a 1-5 scale, where 1 is to help shops earn money from citizens and 5 is to reduce environmental pollution	4.721	4.172	4.050	4.349	0.000[c]	0.000[c]
Supportive attitude	= subject's level of support of the regulation on a 1-5 scale, where 1 is does not at all support and 5 is strongly support	4.463	4.045	4.142	4.201	0.000[c]	0.000[c]
Inconvenience of not using plastic bags	= subject's perception of the inconvenience level of not using plastic bags on a 1-5 scale, where 1 is not inconvenient at all and 5 is very inconvenient	2.739	2.972	3.119	2.908	0.000[c]	0.000[c]
Perceived effectiveness	= subject's perception of effectiveness of the regulation on a 1-5 scale, where 1 is no use at all and 5 is very effective	3.550	3.245	3.326	3.360	0.000[c]	0.001[c]
Understanding plastic bag's indissolubility	= 1 if subject's perception of biggest problem caused by plastic bags is indissolubility of the bags	0.529	0.544	0.469	0.530	0.459[b]	0.056[b]
Perceived seriousness of environmental problem	= subject's perception of seriousness of environmental problem faced by China on a 1-5 scale, where 1 is no problem at all and 5 is very serious problem	4.365	4.214	4.211	4.266	0.000[c]	0.014[c]

Table 2. (continued)

Variable	Description	*Ex-ante*	*Ex-post*		All subjects pooled	P-value of tests between Columns [1] and [2]	P-value of tests between Columns [1] and [3]
		Hypo. price of 0.3 and 0.5 yuan [1]	Actual price of 0.3 yuan [2]	Actual price of 0.5 yuan [3]	[4]		
Age	= age of subject (years)	42.929	40.534	38.599	41.143	0.000[a]	0.000[a]
Male	= 1 if subject is a male	0.418	0.456	0.442	0.441	0.054[b]	0.428[b]
Businessman	= 1 if subject works in sales or has own business	0.090	0.097	0.110	0.096	0.561[b]	0.276[b]
Rural register	= 1 if subject is registered as a rural resident	0.178	0.197	0.223	0.193	0.218[b]	0.067[b]
Education Years	= subject's number of years of schooling (years)	12.386	12.845	12.985	12.702	0.000[a]	0.004[a]
Monthly income	= subject's net monthly income divided by 1000 (thousand yuan)	2.182	2.133	2.555	2.198	0.450[a]	0.001[a]
Party member	= 1 if subject is a communist party member	0.227	0.176	0.226	0.200	0.001[b]	0.946[b]
Family size	= number of family members living together in subject's household (persons)	2.866	2.948	3.095	2.936	0.133[a]	0.008[a]
No. of Obs.		1025	1595	337	2957	-	-

Notes: 1. [a] indicates it is from t test; [b] indicates it is from the proportional test; [c] indicates it is from Wilcoxon-Mann-Whitley test; 2. The currency used in the survey is Chinese Yuan Renminbi. At the time of the survey, 6.98 Chinese Yuan Renminbi = 1 USD (2008-05) and 6.85 Chinese Yuan Renminbi = 1 USD (2008-11).

Table 3. The share of respondents with different reaction patterns

Reaction pattern	0.5 yuan	0.3 yuan	1 yuan	Frequency (No. of Obs.)	Percent (%)
1	the same use	n.a.	the same use	31	3.0%
2	the same use	n.a.	reduce use	30	2.9%
3	the same use	n.a.	stop use	9	0.9%
4	reduce use	the same use	n.a.	36	3.5%
5	reduce use	reduce use	the same use	0	0.0%
6	reduce use	reduce use	reduce use	294	28.7%
7	reduce use	reduce use	stop use	269	26.2%
8	reduce use	stop use	n.a.	0	0.0%
9	stop use	the same use	n.a.	4	0.4%
10	stop use	reduce use	n.a.	71	6.9%
11	stop use	stop use	n.a.	281	27.4%
No. of Obs. directly facing the price	1025	955	633		

Notes: 1. Patterns 5 and 8 are the inconsistent patterns; 2. "n.a." means the question was not asked to the subjects directly; 3. The currency used in the survey is Chinese Yuan Renminbi. At the time of the *ex-ante* survey, 6.98 Chinese Yuan Renminbi = 1 USD (2008-05).

Table 4. The shares of respondents with different reaction patterns after deduction processing*

Responses	0.3 yuan		0.5 yuan		1 yuan	
	Frequency of Obs.	Cumulative percent	Frequency of Obs.	Cumulative percent	Frequency of Obs.	Cumulative percent
The same use	110	10.7%	70	6.8%	31	3.1%
Reduce use 0-20%	19	12.6%	12	8.0%	8	3.9%
Reduce use 20-40%	102	22.5%	63	14.1%	11	5.1%
Reduce use 40-60%	234	45.4%	216	35.2%	52	10.3%
Reduce use 60-80%	168	61.8%	191	53.9%	92	19.6%
Reduce use 80-100%	111	72.6%	117	65.3%	161	35.9%
Stop use	281	100.0%	356	100.0%	634	100.0%
No. of Obs. at each price	1025		1025		989	

Notes: 1. * Deduction processing means that many responses at the non-answered prices are complemented by utilizing two deduction rules mentioned in Section 2.1; 2. The currency used in the survey is Chinese Yuan Renminbi. At the time of the *ex-ante* survey, 6.98 Chinese Yuan Renminbi = 1 USD (2008-05).

Table 5. Descriptive statistics of the number of new plastic bags per week

	Number of new plastic bags per week	Obs.	Mean	Std. Dev	Proportion of zero-bag users
Actual and predicted bag consumption obtained from the *ex-ante* survey	$Q_{p=0}^{A\_total}$	1025	20.937	18.304	0.20%
	$Q_{p=0.3}^{P\_total}$	1025	7.829	11.496	27.61%
	$Q_{p=0.5}^{P\_total}$	1025	6.392	10.768	34.93%
	$Q_{p=1}^{P\_total}$	989	2.759	8.662	64.31%
Actual bag consumption obtained from the *ex-post* survey	$Q_{p=0.3}^{A\_total}$	1595	11.362	14.913	7.77%
	$Q_{p=0.3}^{A\_paid}$	1595	4.125	6.959	13.73%
	$Q_{p=0.3}^{A\_free}$	1595	7.237	11.477	13.67%
	$Q_{p=0.3}^{A\_adjusted\ total}$	1595	8.971	12.868	10.09%
	$Q_{p=0.5}^{A\_total}$	337	7.810	11.933	14.54%
	$Q_{p=0.5}^{A\_paid}$	337	3.415	6.056	22.55%
	$Q_{p=0.5}^{A\_free}$	337	4.396	9.073	24.63%
	$Q_{p=0.5}^{A\_adjusted\ total}$	337	6.239	10.456	18.99%

Note: $Q_p^{P\_total}$ denotes the predicted total bag consumption at price *p*; $Q_p^{A\_total}$ denotes the actual total bag consumption at price *p*; $Q_p^{A\_paid}$ denotes the actual paid-for bag consumption at price *p*; $Q_p^{A\_free}$ denotes the actual free obtained bag consumption at price *p*; $Q_p^{A\_adjusted\ total}$ denotes the adjusted actual total bag consumption at price *p*.

Table 6. The results of statistical tests

	Hypothesis
Null hypothesis (For 0.3 yuan case)	$\boldsymbol{Q_{p=0.3}^{A\_adjusted\ total} = Q_{p=0.3}^{P\_total}}$
Difference in mean consumption	1.141
t-test (p-value)	0.018
Rank-sum test (p-value)	0.000
No. of obs: Q^A / Q^P	1595/1025
Difference in proportion of subjects with zero bag consumption	-17.52%
Proportional test (p-value)	0.000
No. of obs: zero Q^A / zero Q^P	161/283
Difference in mean consumption if above 0	-0.838
t-test (p-value)	0.141
Rank-sum test (p-value)	0.000
No. of obs: non-zero Q^A / non-zero Q^P	1434/742
Null hypothesis (For 0.5 yuan case)	$\boldsymbol{Q_{p=0.5}^{A\_adjusted\ total} = Q_{p=0.5}^{P\_total}}$
Difference in mean consumption	-0.153
t-test (p-value)	0.817
Rank-sum test (p-value)	0.067
No. of obs: Q^A / Q^P	337/1025
Difference in proportion of subjects with zero bag consumption	-15.94%
Proportional test (p-value)	0.000
No. of obs: zero Q^A / zero Q^P	64/358
Difference in mean consumption if above 0	-2.121
t-test (p-value)	0.010
Rank-sum test (p-value)	0.000
No. of obs: non-zero Q^A / non-zero Q^P	273/667

Note: $Q_p^{P\_total}$ denotes the predicted total bag consumption at price *p*; $Q_p^{A\_adjusted\ total}$ denotes the adjusted actual total bag consumption at price *p*.

Table 7. Regression results regarding the validity of the prediction for both prices

Dependent variable	Number of new plastic bags per week			
Price	When price is 0.3 yuan		When price is 0.5 yuan	
Model specification	[1] Tobit Model 1	[2] Tobit Model 2	[3] Tobit Model 3	[4] Tobit Model 4
	Mar. Eff.	Mar. Eff.	Mar. Eff.	Mar. Eff.
Actual price	2.041 (4.49)***	-0.084 (0.13)	1.517 (2.44)***	1.137 (1.16)
Percentage of paid-for bags	-	-0.038 (4.47)***	-	-0.007 (0.49)
Know regulation	1.104 (1.17)	1.180 (1.26)	0.027 (0.03)	0.036 (0.04)
Understanding of regulation’s purpose	-0.131 (0.50)	-0.208 (0.79)	0.219 (0.68)	0.214 (0.66)
Supportive attitude	-0.777 (2.89)***	-0.738 (2.75)***	-0.351 (-1.12)	-0.349 (1.12)
Inconvenience of not using plastic bags	0.495 (2.86)***	0.538 (3.11)***	0.760 (3.84)***	0.762 (3.85)***
Perceived effectiveness	-0.378 (1.69)***	-0.308 (1.38)	-0.345 (-1.33)	-0.344 (1.32)
Understanding of plastic bag's indissolubility	-0.357 (0.82)	-0.408 (0.94)	-0.181 (-0.36)	-0.176 (0.35)
Perceived seriousness of environmental problem	-0.094 (0.35)	-0.147 (0.54)	-0.307 (-1.01)	-0.314 (1.03)
Age	-0.048 (3.06)***	-0.059 (3.74)***	-0.043 (-2.26)***	-0.043 (2.29)***
Male	1.334 (3.10)***	1.399 (3.25)***	1.662 (3.28)***	1.678 (3.31)***
Businessman	3.346 (4.01)***	3.356 (4.04)***	2.419 (2.45)***	2.440 (2.47)***
Rural register	0.133 (0.22)	0.067 (0.11)	1.195 (1.61)	1.184 (1.60)
Education years	-0.288 (3.55)***	-0.297 (3.67)***	-0.117 (-1.23)	-0.114 (1.19)
Monthly income	0.551 (3.88)***	0.579 (4.09)***	0.358 (2.32)***	0.359 (2.32)***
Party member	0.193 (0.35)	0.285 (0.51)	1.068 (1.69)***	1.064 (1.68)***
Family size	0.332 (2.15)***	0.359 (2.33)***	0.200 (1.10)	0.203 (1.12)
Dummies for time when survey was conducted	*Yes*	*Yes*	*Yes*	*Yes*
Dummies for shops where survey was conducted	*Yes*	*Yes*	*Yes*	*Yes*
No. of Obs	2620	2620	1362	1362
Pseudo R-square	0.029	0.030	0.018	0.018
Prob > chi2	0.000	0.000	0.000	0.000

Note: 1. Absolute value of z statistics in parentheses; 2.* significance at 10%; ** significance at 5%; *** significance at 1%.

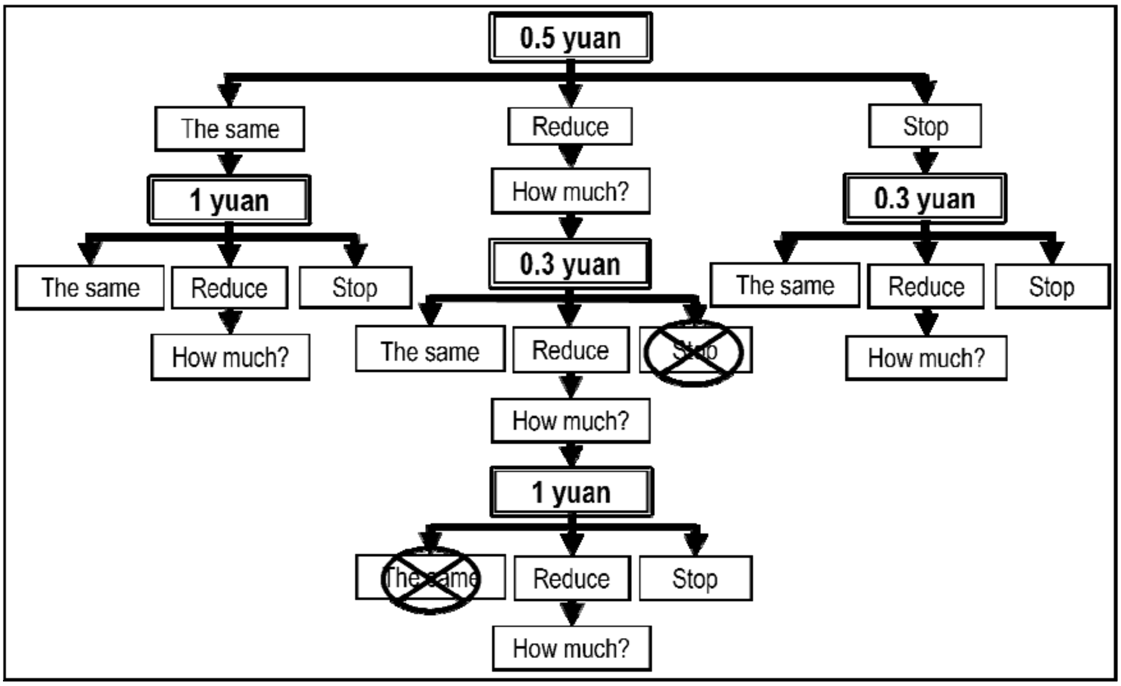

Figure 1. The valuation question structure in the *ex-ante* survey questionnaire

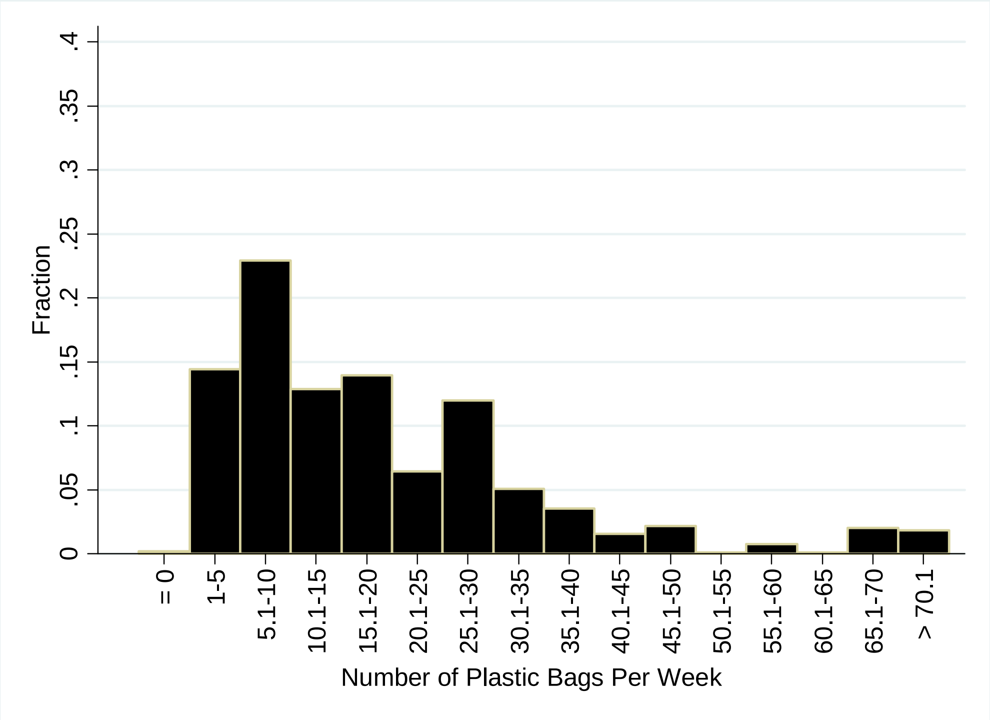

Figure 2. Histogram of number of plastic bags per week before the regulation

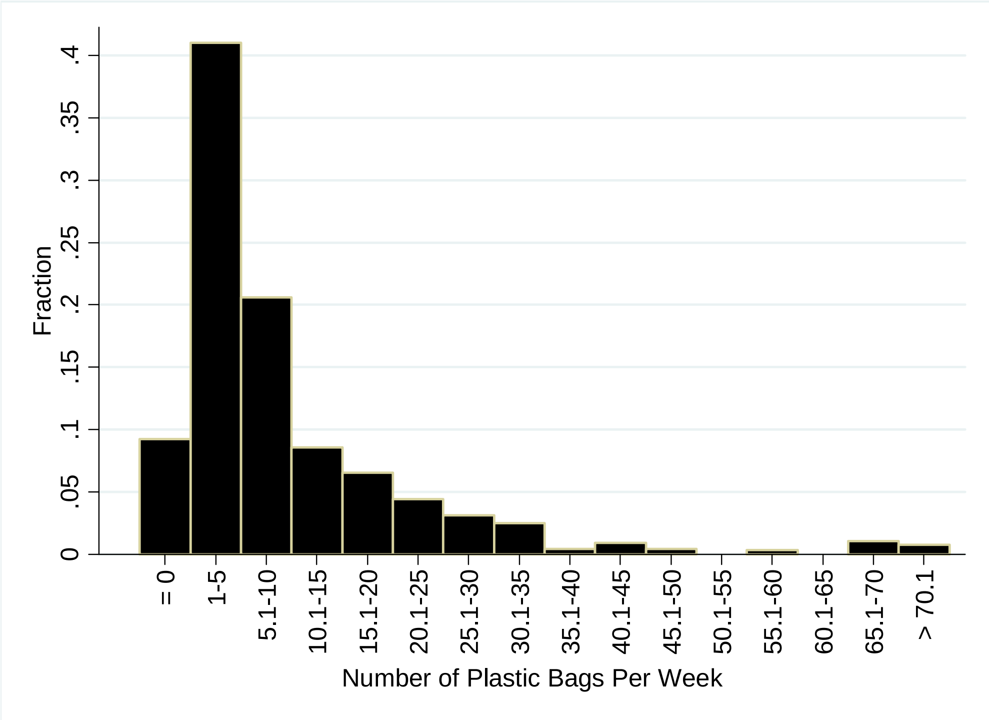

Figure 3. Histogram of number of plastic bags per week after the regulation

Appendix I. Results of alternative specification

Table A1. Regression results regarding the validity of the prediction for both prices

Dependent variable	Adjusted number of new plastic bags per week	
Price	When price is 0.3 yuan	When price is 0.5 yuan
Model specification	[1] Tobit Model 1	[3] Tobit Model 3
	Mar. Eff.	Mar. Eff.
Actual price	0.196 (0.47)	0.078 (0.14)
Percentage of paid-for bags	-	-
Know regulation	0.976 (1.16)	-0.095 (0.11)
Understanding of regulation's purpose	-0.177 (0.75)	0.078 (0.25)
Supportive attitude	-0.598 (2.48)**	-0.135 (0.45)
Inconvenience of not using plastic bags	0.510 (3.29)***	0.775 (4.05)***
Perceived effectiveness	-0.318 (1.59)	-0.281 (1.12)
Understanding of plastic bag's indissolubility	-0.639 (1.64)	-0.055 (0.11)
Perceived seriousness of environmental problem	-0.138 (0.56)	-0.394 (1.35)
Age	-0.063 (4.47)***	-0.047 (2.57)***
Male	1.478 (3.82)***	1.497 (3.06)***
Businessman	3.144 (4.17)***	2.643 (2.73)***
Rural register	0.180 (0.33)	0.741 (1.05)
Education years	-0.244 (3.36)***	-0.078 (0.85)
Monthly income	0.510 (4.02)***	0.343 (2.30)***
Party member	0.347 (0.69)	0.945 (1.55)
Family size	0.263 (1.90)*	0.213 (1.22)
Dummies for time when survey was conducted	Yes	Yes
Dummies for shops where survey was conducted	Yes	Yes
No. of Obs	2620	1362
Pseudo R-square	0.026	0.016
Prob > chi2	0.000	0.000

Note: 1. Absolute value of z statistics in parentheses; 2.* significance at 10%; ** significance at 5%; *** significance at 1%.

Appendix II. Relevant questions asked in the ex-ante and ex-post surveys

Part 1. Questions in the ex-ante survey

For collecting $Q_{p=0}^{A\_total}$

1. How many new plastic shopping bags on average do you* think you use from various shops <u>in one week</u>? ___________bag(s)

For calculating $Q_{p=0.3}^{P\_total}$, $Q_{p=0.5}^{P\_total}$, $Q_{p=1}^{P\_total}$

1. If the price of one new plastic shopping bag in all shops turns to be <u>0.5 yuan</u> after implementation of this policy, what will you do?

   ☐ Keep buying and using the same number of new plastic shopping bags as before (Go to question 5)

   ☐ Keep buying and using new plastic shopping bags, but fewer than before

   ☐ Stop buying and using new plastic shopping bags altogether (Go to question 3)

2. In percent, how many fewer new plastic shopping bags will you buy and use in various shops when shopping?

   ☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

3. If the price of one new plastic shopping bag in all shops turns to be <u>0.3 yuan instead</u>, what will you do?

   ☐ Keep buying and using the same number of new plastic shopping bags as before (Go to next part)

   ☐ Keep buying and using new plastic shopping bags, but fewer than before

   ☐ Stop buying and using new plastic shopping bags altogether (Go to next part)

* The second person pronoun "you" has two different words for its singular and plural forms in Chinese. The "yous" used in the Chinese questionnaire are all strictly limited to the singular form.

4. In percent, how many fewer new plastic shopping bags will you buy and use in various shops when shopping?

   ☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

   (If they answered question 3, then go to next part)

5. If the price of one new plastic shopping bag in all shops turns to be <u>1 yuan instead</u>, what will you do?

   ☐ Keep buying and using the same number of new plastic shopping bags as before (Go to next part)

   ☐ Keep buying and using new plastic shopping bags, but fewer than before

   ☐ Stop buying and using new plastic shopping bags altogether (Go to next part)

6. In percent, how many fewer new plastic shopping bags will you buy and use in various shops when shopping?

   ☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

Part 2. Questions in the ex-post survey

For collecting average prices faced by subjects and $Q_{p=0.3}^{A\_total}$, $Q_{p=0.5}^{A\_total}$

1. How many new plastic shopping bags on average do you think you use from various shops <u>in one week now</u>? ___________bag (s)

2. On average, which of the following prices is closest to the average price that you currently pay for one new plastic shopping bag in the supermarkets or open markets that you usually visit?

   ☐ 3 Jiao ☐ 5 Jiao ☐ provided free ☐ I don't know

For calculating $\boldsymbol{Q^{A\_paid}_{p=0.3}}$, $\boldsymbol{Q^{A\_free}_{p=0.3}}$, $\boldsymbol{Q^{A\_paid}_{p=0.5}}$, $\boldsymbol{Q^{A\_free}_{p=0.5}}$

1. Since the 1st of June, according to policy, most supermarkets have begun charging for new plastic shopping bags, but many other shops such as open markets or shops along streets have not applied this new regulation. On average, what percentage of the new plastic shopping bags you get now are provided by the shops with a charge and what percentage of the new shopping bags you get now are free of charge?

Paid	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Free	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	0%
	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

For calculating $\boldsymbol{Q^{A\_adjusted\ total}_{p=0.3}}$, $\boldsymbol{Q^{A\_adjusted\ total}_{p=0.5}}$

1. Now that the supermarkets or open markets have begun charging 3 Jiao/5 Jiao as the average price for one new plastic shopping bag, what do you actually do when shopping?

☐ Keep buying and using the same number of new plastic shopping bags as before charging (Go to next part)

☐ Keep buying and using new plastic shopping bags, but fewer than before charging

☐ Stop buying and using new plastic shopping bags altogether (Go to next part)

2. In percent, how many fewer new plastic shopping bags do you use in the shops that charge for them?

☐ 0-20% ☐ 20-40% ☐ 40-60% ☐ 60-80% ☐ 80-100%

Paper 3

Household Decision Making in Rural China: Using Experiments to Estimate the Influences of Spouses

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Abstract

Many economic decisions are made jointly within households. This raises the question about spouses' relative influence on joint decisions and the determinants of relative influence. Using a controlled experiment (on inter-temporal choice), we let each spouse first make individual decisions and then make joint decisions with the other spouse. We use a random parameter probit model to measure the relative influence of spouses on joint decisions. In general, husbands have a stronger influence than wives. However, in richer households and when the wife is older than the husband, we find a significantly stronger influence of the wife on joint decisions.

***Key words**:* field experiment; household decision making; random parameter model; relative influence; spouses; time preferences

***JEL classification**:* C91, C92, C93, D10

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Acknowledgments: We would like to thank Gunnar Köhlin, and seminar participants at the University of Gothenburg for helpful discussions and comments on this paper. We are also grateful to the fieldwork support team from Guizhou University, Beijing Forestry University, and Peking University. All errors and omissions remain the sole responsibility of the authors. Financial support from the Swedish International Development and Cooperation Agency (Sida) to the Environmental Economics Unit at the University of Gothenburg, from the Jan Wallander and Tom Hedelius Foundation, and from Vetenskapsrådet (The Swedish Research Council) is gratefully acknowledged.

1. Introduction

Many important economic decisions are made by households, implying joint rather than individual decisions. For example, decisions regarding labor supply, savings, and investments are often made jointly within the household. This implies that such decisions are a function of the preferences of household members and the relative influence of each household member on the joint decisions. However, it is not straightforward to measure the relative influence of spouses on joint decisions. One often used approach has been to look at who is in control of the household income and correlate this with household behavior and outcomes.[1] However, this approach has its obvious limitations as a means to study the relative influence of spouses since with field data it is by definition difficult to obtain data on preferences/choices of the spouses and the joint household decisions. Therefore, an alternative and increasingly popular approach is to use experiments and survey methods to study household decision making, since they allow for collection of data for both individual and joint decisions under controlled conditions. This means that spouses first have to make individual choices on a series of tasks, after which they are united and have to make joint choices on the same or a similar set of tasks. By construction, the researchers then have both measures of the individual preferences and of the joint choices, and can thus explain the joint choices with the individual preferences. This approach has been used to study household decision making in many different domains, such as risk taking (Bateman and Munro, 2005; Iversen et al., 2006; Munro et al., 2008; de Palma et al., 2010), consumption choices (Arora and Allenby, 1999; Browning and Chiappori, 1998), behavior in social dilemma situations (Cochard et al., 2010), and stated preferences (Quiggin, 1998; Dosman and Adamowicz, 2006; Strand, 2007; Beharry-Borg et al., 2009).

In the present paper, we investigate the relative influences of husbands and wives on joint household decisions by conducting a high-stakes artefactual field experiment (Harrison and List, 2004) in rural China. The experimental task is to make inter-temporal decisions in which spouses have to choose between earlier but smaller rewards and later but higher rewards. While

[1] For instance, Thomas (1994), Lundberg et al. (1997), Phipps and Burton (1998), Duflo (2003), and Qian (2008) find that, for instance, child health and survival rates, nutrition, expenditures for different goods and services (such as tobacco and child care), and the educational attainment of children depend strongly on whether the household income is controlled by the husband or the wife.

investigating household decision making in inter-temporal choice is a contribution in itself – in particular since inter-temporal choices (e.g., on investments, education, farming) are very important for the development of poorer regions – our main contribution is that we develop a method for estimating the relative influence of husbands and wives. To achieve this, we build on earlier work by Dosman and Adamowicz (2006) and Beharry-Borg et al. (2009), who use hypothetical survey questions to study stated preferences, separately for each spouse and then jointly for the couple. They assume a bargaining model where the joint decision depends on a weighted average of the two spouses' preferences. This is (unnecessarily) restrictive since it does not allow for the influence of other (socio-demographic) aspects and does not allow for the possibility that joint choices can be more extreme than those made by either of the spouses (something which can be expected to happen in some cases; see Mazzocco, 2004, or Eliaz et al., 2006). Our approach is more general by using a random parameter model where we first estimate the preferences of each spouse from his/her individual choices. From these two models – respectively dealing with the husbands' and wives' individual choices – we then estimate the predicted probability of choosing an alternative from each choice situation of the experiment. By this way we can obtain a measure of the strength of the preferences of the spouses. These predicted probabilities are then included as explanatory variables in a model explaining the joint decisions.

Our approach allows us to estimate the relative influence of husbands and wives and also what socio-demographic household characteristics affect this relative influence. We find that in 90% of households, the husband has a stronger influence on household decisions than the wife. With respect to the factors determining the relative influences of husbands and wives, we are able to identify three important variables. Wives have a stronger influence on the joint decisions in high-income households and in households where the wife is older than the husband. The influence of wives is also stronger if the couple reports that the wife is in charge of small investment decisions in the household. The latter finding confirms earlier studies showing that it is important who controls the household income. The former findings, however, add to the literature the insight that the relative influence of husbands and wives depends also on important socio-demographic household characteristics. The random parameter modeling approach proposed here is suitable to detect these factors. Using this approach, together with eliciting the behavior of spouses and couples in an incentivized experiment, allows us to contribute to a better understanding of what drives household decision making. The outline of the paper is as follows: Section 2 introduces the experimental design and procedure, Section 3 presents the empirical model, Section 4 reports the experimental results, and Section 5 concludes the paper.

2. Experimental design and procedure

2.1. Location of the experiment

The experiment was conducted in October 2007 in several villages of Majiang County in the province of Guizhou, which is located in the southwestern part of China. The province is one of the least developed provinces in China, with inhabitants having on average 6.75 years of schooling and with a GDP per capita of 6,742 Chinese yuan (yuan hereafter) in 2007, which is equal to only 32% of the national average of 21,049 yuan (NBS, 2008).

Seven villages from five townships were randomly chosen, and in each village, 10-24 households with official marital status were randomly selected based on the official registration list provided by the local government. The number of households chosen in each village was proportional to the size of the village. The interviewers were sent to the households' homes, and each household was first asked to answer a survey concerning farming and forestry issues. Then spouses could voluntarily choose to participate in the experiment. In order to prevent villagers from spreading the word about the experiment within a village, we employed 20 interviewers so that all experiments in a village were finished within a couple of hours. The experiment lasted for less than one hour for each household and the expected average individual payoff from the experiment was 30 yuan, which corresponds to an average payoff of roughly two days of paid work. This means that our experiment provided much greater incentives than a usual laboratory experiment. In total, 101 couples voluntarily participated in the experiment; no couple refused to participate.

The socioeconomic characteristics of the sampled households are shown in Table 1. The average yearly per capita income is 4,203 yuan. Women contribute on average 42% of the total household income. Among the couples in our sample, the average length of marriage is 26 years, and the average number of children is 2.7.[2]

<Table 1 to be here>

2.2. Experimental design

The time preference experiment consisted of 18 pair-wise choices as shown in Table 2. To avoid order effects, the subjects faced a randomized order of the choices in the experiment and not the order presented in the table. In the experiment, subjects had to make a choice between Option A (early reward) and Option B (late reward). For example, in the first set, subjects chose between receiving 12 yuan today and 13 yuan in four days. The reward amount varied from 9 to 21 yuan. The timing of the early reward was either today (i.e., on the day of the experiment) or in four days, and the timing of the late reward was four or eight days from the day of the experiment.[3] The difference between the early and the late rewards was one, three, or five yuan.[4]

<Table 2 to be here>

[2] It is important to note that the one-child policy only applies for the ethnic majority of Han. The county in which we conducted the experiment is an ethnic minority autonomous prefecture, meaning that many families in this region are not affected by the official one-child policy. This explains the relatively large number of children in our sample.

[3] It is possible that subjects have strong preferences for receiving the money today because of trust issues. As explained later, we used a signed certificate from Peking University containing information on when and how participants would be paid if they chose the late reward. We believe that this was important for the subjects' ability to trust us that they would be paid. Moreover, in the results section we show that there is no sign of present-biased preferences within the time frame of the experiment, i.e., time preferences do not depend on whether we compare today to 4 days, or 4 days to 8 days. We designed the time preference experiment with only a few days' delay between the early and late rewards mainly for two reasons. First, the short time horizon could avoid any concerns about inflation. Second, for practical reasons, choosing a short delay allowed us to keep the time that interviewers had to be in the field reasonably short (since they could bring the money to relatively close-by villages while running experiments in another village on the same day), thus significantly reducing the costs of the experiment.

[4] Given the design of the experiment, with a very short time difference between the early and late reward, the implicit annual discount rates were very high. However, the main aim of our experiment is to investigate the relative influences of husbands and wives in household decision-making, rather than estimating discount rates *per se*.

Two experimenters were sent to each household to conduct the experiment. After agreeing to participate, the two spouses were separated into two rooms. Once they were seated, the instructions were read out by the experimenters. Throughout the experiment, the subjects completed the tasks step by step by following the experimental instructions. The whole experiment consisted of four parts. In Part 1, each spouse individually answered a detailed questionnaire about socio-demographic characteristics, health status, and social capital. In Part 2, each spouse made individual decisions in the time preference experiment. In Part 3, the two spouses were reunited and had to give agreed-upon answers regarding the financial situation of the household and some additional household characteristics. Part 4 was identical to Part 2, except that the spouses had to make joint decisions after reaching an agreement on which options to choose for each of the 18 choice tasks. Note that each part was introduced sequentially only after the previous part had been completed.

When introducing Part 4, participants were informed that the reward amount in the selected option would be paid to each of the spouses. This procedure was used to keep each spouse's direct monetary incentives constant across Parts 2 and 4. Both experimenters were present during the joint decision experiment and they recorded a joint decision only after both spouses had given their consent. Both in Part 2 and in Part 4, participants were instructed in advance that one of the 18 decisions in each part would be played out for real at the end of the experiment by drawing one card from a deck of cards, numbered 1 to 18. Subjects were also informed that they would be paid directly after completion of the whole survey and experiment if they chose a reward amount due "today", while if they chose to be paid later (in four or eight days), they would be given a signed certificate by Peking University indicating the amount of money redeemable on the specified date. The payment would be delivered to their home by a project assistant at a time of day specified by the couple and they needed to show the certified paper in order to receive the payment. In Part 2, it was stressed that the payment for Part 2 would be made in private for husbands and wives in different rooms.

3. Empirical model

The data needed to measure the relative influence within a household comprise both the individual preferences of each spouse and the joint decisions of the couple. In the experiment, we observe the choices between alternatives rather than the preferences directly. The alternatives in turn can be described by a set of attributes, i.e., the reward amounts at certain times. We analyze the decision problem with a random utility framework developed by McFadden (1973). The utility function consists of two parts, an observable non-stochastic part, v, and an unobservable stochastic part, ε. If there are only two alternatives to choose between, then the probability of choosing alternative A for individual i in choice situation j is equal to the probability that individual i's utility from choosing alternative A is higher than the utility from choosing alternative B:

$$P_{ij}(A) = P\left[v_i(X_{jA}) + \varepsilon_{ijA} > v_i(X_{jB}) + \varepsilon_{ijB}\right], \tag{1}$$

where X denotes a vector of attributes of the alternatives. From the experiment, we want to measure the relative influence of the wife (W) and of the husband (H). In order to estimate this, we first need to estimate the individual preferences of the husband and of the wife separately. For a wife in household i, the probability of choosing an early reward (A) in choice situation j is

$$P_{ij}^{W}(A) = P\left[u_i^{W}(time_{jA}, amount_{jA}) + \varepsilon_{ijA}^{W} > u_i^{W}(time_{jB}, amount_{jB}) + \varepsilon_{ijB}^{W}\right], \tag{2}$$

where alternative A is the early reward and alternative B is the late reward. Assuming utility is a linear function of the timing and amount of the rewards, the probabilistic model can be rewritten as

$$\begin{aligned} P_{ij}^{W}(A) &= P\left[\alpha_i^{W} + \beta_i^{W} time_{jA} + \gamma_i^{W} amount_{jA} + \varepsilon_{ijA}^{W} > \beta_i^{W} time_{jB} + \gamma_i^{W} amount_{jB} + \varepsilon_{ijB}^{W}\right] \\ &= P\left[\alpha_i^{W} + \beta_i^{W}(time_{jA} - time_{jB}) + \gamma_i^{W}(amount_{jA} - amount_{jB}) + (\varepsilon_{ijA}^{W} - \varepsilon_{ijB}^{W}) > 0\right], \end{aligned} \tag{3}$$

where α_i^{W} is introduced to allow for a preference for early or late rewards that is not explained by the difference in timing and amount of the rewards. This could be an indication of a general preference for early rewards or simply a reflection of a left-hand or right-hand side preference when choosing the options.

In the experiment, there are two possible levels of the timing of the early rewards – zero (now) and four days from now – and two possible levels of the timing of the late rewards – four days and eight days from now. In order to allow for non-linear effects of the timing of the rewards, and the reward structure we express the probability of choosing an early reward as

$$P_{ij}^{W}(A) = P\left[\alpha_i^{W} + \beta_{i08}^{W} D_{08} + \beta_{i48}^{W} D_{48} + \gamma_{i1}^{W} amount_{jA} + \gamma_{i2}^{W} \Delta amount_j + \eta_{ij}^{W} > 0\right], \tag{4}$$

where D_{08} is a dummy variable equal to one when the early reward is received today and the late reward in eight days from now, and D_{48} a dummy variable equal to one when the early reward is received in four days and the late reward in eight days from now. $\Delta amount_j = amount_{jB} - amount_{jA}$, $\eta_{ij}^{W} = \varepsilon_{ijA}^{W} - \varepsilon_{ijB}^{W}$, and β and γ are parameters to be estimated. Since the reference case is a reward today versus a reward in four days, we expect that β_{i08}^{W} is negative. If β_{i48}^{W} is not significantly different from zero, then subjects do not suffer from a present bias within the time frame of the experiment (see, e.g., McClure et al., 2004, 2007, and Read et al., 1999). The sign of the coefficient of the differences in rewards, γ_{i2}^{W}, is expected to be negative. Moreover, the size of the early reward, $amount_{jA}$, is included in the model to control for a possible income effect.

For a husband in household *i*, the probability of choosing an early reward in choice situation *j* is expressed in the same way as

$$P_{ij}^{H}(A) = P\left[\alpha^{H}{}_{i} + \beta_{i08}^{H} D_{08} + \beta_{i48}^{H} D_{48} + \gamma_{i1}^{H} amount_{jA} + \gamma_{i2}^{H} \Delta amount_j + \eta_{ij}^{H} > 0\right]. \tag{5}$$

The preferences of a wife and a husband can be estimated with standard discrete choice models. However, we apply random parameter models where the coefficients of the attributes are assumed to be randomly distributed due to unobserved preference heterogeneity (see Train, 2003). In order to facilitate estimations, we keep the intercept as a fixed parameter. Using random parameter models enables us to estimate individual-specific predicted choice probabilities for each choice situation, denoted as $\hat{P}_{ij}^{H}$ and $\hat{P}_{ij}^{W}$, even if we do not include individual characteristics as explanatory variables. We assume that all the random parameters are normally distributed. Since we have repeated observations, we further assume that the random parameters are constant across choice sets for a given respondent, i.e., the individual time preferences are stable. Finally, we assume that the error term is normally distributed so that we can estimate random parameter binary probit models. The models are estimated using simulated maximum likelihood.

In the next step, we estimate a similar model explaining the choices in the joint part of the experiment. In this model, the probability of choosing the early reward is again a function of the attributes of the alternatives. In addition, we include two variables reflecting the individual preferences of the spouses. The obvious choice might seem to be the individual choices made by the spouses. Yet, the main drawback of using individual choices is that they reveal little information about the strength of the preferences. We therefore use the predicted probabilities of the spouses' individual choices ($\hat{P}_{ij}^{H}$ and $\hat{P}_{ij}^{W}$) instead. By doing this, we can measure the influences of the spouses' preferences on the joint decisions. The probability of choosing the early reward (A) for household *i* in choice situation *j* in the joint time preference experiment is then specified as

$$P_{ij}^{J}(A) = P\left[\alpha_i^J + \beta_{i08}^J D_{08} + \beta_{i48}^J D_{48} + \gamma_{i1}^J amount_{jA} + \gamma_{i2}^J \Delta amount_j + \delta_i^H \hat{P}_{ij}^H + \delta_i^W \hat{P}_{ij}^W + \eta_{ij}^J > 0\right]. \qquad (6)$$

This model is also estimated as a random parameter binary probit model. All the random parameters are again specified as normally distributed and assumed to be constant across the choice situations for a given household.

What we are interested in here is obtaining household-specific estimates of the two parameters relating to the absolute influences of the husband and the wife on the joint decisions, i.e., the parameters of the predicted individual choice probabilities. The ratio of these two parameters can then be used to identify the relative influences of the husband and wife on the joint decisions. In the following analyses, we focus on the relative influence of the spouses, i.e., the ratio between the wife's influence parameter and the husband's influence parameter.

$$Influence_i = \frac{\hat{\delta}_i^W}{\hat{\delta}_i^H} \tag{7}$$

If the ratio is larger than one, then the wife has a stronger influence on the joint decisions than the husband, and vice versa.

In order to obtain the estimates of $\hat{\delta}_i^W$ and $\hat{\delta}_i^H$, we rely on simulation, i.e., we estimate distributions of the parameters rather than individual-specific parameters. This is done by using Bayes Theorem (Train, 2003). If $h(\beta \mid y_i, \theta)$ denotes the distribution of a parameter vector β conditional on a sequence of choices (y_i) and the population parameter (θ), Train (2003) shows that the mean β for an individual *i* making a specific choice is

$$E[\beta_i \mid y, \theta] = \int \beta \cdot h(\beta \mid y_i, \theta) = \frac{\int \beta P(y_i \mid \beta) f(\beta \mid \theta) d\beta}{\int P(y_i \mid \beta) f(\beta \mid \theta) d\beta}, \tag{8}$$

where $f(\beta \mid \theta)$ is the distribution of β in the population. The expression in equation (8) is thus an estimate of the parameter for a particular individual (in our case a spouse or a household). This estimate in turn comes from the estimated population distribution that we obtain with the random parameter models. This expression does not have a closed form and we therefore again have to rely on simulation methods. The simulated approximation to equation (8) is

$$\tilde{E}[\beta_i \mid y, \theta] = \sum_r w^r \beta^r = \sum_r \frac{\beta^r P(y_i \mid \beta^r)}{\sum_r P(y_i \mid \beta^r)}, \tag{9}$$

where β^r is the r-th draw from the population density $h(\beta \mid y_i, \theta)$.

We are primarily interested in the distribution of the ratio of the two parameters relating to the influences of the husband and the wife on the joint decisions. However, we are also interested in finding household characteristics that can explain the variation of the variable $Influence_i$ among the households. In the final part of the analysis, we estimate a truncated regression model where the relative influence is explained by a number of individual and household characteristics, such as education level of the spouses, absolute income, relative income contribution of the spouses, age of the spouses, and length of marriage.

4. Results

Table 3 reports the frequency with which husbands, wives, and couples choose the early rewards. The aggregate data in Table 3 shows that husbands on average choose early rewards more often than wives, and that the share of early rewards in the joint choices is often closer to the average of the husbands' choices. However, chi-square tests do not reveal any significant distributional differences in the choices between husbands, wives, and joint choices.[5] More importantly, this is only a description of the average choices, and it provides no information on what happened at the level of single households.

<Table 3 to be here>

In eight households, the husband and the wife made exactly the same choices in all 18 choice situations. We will exclude these households from the rest of the analyses since it is impossible to obtain any information about the individual spouses' relative influences on the joint decisions from these observations. This leaves us with 93 married couples for estimation and analysis.

Now we turn to the econometric model to analyze the individual and household decisions. The first step of the analysis is to estimate the random parameter models for the individual choices. We estimate random parameter binary probit models. All models are estimated in Nlogit 4.0 using 500 Halton draws. The results are presented in the first two columns of Table 4. Not all mean coefficients are significant, but all estimated standard deviations are, indicating that we capture unobserved heterogeneity both among husbands and among wives. The constant is positive and significant for both groups, which indicates that there is a preference for early rewards not related to the variation in the timing of the rewards and the amounts of the rewards. The coefficient of the dummy variable for four days versus eight days is insignificant for both

[5] We conduct chi-square tests for each of the 18 choice sets, and the results of the 54 chi-square tests reveal that there are no statistically significant differences between the different decision situations (husbands vs. wives, husbands vs. joint decisions, wives vs. joint decisions).

husbands and wives, and since the reference case is today versus in four days, this is an indication that the subjects do not have present-biased preferences within the time frame of the experiment. However, the coefficient of the dummy for today versus in eight days is significantly positive meaning that, not surprisingly, when the time difference between the early and the late reward increases, the likelihood of choosing the early reward increases. The size of the early reward has no significant impact on choices, which implies no income effect regarding the initial endowment of early rewards in the experiment. Yet, the difference between the early and the late reward has a significant impact on choices. As expected, if the difference between the late and the early reward increases, the likelihood of choosing the early reward decreases.

The next models to be estimated deal with the probability of choosing the early reward in the joint decisions. The results are presented in the last two columns of Table 4. The first model does not include the predicted probabilities of the husband and the wife. In terms of significance, the first model's results are the same as the two individual estimates. There is a preference for early rewards; longer delay in late rewards and smaller reward differences between early and late rewards increase the likelihood of choosing the early rewards. In the second model, the predicted choice probabilities of the husband and wife are used as explanatory variables in addition to the characteristics of the alternatives. The parameters of the predicted probabilities of the husband and of the wife are highly significant, indicating that, on average, both the husband's and the wife's preferences influence the joint decisions. The mean estimated coefficient is larger for husbands, suggesting that, on average, husbands have a stronger influence on joint decisions than wives. The mean estimate of the relative influence is 0.79; using a t-test, this ratio is statistically significantly different from one (p-value = 0.032). The relative influence measure actually shows how much more influence husbands have, since the ratio is directly related to the ratio of the marginal effects. An increase in the predicted individual probabilities of choosing the early reward increases the probability that the early reward is chosen in the joint decisions for both husbands and wives, but the increase in the joint probability for wives is on average only 79% of the increase for husbands.

<Table 4 to be here>

The next step is to generate household-specific mean estimates of the two parameters related to the influence of the husband and the wife, and then calculate the ratio of the wife's and the husband's predicted probability parameters for each household. If the ratio is larger than one, the wife has more influence than the husband, and vice versa. The mean ratio is 0.71, the maximum 2.42, and the minimum 0.26. Using a t-test the ratio is significantly different from one (p-value = 0.000). The estimated mean based on the individual estimates is slightly lower than the population mean of 0.79. The ratio based on the individual estimates is higher than one for 10% of the households, implying that in only 10% of households, the wife has more influence than the husband on joint decisions. A plot of the distribution of the relative influences on the joint decisions is presented in Figure 1.

<Figure 1 to be here>

As can be seen in Figure 1, the estimated random parameter model does not predict a large variation in the relative influences on joint decisions. However, it is still interesting to explore which household characteristics can explain the variation. This is done by estimating a truncated regression model (truncated at zero) with the relative influence as the dependent variable. We include a number of household characteristics that could explain the relative influence, such as household income, length of marriage, and having children. In addition, we include a number of characteristics that have the potential to shift the relative influence of spouses: a wife who is more educated than the husband, a wife who is older than the husband, and husband's parents living in the same household.[6] Finally, we include a self-reported measure of the influence on small investment decisions in the household. The results of the truncated regression model are presented in Table 5.

<Table 5 to be here>

Given the relatively small variation in the dependent variable, it is difficult to explain the variation in the relative influence on joint decisions within households. However, three characteristics have significant effects. First, if the household is richer, then the wife has a stronger influence on joint decisions. Second, if the wife is older than the husband, she has a stronger influence. Third, the relative influence is correlated with a couple's self-report on who is in charge of small investment decisions. In a household where the husband typically makes the

[6] In rural China, couples live either alone or with the husband's parents. Couples hardly ever live with the wives' parents.

household's small investment decisions, the husband's influence on the joint decisions in the experiment is stronger.

5. Conclusions

In this paper, we have measured the relative influence of husbands and wives on joint household decisions in a field experiment conducted in the homes of 101 married couples in a poor, rural region of China. The average earnings from the experiment were equal to the average pay for two days of work. Hence, participants had strong incentives to make decisions that corresponded to their preferences. The experimental task was to make inter-temporal decisions in which an earlier, but smaller, reward could be traded for a later, but larger, reward. Both spouses had to make decisions, first individually and then jointly. In general, we found that participants were rather impatient, both in the individual and the joint decisions. Yet, the focus of our paper has been to estimate how the individual preferences of husbands and wives determine the joint household decisions.

As a first step in understanding these household decisions, we aimed at disentangling the husband's and the wife's influences on joint inter-temporal decisions and determining the factors that affect the relative influences. As our methodological approach, we applied random parameter models that have allowed us, first, to estimate the time preferences of spouses separately and, second, to use the separate estimates as explanatory variables in a model explaining each household's joint decisions. Hence, the random parameter model provides a very suitable tool to estimate the influences of spouses in a household.

We have found that, on average, husbands have a stronger influence on joint decisions than wives. This reflects the traditional Chinese norm that husbands are mainly in charge of household decisions. Our estimations reveal that in 90% of households, the joint household decisions are more influenced by the husband's individual time preferences than the wife's. It is also remarkable that across the 93 households used in the analysis, we find relatively small variation in the relative influences, suggesting that the spouses' relative influences are persistent. Despite the small variation, it is interesting to note the factors that have a significant influence on the spouses’ relative strength in influencing the joint decisions. Our most important finding in this respect is the fact that in richer households, the relative influence of spouses shifts significantly in favor of the wife’s time preferences. This is a clear indication that (increasing) wealth improves the relative power of women in households. Moreover, we found that wives have more influence on joint decisions if they are older than their husbands. Finally, wives have more power in households where they are in charge of small investment decisions. The latter finding confirms earlier findings pointing to the importance of who is in charge of the household income. Previous studies have shown that changing who controls the income in a household leads to changes in patterns of consumption, savings, education for children or even survival rates of children (e.g., Thomas, 1994; Lundberg et al., 1997; and Qian, 2008). Based on our methodological approach, we were able to show that underlying this indirect evidence for the influence of income control on households’ economic behavior is the fact that controlling income allows wives to influence joint decisions; and as a result, the wives’ preferences are better reflected in the joint decisions.

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Tables and Figures

Table 1. Descriptive statistics of household characteristics (N = 101 households)

Variable	Description	Mean	Std. Dev.	Min	Max
Income per capita	Income per capita per year in Chinese yuan [a]	4,203	8253	200	84,117
Wife income contribution	Wife's share of the household income [b]	0.418	0.152	0	1
Length of marriage	Number of years the couple has been married	26.47	12.46	1	52
Number of children	Number of children the couple have	2.675	1.401	0	7

Notes:

[a] This is the per capita average of all family members.

[b] This is a joint self-reported measure, where both husband and wife had to agree about the income contribution of the husband and the wife.

Table 2. Description of the 18 pair-wise choices in the time preference experiment

Set	**Option A (early reward)**		**Option B (late reward)**	
	Time (days)	Amount (yuan)	Time (days)	Amount (yuan)
1	0	12	4	13
2	0	17	4	18
3	0	11	4	14
4	0	16	4	19
5	0	10	4	15
6	0	15	4	20
7	0	11	8	12
8	0	16	8	17
9	0	10	8	13
10	0	15	8	18
11	0	9	8	14
12	0	14	8	19
13	4	13	8	14
14	4	18	8	19
15	4	12	8	15
16	4	17	8	20
17	4	11	8	16
18	4	16	8	21

Note: 0, 4, and 8 in column "Time" refer to today and in four and in eight days from now, respectively.

Table 3. Frequencies of early reward choices in the time preference experiment (N = 101 households)

Set	Option A (early reward)		Option B (late reward)		Share of early reward choices		
	Time (days)	Amount (yuan)	Time (days)	Amount (yuan)	Husband	Wife	Joint
1	0	12	4	13	0.73	0.67	0.79
2	0	17	4	18	0.74	0.64	0.79
3	0	11	4	14	0.38	0.28	0.38
4	0	16	4	19	0.42	0.38	0.39
5	0	10	4	15	0.24	0.13	0.19
6	0	15	4	20	0.28	0.17	0.21
7	0	11	8	12	0.75	0.70	0.81
8	0	16	8	17	0.72	0.68	0.81
9	0	10	8	13	0.57	0.51	0.56
10	0	15	8	18	0.56	0.52	0.54
11	0	9	8	14	0.40	0.30	0.30
12	0	14	8	19	0.38	0.33	0.28
13	4	13	8	14	0.64	0.61	0.76
14	4	18	8	19	0.72	0.67	0.76
15	4	12	8	15	0.52	0.35	0.46
16	4	17	8	20	0.39	0.3	0.39
17	4	11	8	16	0.32	0.19	0.22
18	4	16	8	21	0.28	0.17	0.24
Overall average share of early reward choices					0.50	0.42	0.49

Note: 0, 4, and 8 in column "Time" refer to today and in four and in eight days from now, respectively.

Table 4. Estimated results for random parameter binary probit models for husband, wife, and joint decisions

	Husband	Wife	Joint	
Mean parameters	Coeff.	Coeff.	Coeff.	Coeff.
Constant	2.064***	1.530***	4.163***	-0.133
	(0.282)	(0.306)	(0.429)	(0.447)
Dummy 4 vs. 8 days	0.033	0.002	0.301*	0.266
	(0.126)	(0.124)	(0.170)	(0.163)
Dummy 0 vs. 8 days	0.922***	1.134***	1.331***	0.315**
	(0.137)	(0.130)	(0.196)	(0.155)
$\text{Amount}_{\text{Early}}$	-0.010	-0.007	-0.012	-0.035
	(0.019)	(0.021)	(0.025)	(0.027)
$\text{Amount}_{\text{Late}} - \text{Amount}_{\text{Early}}$	-0.933***	-0.920***	-1.766***	-0.824***
	(0.050)	(0.044)	(0.112)	(0.072)
Husband: predicted probability				3.751***
				(0.262)
Wife: predicted probability				2.337***
				(0.221)
Standard deviation parameters				
Dummy 4 vs. 8 days	0.216**	0.090	0.216	0.227
	(0.094)	(0.098)	(0.140)	(0.144)
Dummy 0 vs. 8days	0.995***	0.879***	1.219***	0.855***
	(0.118)	(0.107)	(0.155)	(0.137)
$\text{Amount}_{\text{Early}}$	0.132***	0.167***	0.219***	0.132***
	(0.008)	(0.009)	(0.015)	(0.009)
$\text{Amount}_{\text{Late}} - \text{Amount}_{\text{Early}}$	0.764***	0.391***	0.742***	0.409***
	(0.042)	(0.024)	(0.053)	(0.034)
Husband: predicted probability				1.713***
				(0.157)
Wife: predicted probability				1.360***
				(0.156)
No. of households	93	93	93	93
Pseudo R-square	0.45	0.39	0.54	0.39

Notes:

Figures in parentheses are the standard errors of the coefficients.

*, **, and *** denote that the coefficient is statistically significant at the 10%, 5%, and 1% level, respectively.

Table 5. Marginal effects of the truncated regression model on the relative influence of the wife

Variable	Description (Mean value)	Mar. eff.
Constant	-	0.025 (0.386)
Log Equivalence scaled income	Log of equivalence scaled household income in Chinese yuan. Equivalence scale = (Adults + 0.5 x Kids)^0.75 (9.03)	0.076** (0.035)
Wife income contribution	Wife's share of total household income (0.40)	-0.314 (0.248)
Length of marriage	Number of years the couple has been married (24.81)	0.005 (0.003)
Have children	= 1 if couple has at least one child (0.42)	0.018 (0.070)
Wife more educated	= 1 if wife has a higher education than the husband (0.14)	0.049 (0.096)
Wife older	= 1 if wife is older than husband (0.29)	0.165** (0.074)
Influence on small investment decisions	When it comes to small investment decisions, for example buying equipment for the house, would you say that: 1 = mainly wife decides, 2= decide jointly, 3 = mainly husband decides (2.17)	-0.072* (0.044)
Living with husband's parents	= 1 if the couple is living with the husband's parents (0.24)	-0.129 (0.083)
No. of households		93

Notes:

Figures in parentheses are the standard errors of the coefficients.

*, **, and *** denote that the coefficient is statistically significant at the 10%, 5%, and 1% level, respectively.

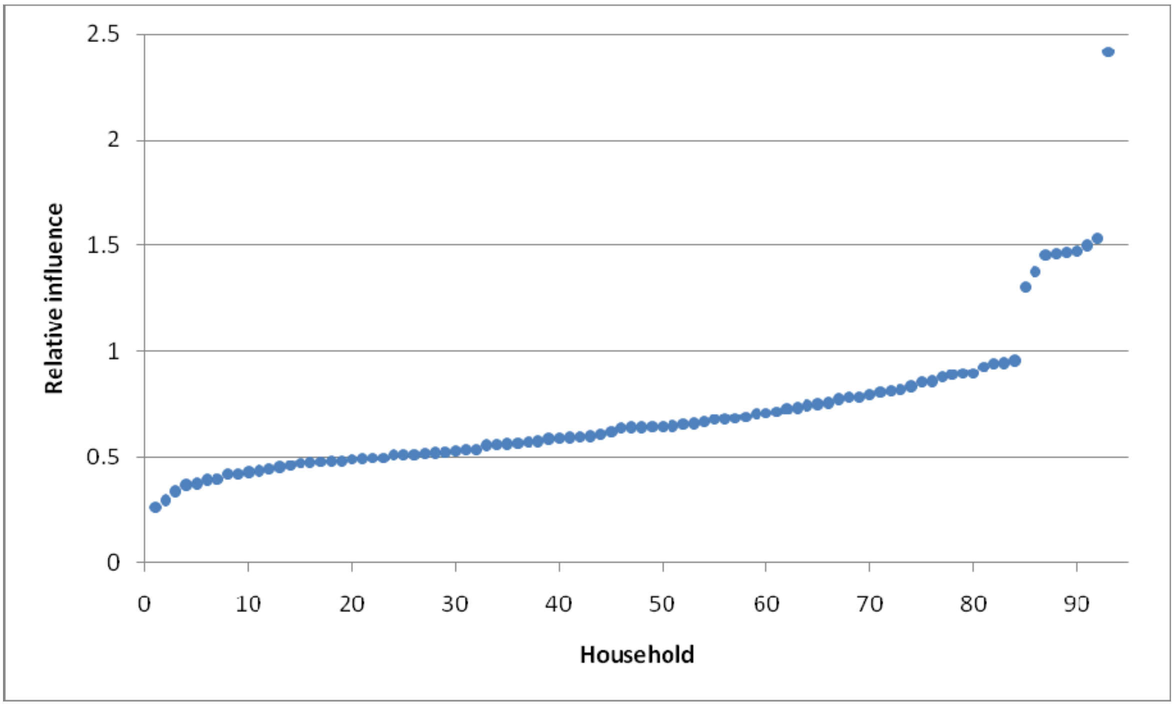

Figure 1. Distribution of relative influences on joint decisions

Appendix. Experimental script for eliciting inter-temporal choices individually and jointly

Separate decisions (for each of the two spouses respectively)

"In this experiment, we will ask you to make decisions between earning money at different points in time. You will be asked to make 18 decisions. Let us look at the first decision [*show card 1*]. In this case you can either receive 12 yuan today if you choose alternative 1 or receive 13 yuan in four days if you choose alternative 2.

At the end of this survey, when your household has answered all the questions, you will draw a card one time for this part to determine the one of the 18 decisions to be actually paid. Even though you will make 18 decisions, only one of these will end up affecting your earning, but you will not know in advance which decision will be used. Each decision has an equal chance of being used in the end.

Please note that if a time today is chosen, you will receive the money right after the survey. If a time different from today is chosen, we will write this "We owe you paper" [*Show the certification to the subject*]. This is a legally binding paper from Peking University assuring you that payment will be done in the future. In practical terms, we will come back to your household at the time chosen to pay you the money."

"Do you have any questions?" [*Experimenters need leave enough time and opportunity to the subjects*] If NOT, "Shall we proceed with the 18 decisions?"

Joint decisions

"In this part of experiment, we will ask you to make decisions between earning money at different points in time. But this time we want you to make decisions together. The questions are exactly the same as before.

The way to determine your payments is the same as before, but this time each of you will receive the amount of money stated in the chosen alternative. That is, you will draw a card one time to determine the one of the 18 decisions to be used. If a time today is chosen, you will receive the money right after the survey. If a time different from today is chosen, we will write the 'We owe you paper' to both of you, and will come back to your household at the time chosen to pay both of you the money."

"Do you have any questions?" [*Experimenters need leave enough time and opportunity to the subjects*] If NOT, "Shall we proceed with the 18 decisions?"

Paper 4

Easy Come, Easy Go
The Role of Windfall Money in Lab and Field Experiments

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Abstract

A growing number of experimental studies focus on the differences between the lab and the field. One important aspect of them is the role of windfall money. By conducting a dictator game experiment, we investigate the influences of windfall and earned endowment on behavior in the laboratory and in the field. We find subjects donate more in both environments if the endowment is a windfall gain. However, although the experimental design was intended to control for all other effects except environment, there are significant differences in behavior between the lab and the field for both windfall and earned endowment. This points to the importance of discussing the environment when interpreting both laboratory and field experiment results as well as of conducting replication studies.

Key words: charitable giving; dictator game; laboratory experiment; field experiment; windfall money

JEL classification: C91, C93, D64

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Acknowledgments: We have received valuable comments from Yu Duan, Martin Dufwenberg and seminar participants at the University of Gothenburg, Ratio Institute, the University of California Berkeley, and IMEBE 2009 in Granada. Financial support from Swedish International Development Cooperation Agency (Sida) to the Environmental Economics Unit at the University of Gothenburg and logistic support from the China Foundation for Poverty Alleviation are gratefully acknowledged.

1. Introduction

Laboratory experiments are an important tool to gain various economic insights that cannot easily be obtained using market data or field experiment data. Also, many experiments are designed to investigate human behavior. Thus, a crucial question is whether subjects' behavior in the laboratory is consistent with their behavior outside the lab. There are of course many differences between the laboratory and the field; therefore it is difficult to compare behaviors in these two settings. For example, if people do not give away a large share of their income to charity, it does not prove that the behavior in a dictator game, where subjects on average give away 20% of their endowment (e.g., Camerer, 2003), is not externally valid. Levitt and List (2007) argue that a number of factors can explain the behavioral differences found between the laboratory and the real world: scrutiny, context, stakes, selection of subjects, and restrictions on time horizons and choice sets. One development in lab experiments is therefore to reduce the differences, by for example using non-standard subject pools and having subjects earn the endowment. An important reason for the increased use of non-windfall gain is the intent to mimic the setting outside the lab, where almost all incomes are earned rather than obtained as windfalls. The evidence of the effect of windfall money on subject behavior in the lab is mixed. In dictator games, the dictators contribute less when the endowment is earned (Cherry et al., 2002; Ruffle, 1988; Oxoby and Spraggon, 2008). On the other hand, Cherry et al. (2005) and Clark (2002) find no evidence of a windfall-gains effect on contributions in a public good experiment, while Kroll et al. (2007) find significant differences in a public good experiment with heterogeneous endowment.[1] In a recent paper, Smith (2010) argues that using laboratory experiments have resulted in many insights into human behavior, but the extent to which these can be carried over to behavior when own money is involved is questionable.[2] Note that this should not be seen as a general critique

[1] However, see the comment by Harrison (2007), where it is shown that the windfall gain in the experiment by Clark (2002) actually shows a significant effect on the share of free-riding subjects.

[2] It should however be noted that stake, selection of subjects, and choice sets and time horizons of the experiment have shown to have a significant impact on behavior. For experiments on stake size effects in dictator games, see e.g., Carpenter et al. (2005) and Cherry et al. (2002) and on selection of subjects see, e.g., Fehr and List (2004). For effects of choice sets in dictator games see Bardsley (2008) and List (2007), who allow

against laboratory experiments. In many instances, we as researchers would like to test the effects of a certain treatment or stimuli keeping all other factors constant, and in those cases there are strong arguments for conducting laboratory experiments (Falk and Heckman, 2009). Not the least the strong control over the environment in which the decision is made.

In this paper, we are interested in analyzing the behavioral effects of conducting experiments in the lab and the field, and in particular we investigate the role of windfall and non-windfall money in the lab and the field. To do this, we use a 2×2 experimental design. We let the subjects participate in a dictator game with a charity organization as the recipient (see, e.g., Eckel and Grossman, 1996, for a similar experiment). In the experiment, we keep all other factors such as stake, selection of subjects, and choice sets and time horizons of the experiment constant and only vary windfall gain and whether the experiment is conducted in the lab or in the field. This means that the main differences between the lab and the field in our experiment are due to the environment *per se* and the degree of scrutiny.[3] The advantage of using a dictator game is that the game is very easy to understand and there are no strategic motives involved. The game also resembles a charitable giving situation, which means that it is possible for us to compare the behavior with that in a field experiment involving charitable giving. Treatment 1 is a standard lab experiment with windfall endowment, and Treatment 2 is a lab experiment with earned endowment. Treatment 3 is a field experiment with windfall endowment, and Treatment 4 is a field experiment with earned endowment. Our design allows us to make two important comparisons. First, we can investigate the effect of windfall gain in the lab (by comparing Treatment 1 and Treatment 2) and in the field (Treatments 3 and 4). Second, by comparing Treatments 1 and 3, and 2 and 4, we can make an overall

some of the subjects in a traditional dictator game to also take money from the recipients' endowments.

[3] It is likely that subjects will feel more scrutinized in the lab than in the field. This is not to say that subject in the natural field experiment do not feel scrutinized at all. Even if ensuring anonymity of their behavior, they might still have the feeling of being observed by for example the solicitor. Scrutiny is also related to the degree of anonymity in an experiment, which could be anything from publicly announced behavior to a double-blind procedure. The general finding is that when the degree of anonymity is reduced, people behave less selfishly (e.g., List et al., 2004; Rege and Telle, 2004; Soetevent, 2005). Therefore, it is reasonable to expect a difference in behavior between the lab and the field due to scrutiny.

comparison between the lab and the field conditional on the way the endowment is received and earned.

Why would windfall money matter in a dictator game? One explanation to the potential difference is that people's preferences for the distribution of money depend on, among other things, the input of the subjects (Konow, 2000). When the endowment is a windfall gain, the dictator prefers to split the money more evenly, since she does not do anything to receive the money. Cherry et al. (2002) make a similar argument: non-windfall money legitimizes the endowment and invokes a more selfish behavior. In psychology, it has been suggested that subjects use different mental accounts for non-windfall and windfall money (Arkes et al., 1994).

A number of previous studies have studied the differences in behavior between the lab and the field (e.g., List, 2006; Karlan, 2006; Benz and Meier, 2008; Laury and Taylor, 2008; Antonovics et al., 2009; Carpenter and Seki 2009). However, the only other study we are aware of that makes a direct comparison between lab and field using a dictator game is the one by Benz and Meier (2008), who use an ingenious within-subject design to compare individuals' donation behaviors in the field and in the lab. They conduct a dictator game with two social funds as external recipients, and compare the behavior in the experiment with actual charitable giving by the same subjects. They find a stronger donation behavior in the lab, but that it is correlated with the behavior in the field. An important reason for the difference between the lab and the field settings could be that the lab experiment uses windfall money, while the field experiment does not involve an experimental endowment at all. This is exactly what our experimental design allows us to test. By applying a between-subject design and keeping the difference between the laboratory and field experiments to a minimum, our experiment allows us to make clear comparisons of the behavior in the lab and the field. The remainder of the paper is organized as follows. Section 2 introduces the experimental design, and Section 3 reports the experimental results. Section 4 concludes the findings.

2. Experimental design

The experiment was conducted in October 2008 at Renmin University of China, which is located in the northern part of the capital Beijing and has approximately 22,000 full-time and 13,000 part-time students. We conducted a one-shot dictator experiment. The subjects were given ten 5-yuan[4] bills and were subsequently asked how much they would like to donate to the China Foundation for Poverty Alleviation.[5] This type of campaign, where people are asked to donate to a charity, is not uncommon in China, and the China Foundation for Poverty Alleviation occasionally conducts similar campaigns on campus to give students the opportunity to donate money, old clothes, or other consumer goods to the poor or those in need. In order to test for (i) the difference between the lab and the field and (ii) the effect of windfall gains, we designed an experiment with four treatments using a 2×2 experimental design.

The laboratory experiment was conducted at the School of Economics at Renmin University of China, while we used a supermarket located on the campus of Renmin University of China as the scene for our field experiment. The endowment was given as either a windfall or a non-windfall gain, where in the latter case subjects earned the endowment by answering a lengthy questionnaire. The recruitment to all treatments was such that every third customer that exited the supermarket was approached. In the laboratory experiment, the customers were approached by one of our experimenters and asked if they would like to participate in a study conducted by university researchers. The field experiments were done in collaboration with the supermarket, and the experimenters were employed by the supermarket. Therefore, in the field experiments the customers were approached by one of our experimenters dressed in a supermarket uniform and asked if they would like to participate in

[4] At the time of the experiment, 1 US dollar = 6.85 Chinese yuan.

[5] This is China's largest and most well-known charitable organization for poverty alleviation. Its main activities include community development, disaster relief, education and training, information technology services, relief, and shelter and housing provision. Traditionally, there has been a low level of trust and thereby low levels of donations to charities in China. However, in the aftermath of the Sichuan earthquake, there were numerous media reports about the earthquake and how the donations that people made actually went to and helped the people in need.

a campaign conducted by the supermarket. Since we want to keep the subject pool variations at a minimum, we only allowed students from Renmin University to participate and therefore all treatments began with a screening question asking whether or not they were students at the university. In addition, all the treatments were double-blind.

We begin by describing the laboratory experiment treatments and then the field experiment treatments. The full scripts are presented in Appendix. Table 1 below summarizes the key features of the experimental design.

<Table 1 to be here>

In the laboratory experiment treatments, subjects were asked to participate in an experiment conducted by the School of Economics at Renmin University at a scheduled time.[6] They were told they would receive 10 yuan as a show-up payment at the end of the experiment to compensate for the inconvenience to come to the experimental session on a specific date and time. When subjects arrived at the lab, they were randomly assigned to either the windfall or the non-windfall treatment. In the treatment with windfall endowment (Treatment 1), an experimenter welcomed the subject who was then led to a cashier where the 50 yuan was given in ten 5-yuan notes. After the subject had received the money, the experimenter presented the opportunity to donate to the China Foundation for Poverty Alleviation using the money that had just been received. The objectives of the foundation and for what purpose the donations would be used were then explained. At this point, the subjects were again told that the donation campaign was part of a research study. In order to ensure that the decision was anonymous, we put up a booth in which the subjects could make their

[6] The recruitment procedure was the same in all experiments, and although the refusal rate was somewhat higher for Treatments 1 and 2, we do not expect any significant differences in subject pools due to the recruitment from a homogeneous subject pool consisting of students. Since the subjects in Treatments 2 and 4 answered the same survey, we can test whether there are any differences in a number of socio-economic characteristics. We cannot reject at 5% significance level the hypothesis of equal means or proportions between Treatments 2 and 4 in the variables gender, age, education, income, party membership and family size by using a t-tests and a proportion test respectively (see Table A1 in Appendix I). However, not all of the recruited subjects showed up at their scheduled time in Treatments 1 and 2. If this is correlated with unobserved subject characteristics, we could have a difference in subject pool.

decisions privately. The subjects were asked to leave any donation in a supplied envelope and keep the remaining money, then seal and put the envelope in an official donation box from the China Foundation for Poverty Alleviation.[7]

The lab experiment with earned endowment (Treatment 2) was the same as Treatment 1 except that upon arriving at the lab the experimenter asked the subjects whether they would be willing to answer a survey on the use of plastic bags and their views on the supermarket in general.[8] They were told that if they completed the survey they would receive 50 yuan. The subjects were again reminded that the donation campaign was part of a study conducted by researchers from the School of Economics. It was made clear that the money was a compensation for their time and effort. Once the survey had been completed, the experimenter asked the subject to follow along to the cashier, who paid the 50 yuan in ten 5-yuan notes. After the subject had received the money, the dictator game was conducted in exactly the same way as in Treatment 1.

In the field experiment with windfall endowment (Treatment 3), the experimenter informed the subject that the supermarket was conducting a “Thank you customer” campaign and that the subject had been randomly selected to receive 50 yuan. In China, it is common that supermarkets conduct commercial campaigns to improve their customer relations, although in most cases vouchers valid at the supermarket are used rather than cash. In order to keep logistics the same, the money was given by the cashier. Once the subject had received the money, the experimenter explained that there was an opportunity to donate to the China Foundation for Poverty Alleviation using the money that had just been received. The donation

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[7] The box could only be opened by a foundation representative, and subjects were clearly informed about this.

[8] The survey was anonymous and we linked subjects’ survey information to their donation decisions by using an identification number on the envelopes. The survey was a face-to-face interview with questions about the use of plastic bags and the supermarket. The reason why we asked about the use of plastic bags was that four months before the experiment, a new policy was implemented in China requiring all retailers to charge money for providing plastic shopping bags. The survey took 20 minutes, and the experimenters were instructed to use the same amount of time for all surveys.

was made in private in a booth. In order to keep the differences between the laboratory and the field settings at a minimum, we used the same recruitment procedure, the same experimenters, the same payout and donation procedure, the same cashiers, the same charity and dictator game introduction script, and the same donation booth.

Finally, in the field experiment with earned endowment (Treatment 4), the experimenter asked the subjects if they would be willing to participate in a survey carried out by the supermarket on the use of plastic bags and on views on the supermarket in general. The survey was exactly the same as in Treatment 2. They were told that if they chose to participate, they would be paid 50 yuan in cash. It was made clear that the money was a compensation for their time and effort. Once the survey had been completed, the experimenter asked the subject to follow along to the cashier, who paid the 50 yuan in ten 5-yuan notes. After the subject had received her earnings, the dictator game was conducted in the same way as in the previous treatments.

We used the same experimenters in all treatments, i.e., female university students not from Renmin University of China. The cashiers who handed out the money were always the same male students (not from Renmin University of China). Each experimenter and cashier conducted the same number of experiments in each treatment. The supermarket where the experiments were conducted is the largest supermarket on the campus of Renmin University with around 1,000 customers per day. Treatments 3 and 4 were conducted first over a two-day period. Then the recruitments to Treatments 1 and 2 were made over a two-day period, and the lab experiments were conducted during the two days that followed.

3. Results

In total 211 subjects participated in the experiments. Table 2 reports the descriptive statistics of the donations for all treatments. The mean donation amount and the share of subjects donating the whole endowment of 50 yuan vary considerably across treatments.[9] In the

[9] Since we could not limit the individual donations to 50, particularly not in the field setting, we have three

standard dictator game (Treatment 1), the average donation is 37.1 yuan, corresponding to 74% of the endowment. In the other three treatments, the donations are much lower. The mean donations are higher in the laboratory experiment treatments (Treatments 1-2) than in the field experiment treatments (Treatments 3-4). This is to a large extent explained by a higher fraction of subjects donating everything in the laboratory experiments.

The mean donations in our experiment are in general higher than in other similar experiments. For example, with a similar experimental design with a charity recipient, Eckel and Grossman (1996) find that subjects donate on average 30% of the endowment, while in our experiment the average donation is 74% of the donation. On the other hand the average proportion donated in Benz and Meier (2008) is also rather high, between 62% and 67% of the endowment. Clearly, the amount donated is very context specific, but we believe that one important reason for the high donation rate in our experiment is that China just had experienced several large natural disasters, which has resulted in a general increase in charitable giving. For example, the total amount of money from individual charitable giving increases more than 13 times higher in 2008 than in 2007 (Chinese Ministry of Civil Affairs, 2007; 2008).

<Table 2 to be here>

Table 3 reports the results from statistical tests of the effects of windfall money in lab and the field environments. We conduct a t-test to test for mean differences as well as a Wilcoxon rank-sum test of equality of distributions for amounts donated across treatments. Moreover, we test the hypothesis of equally sized zero-yuan and 50-yuan donation shares and perform t-tests and rank-sum tests for amount donated conditional on giving a positive amount but less than 50 yuan.

We can reject the null hypothesis of no effect of windfall gain both in the lab and in the field. In both cases, the mean donation is significantly lower when the subjects have to earn their endowment, and this is largely explained by the large difference in share of subjects

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subjects who donated more than 50 Yuan. We truncate these donations at 50 Yuan.

donating 50 yuan. The proportion of subjects giving 0 or 50 yuan is significantly different between windfall and non-windfall at the 5% significance level for both the lab and the field experiments, except for the proportion of subjects giving 0 yuan in the lab. However, there is no difference in the amount donated if the two extreme values of donating either nothing (0 yuan) or fully (50 yuan) are removed. This is true for both the lab and the field experiments. Consequently, in both the lab and the field, the major effect of introducing non-windfall endowment is that it increases the share of zero donations and decreases the share of full (50 yuan) donations.

The effect of earned endowment is similar to that of previous studies using dictator games in a laboratory environment in the sense that the mean contributions decrease when the endowment is earned. However, since there is a number of differences in design and context, it is difficult to make direct comparisons. Cherry et al. (2002) finds a stronger effect in terms of subjects offering zero since while around 15-20 percent offered zero in the treatment with windfall, in the treatments with earned endowment 70-79 percent offer zero. In Oxoby and Spraggon (2006), while all subject offered zero, when their endowment was earned, between 11 and 35 percent offered zero when the endowment was a windfall gain.

<Table 3 to be here>

Finally, Table 4 reports the statistical test results of the null hypothesis of no difference between the lab and the field, conditional on that the endowment was obtained in the same manner. We can reject the hypothesis of equal donation amounts for both the windfall and the earned endowment treatments. However, the difference is much smaller when the endowment is earned. If the extreme donations are deleted, the difference in mean donations is reduced substantially. For the two treatments with earned endowment, the difference in mean donations is not significant using both a t-test and a rank-sum test. For the two treatments with windfall endowment, the difference is significant using a rank-sum test, but not significant using a t-test.

The study of Benz and Meier (2008) is perhaps the study that comes closest to our experiment. Their study is not tailored to test whether people are more pro-social in the lab compared with the field. However, they do find some indications of stronger pro-social behavior in the lab, for example subjects who never donated in their field experiment did donate a substantial amount in the lab experiments. As discussed in the introduction of our paper, an explanation for this difference could be that the endowment in the field experiment is earned. Our results suggest that this is an important explanation for the difference between the laboratory and the field results, but even with control for this, there is a remaining difference in pro-social behavior.

<Table 4 to be here>

4. Conclusions

The present paper investigates how behavior is affected by windfall endowments as well as by laboratory and field environments. By using a dictator game and the same set-up between laboratory and field experiments, we aim at holding all experimental design features constant, from recruitment process, experimenter used to the place where subjects make their decision (the booth), except the environment *per se* and how endowment was earned and allow a clean comparison of behavior in the two settings. In particular, we are able to compare them conditional on how the endowment is obtained. First, we find a substantial and significant difference in behavior between using windfall and earned endowment both in the lab and in the field. The absolute and relative differences are larger in the lab environment, but this can partly be due to the overall higher contribution levels in the lab. Consequently, the strong effects of windfall money found in previous lab experiment studies are not only an artifact of lab environment *per se*. Even outside the lab, subjects consider how the endowment is obtained, and are much less pro-social when the endowment is earned. Second, there are sizeable and significant differences in behavior between the lab and the field, in particular with windfall endowment. The overall differences are smaller, but still significant, when non-windfall money is used. It should be noted that in the more detail analyses of the data of the earned endowment treatments on the proportion of giving as well as on the amount conditional giving, there were no significant effects between the lab and the field at 10% significance level. The present study is the first attempt to investigate the issue of windfall gain in different experimental environments, keeping other things constant apart from the basic characteristics of lab and field environments including subject pool. Future studies are needed to understand how sensitive our results are by using different donation recipients and the environment in which the decision is made, and at a more general level how different games, e.g., public games, are affected by these design features.

Our experiment and results should not be interpreted as an argument against conducting laboratory experiments. For example, we find similar effects of windfall endowment in the laboratory and the field. Moreover, it is clear that there are many advantages with conducting laboratory experiments (Falk and Heckman, 2009). Our results show the importance of using earned money to reduce the gap between the laboratory and the field, but whether this calibration results in different policy conclusions when for example comparing different institutions or is a pure level shift is an important question for future research. Although the experimental design was intended to control for all other effects except environment, we still find differences. This points to the importance of discussing the environment when interpreting both laboratory and field experimental results, as well as of conducting replication studies, especially for field experiments. The behavior in the field is likely to also depend on the context and the environment. For example, it is likely that subjects would have been more generous in the field experiment if we would have conducted the experiment at a meeting of the Communist Party in China (or at a church in a Christian country).

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Tables

Table 1. Summary of the experimental design

	Laboratory experiment	Field experiment
Windfall endowment	Treatment 1	Treatment 3
Non-windfall endowment	Treatment 2	Treatment 4

Table 2. Description of donation behavior for each treatment

	Treatment 1	**Treatment 2**	**Treatment 3**	**Treatment 4**
	Lab experiment with windfall	Lab experiment without windfall	Field experiment with windfall	Field experiment without windfall
Mean	37.1	14.5	18.6	9.5
Standard Deviation	17.8	14.7	16.4	9.7
Share of zero donations	0%	6%	0%	10%
Share donating everything (50 yuan)	61%	7%	14%	2%
Number of observations	54	54	53	50
Mean (if donation is above zero and below 50)	16.9	12.4	12.2	9.7
Standard deviation (if donation is above zero and below 50)	11.7	11.0	10.6	9.7
Number of observations	21	47	44	44

Table 3. Test of difference between windfall and non-windfall

	Windfall vs. earned in the lab	**Windfall vs. earned in the field**
Treatments	1 vs. 2	3 vs. 4
Differences in mean	22.6	9.1
t-test (p-value)	0	0.002
Rank-sum test (p-value)	0	0.006
Differences in proportion giving 0 yuan	-0.06	-0.1
Proportional test (p-value)	0.079	0.018
Differences in proportion giving 50 yuan	0.54	0.12
Proportional test (p-value)	0	0.01
Differences in mean donation if above zero and below 50 yuan	4.5	2.5
t-test (p-value)	0.132	0.204
Rank-sum test (p-value)	0.085	0.377

Table 4. Test of differences between the lab and field experiment contexts

	Lab vs. field with windfall endowment	**Lab vs. field with earned endowment**
Treatments	1 vs. 3	2 vs. 4
Differences in mean	18.5	5.0
t-test (p-value)	0.000	0.044
Rank-sum test (p-value)	0.000	0.039
Differences in proportion giving 0 yuan	0	-0.04
Proportional test (p-value)	n.a.	0.395
Differences in proportion giving 50 yuan	0.47	0.05
Proportional test (p-value)	0.000	0.198
Differences in mean donation if above zero and below 50 yuan	4.7	2.7
t-test (p-value)	0.109	0.168
Rank-sum test (p-value)	0.061	0.126

Appendix I. Tables

Table A1. Descriptive statistics for treatments 2 and 4 and tests of equality of means and proportions

Variable	Description	Treatment 2 (lab)		Treatment 4 (field)		P-value
		Mean	Std. dev	Mean	Std. dev	
Male	= 1 if respondent is a male	0.50	0.505	0.5	0.505	1.000 [b]
Age	In years	20.91	2.877	20.22	2.179	0.175 [a]
Education	In years	16.78	1.327	16.78	1.329	0.993 [a]
Monthly income	= respondent's monthly net income in yuan	994.44	479.354	1022	388.24	0.749 [a]
Party member	= 1 if respondent is a Communist Party member	0.28	0.452	0.28	0.454	0.980 [b]
Family size	= number of household members	1.46	0.966	1.56	1.053	0.625 [a]
No. of obs.		54		50		

Note: [a] indicates it is from a t-test; [b] indicates it is from a proportion test.

Appendix II. Script

Recruitment

Treatment	Script
1,2	*"Good morning/afternoon! I am an enumerator from the School of Economics. Are you a student at this university?"*
3, 4	*"Good morning/afternoon! I am a representative from Wu-mart Supermarket. Are you a student at this university?"*

All	IF NO: "*I'm sorry for bothering you, but we are only looking for students from this university*" Terminate the campaign without payment.

1,2	IF YES: "*The School of Economics is conducting a study. The study will be conducted this Wednesday and Thursday in the Ming De building classroom 405, which is close to here. All in all it will last a few minutes. We will pay you 10 yuan for showing up at a scheduled time. If you want to participate, let us make an appointment that is convenient for you. Do you have time to participate?"*
3	IF YES: "*To show our appreciation to our customers we are conducting a 'Thank you customer' campaign. Do you have time to participate?"*
4	IF YES: "*Wu-mart Supermarket is conducting a survey about the use of plastic shopping bags and your opinion about the campus supermarket. The survey will last about 20 minutes. If you participate, we will pay you 50 yuan in cash after you have completed the survey as compensation for your work with answering the survey. Do you have time to participate?"*

All	IF NO: *"That's alright. Thank you anyway."* Terminate the campaign here without payment.

1,2	IF YES: "*Thank you for participating in this research study! Could you please let me see your receipt?"* Take his/her receipt and have a look at it and keep it. *Let's make an appointment. The study will be conducted this Wednesday and Thursday in the Ming De building classroom 405. What time are you available on these days?"* Check the answer with the available times slots on

	the list. *"Could you please come on …. (day) at…. (time)?"* If YES continue. If NO, check another time and ask. If NO again, show the list of available times and ask what time would be convenient to come. --- IF SUBJECT CANNOT PARTICIPATE: because of not being able to make an appointment at the available times: *"Thank you anyway. I understand."* Terminate the campaign here without payment. IF SUBJECT CAN PARTICIPATE: *"Ok, so you will come on …. (day) at … (time) to the Ming De building classroom 405*." Fill in a confirmation card and write down the appointment in the time schedule. *"Here is your confirmation card. Since we cannot remind you again, please don't forget to come on time and bring this card with you. Thank you."* Hand over the card. [Tell the subject he/she will get the receipt back when coming to participate in the research study if he/she asks for it.] Pack up all the appointment files and paste his/her receipt behind the enumerator's part of the confirmation card.
3	IF YES: *"Thank you for participating in this campaign! Could you please let me see your receipt?"* Take his/her receipt, have a look at it and keep it.
4	IF YES: *"Thank you for participating in this survey! Could you please let me see your receipt?"* Take his/her receipt, have a look at it and keep it.

Experiment

Treatment	Script
1	*"Hello, are you here to participate in the study conducted by the School of Economics?"* IF YES: *"Could you give me your confirmation card?"* Take the card, check the card. [If he/she cannot show the card, ask what time his/her appointment is and check the schedule. If appointment EXISTS continue. If NOT, ask the person to leave.] "*Please come with me.*" Go to the interview room. Check the campaign number on the card and take the file with the same number. [check this carefully]

	"Thank you for coming here to participate in the research study conducted by the School of Economics. At the end of the study we will pay you 10 yuan for showing up at the scheduled time. In this study by the School of Economics, we would like to give you 50 yuan."
2	*"Hello, are you here to participate in the study conducted by the School of Economics?"* IF YES: *"Could you give me your confirmation card?"* Take the card, check the card. [If he/she cannot show the card, ask what time his/her appointment is and check the schedule. If appointment EXISTS continue. If NOT, ask the person to leave.] "*Please come with me.*" Go to the interview room. Check the campaign number on the card and take the file with the same number. [check this carefully] *"Thank you for coming here to participate in the research study conducted by the School of Economics. At the end of the study we will pay you 10 yuan for showing up at the scheduled time. You see, the School of Economics is conducting a survey about the use of plastic shopping bags and your opinion about the campus supermarket. The survey will last about 20 minutes. If you participate, we will pay you an extra 50 yuan in cash after you have completed the survey as compensation for your work with answering the survey. Do you have time to participate?"* IF NO: *"I understand. Thank you anyway. Please come with me to the cashier to get the 10 yuan."* Lead the subject to the cashier. *"Here is the confirmation card and receipt. Please give him/her the 10 yuan for showing up."* Hand over the card and the receipt to the cashier and be prepared to sign the form. Cashier: Take the card and the receipt, and write down the number of the receipt in the form. Let the enumerator sign the form. Take out two 5-yuan bills from the money box and count them. (These two 5-yuan bills should have been prepared in advance so that you only show the subject the two 5-yuan bills when he/she comes to you.)

	Cashier: "*Here is your money.*" Hand over the money to the subject. "*Please let me sign the form.*" Sign the form. "*Ok, we are done now*." Terminate the campaign. When the subject has left, the enumerator needs to write down the gender on the script page. IF YES: "*Thank you for participating in this survey!*" Conduct the survey "*As compensation for your work with answering the survey by the School of Economics, we would like to give you 50 yuan.*"
3	"*To show our appreciation in this "Thank you customer" campaign, the Wu-mart supermarket would like to give you 50 yuan.*"
4	Conduct the survey "*As compensation for your work with answering the survey by the Wu-mart Supermarket, the Wu-mart supermarket would like to give you 50 yuan.*"

All	"*Please come with me to the cashier to get the money.*" Lead the subject to the cashier. "*Here is the receipt.*" Give receipt to the cashier and be prepared to sign the form. Cashier: Take the receipt and write down the number of the receipt in the form. Let the enumerator sign the form. Take out ten 5-yuan bills from the moneybox and count them. (These ten 5-yuan bills should have been prepared in advance so that you only show the subject the ten 5-yuan bills when he/she comes to you.) Cashier: "*Here is your money.*" Hand over the money to the subject. "*Please let me sign the form.*" Sign the form. "*Ok, we are done now.*" Enumerator: Make sure that you stand behind the subject, so that when you start talking, the subject has to turn around, facing you but not the cashier. Preferably walk away a few meters from the cashier.

1,2	"*We are doing a research study on a donation campaign. The donations will finance*

	advertisement material used to collect money for the China Foundation for Poverty Alleviation. The Foundation is a nationwide charitable organization working toward poverty alleviation. Before you leave, you have the opportunity to donate money to the foundation. Over there is a donation box. Please come with me." Lead the subject to the booth and show the donation box to him/her. *"This is a donation box from the foundation. The donations will be deposited into a special account used to cover advertisement material expenditures for collecting money for the foundation. Your donation is anonymous."* *"Here is a donation envelope from the foundation."* Take out the envelope and hand it over it to the subject. "*When I have walked away from here, please go in the booth and leave the money you want to donate in the envelope. Keep the remaining money for yourself and pocket it. Seal the envelope and put it into the donation box. Then go to the place where you received the 50 yuan to collect your extra 10 yuan for showing up. Thank you! Goodbye."* Walk away from the donation booth.
3,4	*"We are doing a donation campaign. The donations will finance advertisement material used to collect money for the China Foundation for Poverty Alleviation. The Foundation is a nationwide charitable organization working toward poverty alleviation. Before you leave, you have the opportunity to donate money to the foundation. Over there is a donation box. Please come with me."* Lead the subject to the booth and show the donation box to him/her. *"This is a donation box from the foundation. The donations will be deposited to a special account used to cover advertisement material expenditures for collecting money for the Foundation. Your donation is anonymous."*

	"Here is a donation envelope from the foundation." Take out the envelope and hand it over it to the subject. "*When I have walked away from here, please go in the booth and leave the money you want to donate in the envelope. Keep the remaining money for yourself and pocket it. Seal the envelope and put it into the donation box. Thank you! Goodbye."* Walk away from the donation booth.

Paper 5

Windfall vs. Earned Money in the Laboratory: Do They Affect the Behavior of Men and Women Differently?

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Abstract

We experimentally investigate, using a dictator game, if the effects of windfall and earned endowments on behavior differ between men and women. In line with previous studies, we find that windfall endowments significantly increase the amount donated. The impact of moving from earned to windfall endowment on behavior is larger for females, yet the gender difference is statistically insignificant. Thus, we do not find evidence that the change in how the endowment is obtained in a laboratory experiment affects male and female behavior differently.

Key words: dictator game; experiment; earned endowment; gender; windfall gain

JEL classification: C91, C93, D64

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Acknowledgments: We have received valuable comments from Martin Dufwenberg, Amrish Patel and seminar participants at University of Gothenburg. Financial support from Swedish International Development Cooperation Agency (Sida) to the Environmental Economics Unit at the University of Gothenburg, from the Swedish Research Council (*Vetenskapsrådet*), and from the Jan Wallander and Tom Hedelius Foundation, and logistic support from the China Foundation for Poverty Alleviation are gratefully acknowledged.

1. Introduction

A key component of laboratory experiments is that subjects are monetarily rewarded and that the rewards are linked to their actions. In most experiments, subjects receive an endowment as a windfall gain and then make their decisions using the endowment, while in some cases subjects have to earn their endowment to be used in the experiment. A reason for using earned endowment is that the origin of the endowment may alter behavior. Thus, earned endowment makes the endowment more likely to be considered as a part of the subject's wealth than a windfall gain, and therefore making it preferable to use in experiments. In experiments involving issues such as altruism, fairness, and pro-social behavior, it is possible that how the endowment is obtained affects subject behavior. Using dictator games, a number of studies suggest that subjects behave differently when the endowment is earned as compared to when receiving a windfall endowment. For example, Cherry et al. (2002) find that if the endowment has to be earned by the subject, it legitimizes the endowment and invokes a more selfish behavior compared to the case with a windfall endowment. Oxoby and Spraggon (2008) use an experimental design in which they endow the senders with the money earned by the receivers in a dictator game. In this case, they even find offers in excess of an equal split. Reinstein and Riener (2009a) disentangle endowment tangibility in terms of when the endowment money is made available and how it is obtained, and find that both matter in a dictator game with a charitable giving context. Moreover, they argue that the result of Cherry et al. (2002) might be largely driven by a cash payment prior to the distribution decision. Thus, subjects in dictator game experiments seem to consider earned money differently than windfall gains.[1]

At the same time, there is evidence that women are more altruistic and contribute more than men in dictator games (see, e.g., Croson and Gneezy, 2009; Eckel and Grossman, 1998; Engel, 2010), and that women are even expected to give more or at least no less than men in a dictator game (Aguiar et al., 2009). Moreover, Saad and Gill (2001) examine the effect of

[1] Behavioral difference yielded by windfall and earned endowments has also been found in the contexts of capital expenditure (Keasey and Moon, 1996) and auctions (Ackert et al., 2006). However, in public good game experiments, no significant effect of windfall gain on contribution levels has been found (e.g., Clark, 2002, although Harrison, 2007, finds a significant effect when re-analyzing the same data; Cherry et al., 2005), and even a negative effect of windfall gain on contribution has been found (Spraggon and Oxoby, 2009). Nevertheless, the nature of a public good game is different from that of a dictator game, and Spraggon and Oxoby (2009) explain these differences in findings with what they call "anticipatory reciprocity".

recipient gender on allocation behavior in a modified dictator game and find that both men and women give more to women. Reinstein and Riener (2009b) conduct a two-stage dictator game to investigate how the first mover influences the second mover's donation by revealing the first mover's donation and gender, and find the female first movers are more influential than male first movers. In the psychological literature, it has been suggested that women's higher sensitivity to changes in experimental design and implementation is due to women being more sensitive to social cues, which might be implied in experimental conditions (see, e.g., Gilligan, 1982). In an overview paper on behavioral differences between genders in laboratory experiments, Croson and Gneezy (2009) argue that this is one potential explanation to differences found. Therefore, the more relevant question to laboratory experimental design is whether the gender difference in behavior is also present when the endowment is changed from a windfall gain to earned money. The objective of the present paper is to investigate gender differences in donations in a dictator game when the endowment is either earned or a windfall gain using a between sample design. In our dictator game experiment, we use a charitable organization as the recipient. We use a 2×2 experimental design, where the two dimensions are how the endowment is received (windfall or earned) and the gender of the subjects.

Our results provide evidence that the impact of changing the type of endowment is larger for women, although the gender difference is statistically insignificant. The rest of the paper is organized as follows. Section 2 introduces the experimental design and Section 3 reports the experimental results. Section 4 concludes the findings.

2. Experimental design

The experiment was conducted in the fall of 2008 at Renmin University of China in Beijing. It consisted of four treatments using a 2×2 design with the dimensions being whether the endowment is earned or a windfall gain and the gender of the subjects. Table 1 depicts the experimental design

<Table 1 to be here>

The subjects, 54 male and 54 female university students were recruited a few days before the experiment from a supermarket at campus by asking whether they would like to participate in an economic research study with a 10 Chinese yuan[2] show-up fee. Upon their arrival to the lab, the subjects who were randomly assigned to the windfall endowment treatments were given an endowment of 50 yuan in ten five-yuan bills. The subjects who were in the earned endowment treatments were asked to answer a lengthy survey to earn the same endowment before proceeding.[3]

In both treatments, after the subject had received the money, the experimenter presented the opportunity to donate to the China Foundation for Poverty Alleviation[4] using the money they had received. The experimenter explained how the money would be used if donated. In order to ensure that the decisions were made anonymously, we put up a booth in which the subjects could make their decisions privately. The subjects were asked to leave any donation in a supplied envelope and keep the remaining money, then seal and put the envelope in an official donation box from the foundation. Finally, they were asked to collect the show-up fee and leave. In Table 1, we summarize the experimental design.

3. Results

First we present the descriptive statistics of the donations in all treatments in Table 2. The mean donation and the share of subjects donating the whole endowment of 50 yuan vary considerably across treatments.[5] In the windfall treatments, the mean donation is 39.3 yuan for females and 35.0 yuan for males, while the mean donation in the earned treatments is 12.1 yuan for females and 16.9 yuan for males. The mean donations in our experiment are relatively high compared to other similar dictator games. One explanation to this could be that China had just experienced several large natural disasters, which has resulted in a general increase in charitable giving.[6]

[2] At the time of the experiment, 1 US dollar = 6.85 Chinese yuan.

[3] They were asked to answer a survey lasting 20 minutes before receiving compensation of 50 yuan. No one refused to answer.

[4] This is a well-known and the largest charitable organization for poverty alleviation in China.

[5] Since we did not limit the individual donations to 50, we have two subjects who donated more than 50 yuan. We truncate these donations at 50 yuan.

[6] In 2008, the total amount of individual charitable donation was more than 13 times the amount in 2007 (Chinese Ministry of Civil Affairs, 2008, 2009).

<Table 2 to be here>

Table 3 reports the statistical test results of the effects of earned endowment for females, males, and the entire sample. We conduct a t-test for equal mean as well as a Wilcoxon rank-sum test for equal distribution of donated amount across treatments. We can reject the hypotheses of no difference in donations between the windfall treatments and the earned treatments for females, males and the entire sample, respectively, based both on the t-test and Wilcoxon rank-sum test.[7] The mean donation is significantly lower when subjects earned their endowment. Consequently, our results are in line with previous findings that earned endowments results in substantially lower donations in dictator games. This holds for both men and women.

<Table 3 to be here>

However, on average, females donate more than males in windfall treatments, while females donate less than males in the earned treatment. Therefore, the remaining question is whether or not males and females are affected differently when moving from earned to windfall endowments. To answer this question, we estimate an OLS model where the donation is the dependent variable

$$\text{Donation} = \alpha + \beta_1 \text{Female} \times \text{Windfall} + \beta_2 \text{Male} \times \text{Windfall} + \beta_3 \text{Female} \times \text{Earned} + \varepsilon. \quad (1)$$

The reference category in the regression is the treatment with male subjects and earned endowments. We can examine whether there are differences between the genders by testing the following two hypotheses H_0: $\beta_1 - \beta_2 = 0$ and H_0: $\beta_3 = 0$ for the windfall treatments and earned treatments, respectively. We then test the hypothesis that the difference in donation between the windfall and earned treatments is the same for males and females. The coefficient β_2 and $\beta_1 - \beta_3$ show the differences in donations between windfall and earned treatments for males and females, respectively. Thus, the explicit null hypothesis tested is: H_0: $\beta_2 = \beta_1 - \beta_3$. Table 4 reports the regression results and statistical test results.

[7] We further test the hypothesis of equal shares of zero-yuan and 50-yuan donations and find that the main difference between the windfall and earned treatments for both males and females is the share of subjects donating the whole endowment, which is significantly higher in the windfall treatments for both females (p-value < 0.001) and males (p-value < 0.001) using proportional tests.

<Table 4 to be here>

The size and significance of the coefficients confirm, as expected, the non-parametric test results in Table 3: there are large and significant differences between the windfall and earned treatments. However, within each type of treatments there are no significant differences between males and females, although the size of the differences is non-negligible ($\beta_1 - \beta_2 = 4.26$ for windfall treatments and $\beta_3 = -4.81$ for earned treatments). The difference between males and females with respect to the effects of moving from windfall to earned endowment is also non-negligible in size ($\beta_2 - (\beta_1 - \beta_3) = 8.34$), but we cannot reject the null hypothesis of no difference.[8]

4. Conclusions

This study has examined the influence of how the endowment is obtained on donations in a dictator game with a special focus on a potential gender difference. In line with previous studies (e.g., Cherry et al., 2002; Reinstein and Riener, 2009a), we find that a windfall endowment results in significantly higher donations than if the endowment is earned. However, with respect to both within windfall or earned treatments and across windfall and earned treatments, we find that the differences in donation between males and females are insignificant, although the sizes of the differences are non-negligible. Our main finding is that there is a sizeable gender difference in donations related to how the endowment is obtained, although in statistical terms we cannot reject that windfall and earned endowments affect men and women in the same way. Consequently, we think it is premature to rule out that there is indeed a difference in effects. This means that any comparison between the genders might be context dependent, and we should therefore think carefully about the context when designing studies aiming at experimentally investigating gender differences.

[8] We also estimate a tobit model with the same model specification, and the results are similar to those of the OLS model.

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Tables

Table 1. Summary of the experimental design

	Windfall endowment	Earned endowment
Female	Treament 1	Treament 3
Male	Treament 2	Treament 4

Table 2. Description of donation behavior for each treatment

Treatment	Windfall female	Windfall male	Earned female	Earned male
Mean	39.26	35.00	12.11	16.93
Standard Deviation	17.30	18.34	13.40	15.70
Share of zero donations	0.0%	0.0%	7.4%	3.7%
Share of 50 donations	66.7%	55.6%	7.4%	7.4%
Number of observations	27	27	27	27
Mean (if donations are above zero and below 50)	17.78	16.25	9.87	14.88
Standard deviation (if donations are above zero and below 50)	13.94	10.25	7.94	12.92
Number of observations	9	12	23	24

Table 3. Tests of differences between windfall and earned endowment treatments

	Windfall vs. Earned		
	Female	Male	Entire sample
Differences in mean	27.15	18.07	22.61
t-test (p-value)	<0.001	<0.001	<0.001
Rank sum test (p-value)	<0.001	<0.001	<0.001

Table 4. OLS regression results of donation amount and tests of gender effects

Variables	Description	Coef.
Constant	-	16.93***
		(5.40)
Female×Windfall endowment	=1 if the subject is male	22.33***
		(5.04)
Male×Windfall endowment	=1 if the endowment is earned	18.07***
		(4.08)
Female×Earned endowment	-	-4.81
		(1.09)
No. of obs.		108
Adjusted/Pseudo R-squared		0.34
Gender differences for each treatment		**P-value**
H_0: No gender difference in windfall endowment treatments (β_1-β_2=0)		0.34
H_0: No gender difference in earned endowment treatments (β_3=0)		0.28
Gender differences between treatments		**P-value**
H_0: No gender difference between windfall and earned endowment treatments (β_2=β_1−β_3)		0.15

Notes: 1. t-statistics in parentheses; 2. *** p<0.01, ** p<0.05, * p<0.1; 3. β_1, β_2, and β_3 are the coefficients of the first, second, and third independent variables of the OLS model, respectively.

Appendix. Script

Recruitment

Treatment	Script
All	*"Good morning/afternoon! I am an enumerator from the School of Economics. Are you a student at this university?"*
All	IF NO: "*I'm sorry for bothering you, but we are only looking for students from this university*" Terminate the campaign without payment. IF YES: *"The School of Economics is conducting a study. The study will be conducted this Wednesday and Thursday in the Ming De building classroom 405, which is close to here. All in all it will last a few minutes. We will pay you 10 yuan for showing up at a scheduled time. If you want to participate, let us make an appointment that is convenient for you. Do you have time to participate?"*
All	IF NO: *"That's alright. Thank you anyway."* Terminate the campaign here without payment. IF YES: *"Thank you for participating in this research study! Could you please let me see your receipt?"* Take his/her receipt and have a look at it and keep it. *Let's make an appointment. The study will be conducted this Wednesday and Thursday in the Ming De building classroom 405. What time are you available on these days?"* Check the answer with the available times slots on the list. *"Could you please come on …. (day) at…. (time)?"* If YES continue. If NO, check another time and ask. If NO again, show the list of available times and ask what time would be convenient to come. -- IF SUBJECT CANNOT PARTICIPATE: because of not being able to make an appointment at the available times: *"Thank you anyway. I understand."* Terminate the campaign here without payment. IF SUBJECT CAN PARTICIPATE: "*Ok, so you will come on …. (day) at … (time) to the Ming De building classroom 405*." Fill in a confirmation card and write down the appointment in the time schedule. *"Here is your confirmation card. Since we cannot remind you again, please don't forget to come on time and bring this card with you. Thank you."* Hand over the card. [Tell the subject he/she will get the receipt back when coming to participate in the research study if he/she asks for it.] Pack up all the appointment files and paste his/her receipt behind the enumerator's part of the confirmation card.

Experiment

Treatment	Script
1, 2	*"Hello, are you here to participate in the study conducted by the School of Economics?"* IF YES: *"Could you give me your confirmation card?"* Take the card, check the card. [If he/she cannot show the card, ask what time his/her appointment is and check the schedule. If appointment EXISTS continue. If NOT, ask the person to leave.] "*Please come with me.*" Go to the interview room. Check the campaign number on the card and take the file with the same number. [check this carefully] *"Thank you for coming here to participate in the research study conducted by the School of Economics. At the end of the study we will pay you 10 yuan for showing up at the scheduled time. In this study by the School of Economics, we would like to give you 50 yuan."*
3, 4	*"Hello, are you here to participate in the study conducted by the School of Economics?"* IF YES: *"Could you give me your confirmation card?"* Take the card, check the card. [If he/she cannot show the card, ask what time his/her appointment is and check the schedule. If appointment EXISTS continue. If NOT, ask the person to leave.] "*Please come with me.*" Go to the interview room. Check the campaign number on the card and take the file with the same number. [check this carefully] *"Thank you for coming here to participate in the research study conducted by the School of Economics. At the end of the study we will pay you 10 yuan for showing up at the scheduled time. You see, the School of Economics is conducting a survey about the use of plastic shopping bags and your opinion about the campus supermarket. The survey will last about 20 minutes. If you participate, we will pay you an extra 50 yuan in cash after you have completed the survey as compensation for your work with answering the survey. Do you have time to participate?"* IF NO: *"I understand. Thank you anyway. Please come with me to the cashier to get the 10 yuan."* Lead the subject to the cashier. *"Here is the confirmation card and receipt. Please give him/her the 10 yuan for showing up."* Hand over the card and the receipt to the cashier and be prepared to sign the form. Cashier: Take the card and the receipt, and write down the number of the receipt in the form. Let the enumerator sign the form. Take out two 5-yuan bills from the money box and count them. (These two 5-yuan bills should have been prepared in advance so that you only show the subject the two 5-yuan bills when he/she comes to you.)

	Cashier: "*Here is your money*." Hand over the money to the subject. "*Please let me sign the form.*" Sign the form. "*Ok, we are done now*." Terminate the campaign. When the subject has left, the enumerator needs to write down the gender on the script page. IF YES: "*Thank you for participating in this survey!*" Conduct the survey *"As compensation for your work with answering the survey by the School of Economics, we would like to give you 50 yuan."*
All	*"Please come with me to the cashier to get the money."* Lead the subject to the cashier. *"Here is the receipt"* Give receipt to the cashier and be prepared to sign the form. Cashier: Take the receipt and write down the number of the receipt in the form. Let the enumerator sign the form. Take out ten 5-yuan bills from the moneybox and count them. (These ten 5-yuan bills should have been prepared in advance, so that you only show the subject the ten 5-yuan bills when he/she comes to you.) Cashier: "*Here is your money*." Hand over the money to the subject. "*Please let me sign the form.*" Sign the form. "*Ok, we are done now*." Enumerator: Make sure that you stand behind the subject, so that when you start talking, the subject has to turn around, facing you but not the cashier. Preferably walk away a few meters from the cashier. *"We are doing a research study on a donation campaign. The donations will finance advertisement material used to collect money for the China Foundation for Poverty Alleviation. The Foundation is a nationwide charitable organization working toward poverty alleviation. Before you leave, you have the opportunity to donate money to the foundation. Over there is a donation box. Please come with me."* Lead the subject to the booth and show the donation box to him/her. *"This is a donation box from the foundation. The donations will be deposited into a special account used to cover advertisement material expenditures for collecting money for the foundation. Your donation is anonymous."*

	"Here is a donation envelope from the foundation." Take out the envelope and hand it over it to the subject. *"When I have walked away from here, please go in the booth and leave the money you want to donate in the envelope. Keep the remaining money for yourself and pocket it. Seal the envelope and put it into the donation box. Then go to the place where you received the 50 yuan to collect your extra 10 yuan for showing up. Thank you! Goodbye."* Walk away from the donation booth.

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