

**Three Essays on Consumer Search Behavior in Experimental
Market Environments**

BY

Changxia Ke

THESIS

Submitted to the University of Adelaide
in partial fulfillment of
the requirements for the degree of

Doctor of Philosophy

in

Economics

February 2010

Table of Contents

Abstract	vii
Acknowledgments	x
1 Introduction	1
2 Consumer Search with Discount Vouchers: An Experimental Study	7
2.1 Introduction	7
2.2 Experimental design	12
2.3 Experimental implementation	14
2.4 The optimal stopping rule	16
2.5 Results	18
2.5.1 Optimality under risk neutrality	19
2.5.2 The impact of discounts	22
2.6 Conclusion	26
3 Discounts and Consumer Search Behavior: The Role of Framing	27
3.1 Introduction	27
3.2 The experiment	32
3.2.1 A baseline search task	32
3.2.2 Treatments	33
3.2.3 Experimental procedure	35
3.2.4 The benchmark predictions	35
3.3 A first look at search behavior	37

3.4	Structural estimation of risk preferences	39
3.4.1	An expected utility maximizer's decision rule	39
3.4.2	Maximum likelihood estimation	42
3.4.3	Results	44
3.5	Discussion	47
3.6	Conclusion	49
4	Asymmetric Price Adjustment with Costly Consumer Search: A Laboratory Study	51
4.1	Introduction	51
4.2	Background and findings	54
4.3	Theoretical framework	57
4.3.1	The monopoly equilibrium	58
4.4	The experiment	62
4.5	Results	64
4.5.1	An overview of the price dynamics	64
4.5.2	The price distributions	68
4.5.3	Sellers' pricing strategy	71
4.5.4	Buyers' probabilistic search rule	74
4.5.5	Buyers' decision after search	78
4.5.6	Are subjects inequality averse?	79
4.6	Discussion	80
4.6.1	Price dispersion under bounded rationality	81
4.6.2	Asymmetric price adjustment following price dispersion	84
4.7	Conclusion	85
5	Conclusion	87

A	Samples of Experimental Instructions	89
A.1	Experiment 1	89
A.1.1	<i>No-Discount</i> treatment	89
A.1.2	<i>Random-Discount</i> treatment	90
A.1.3	<i>Known-Discount</i> treatment	92
A.2	Experiment 2	93
A.2.1	<i>M-Incentive & No-Discount</i> treatment	93
A.2.2	<i>M-Incentive & Shop1-Discount</i> treatment	95
A.2.3	<i>M-Incentive & Shop2-Discount</i> treatment	98
A.3	Experiment 3: <i>MC-Constant</i> treatment	100

List of Tables

2.1	Expected continuation values and reservation prices.	18
2.2	Actual versus optimal decisions under risk neutrality.	19
2.3	Observed search paths and optimal paths under risk neutrality.	20
2.4	A summary of search patterns where recall was exercised.	22
2.5	Multilevel mixed-effects logistic estimation of search probabilities.	25
3.1	A summary of the parameter values by treatment.	33
3.2	The predicted relations of search intensities across treatments.	36
3.3	Summary statistics of the discrete choices by treatment.	38
3.4	Estimation results of the risk and the noise parameters.	45
4.1	A summary of parameter values by treatment.	63
4.2	Wilcoxon rank-sum tests on price adjustment.	67
4.3	A random-effect logistic estimation of the probability to search.	76

List of Figures

4-1	Average posted prices by period and treatment.	65
4-2	Price deviations from the pre-shock level.	66
4-3	Posted prices and search in the <i>MC-Constant</i> treatment.	69
4-4	Posted prices and search in the <i>MC-Increase</i> treatment.	70
4-5	Posted prices and search in the <i>MC-Decrease</i> treatment.	71
4-6	Box plot of the price changes (i.e., $p_t - p_{t-1}$) by treatment and trans- action histories.	73
4-7	Estimated probability of search at the mean (i.e., $p_1 = 59$).	77
4-8	Scatter plot of buyers' decisions after search.	78
4-9	Kernel density estimation and expected payoffs by phase and treatment.	82
4-10	Kernel density estimations and expected payoffs at selected prices.	83

Abstract

This thesis investigates consumer search behavior in different contexts and its implications on certain market outcomes. It consists of three self-contained essays.

Part one investigates if people search optimally and how price promotions (such as the provision of price discounts) influence search intensity and risk-taking behavior. We start with a typical sequential search task in a finite time horizon (with exogenously determined price dispersion) as the baseline treatment. In the two experimental treatments, exogenous discounts are introduced to the search process. The treatments differ in the amount of information on the discounts revealed to the subjects. Subjects' search behavior is roughly consistent with optimality for a risk-neutral agent, but significantly influenced by the introduction of discount vouchers. We find that subjects' search intensity is significantly reduced if they are in a shop that offers discounts, even when the monetary benefit induced by the discount has been taken into account. This suggests that people seem to gain extra non-monetary utility from buying a discounted product. Alternatively, subjects might overestimate the value of a discount.

Following the findings in part one, we focus on price-framing effects of discounts on consumer search behavior in part two. In order to isolate the price-framing effect from all other possible influences, we adopt an extremely simple two-shop search model in which a consumer who sees the price for an item in a shop has to decide either to buy it or to incur a search cost to learn the *ex-ante* uncertain price in a second shop. The experiment is designed such that a rational buyer should make identical decisions in the base treatment (where prices are posted as net prices in both shops) and in the experimental treatments (where the price in one of the shops is framed as a gross price with a discount, holding the net-price constant). Using structural estimation of the observed risk preferences, we find that people tend to be more risk-averse and hence buy from the initial shop more often in

the discount treatments, regardless of where the discount is offered. The seemingly trivial change to a discount-framing increases the complexity of the decision problem. Subjects reveal a tendency to stick with the comparatively less complex options more frequently as the complexity of the decision problem increases. However, this bias declines with experience, as subjects become more and more familiar with the framing.

In part three, we study search behavior in a market experiment, where prices are determined endogenously by human players. More specifically, we examine the behavioral factors and the underlying mechanism which drive the widely observed asymmetric price adjustment to cost shocks (in a world with costly search behavior and information asymmetry). We show that price dispersion, as well as asymmetric price adjustment to cost shocks, arises in experimental markets, even though the standard theory predicts neither. We find that after controlling all the potential theoretical factors, the observed price dispersion can be explained by the presence of bounded rational play. Under price dispersion, asymmetric price adjustment arises naturally, as it is harder for buyers to learn that a negative cost shock has taken place. Learning is much quicker after a positive shock.

Declaration

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution to Changxia Ke and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

I give consent to this copy of my thesis, when deposited in the University Library, being made available for loan and photocopying, subject to the provisions of the Copyright Act 1968.

I also give permission for the digital version of my thesis to be made available on the web, via the University's digital research repository, the Library catalogue, the Australasian Digital Theses Programme (ADTP) and also through web search engines, unless permission has been granted by the University to restrict access for a period of time.

Signature of Author

Acknowledgments

Writing this thesis is by far the most challenging but rewarding work I have done. It would not have been possible without the help of many people. I first extend my utmost gratitude to my supervisor, Dr Ralph-C Bayer, for his continuing encouragement and inspiration, valuable guidance and support throughout my Masters and PhD study since 2004. My appreciation also goes to my Game Theory lecturer, Dr Ludovic Renou, for his guidance during my coursework and his support later from Leicester, UK. I also thank Mickey Chan for his technical support in programming and conducting the experiments, as well as the many discussions we have had which helped me to clarify my thoughts.

I thank the participants at the 3rd ESA Asia-Pacific Meeting (2007), the 2nd Australian Experimental Workshop (2007), Centre for Experimental Economics, University of Copenhagen (2007), Australian Annual PhD Conference in Economics and Business (2008), Department of Public Economics, University of Innsbruck (2009), Max-Planck Institute for Intellectual Property, Competition and Tax Law (2009) and the Brainbag seminar and PhD workshops in School of Economics, University of Adelaide. I also gratefully acknowledge the financial support from the School of Economics, University of Adelaide.

Finally, I thank all the friends I have met in Adelaide (Nopphawan, Frances, Pataporn, Tiger, Bin, Tingting, Ranran, Song Ge) for their companionship. I am forever indebted to my family, for whose endless love and support I dedicate this thesis.