

Prediction and Learning about Credit Card Spending

Liyin Jin[±]

Jaimie W. Lien[‡]

Junji Xiao[†]

Current Version: March 5th, 2022

Initial Draft: April 12th, 2016

Abstract:¹

Consumers are often presented with more than one possible contract choice by firms, and they need to decide which contract is best for their own needs. We study the contract choices and usage of credit card consumers faced with a choice between two possible fee structures: a card with an upfront lump-sum fee without spending requirement, and a card with an annual fee which can be waived each year if a minimum amount is charged to the card. Using panel data of over 16,000 credit card accounts, including contract choice and monthly account usage, we examine consumers' contract choices and their subsequent card usage. Consumers whose spending patterns mismatched with their card choice ex-post, showed evidence of learning according to their future monetary incentives. However, card cancellation rather than spending changes, was the preferred margin for adjustment in the aggregate, indicating an overall unwillingness of consumers to alter their credit card usage on the intrinsic margin in response to financial penalties. We further examine the relationship between contract choice, education and financial health indicators. Consumers with lower education levels had a greater tendency towards contract-spending mismatch. In addition, we find a positive relationship between mismatch and negative indicators of financial health such as months of rolling debt, installment plan participation, and cash advance withdrawals. This suggests that even while the financial stakes are only small to moderate, the consistency between contract choice and product usage may be more generally indicative of consumers' financial planning challenges.

Keywords: credit card spending, contract choice, learning, financial penalties

JEL Codes: D83, D91, G02, L84

¹ ± Jin: Department of Marketing, School of Management, Fudan University, Shanghai, China, jinliyin@fudan.edu.cn ; ‡Lien: Department of Decision Sciences and Managerial Economics, The Chinese University of Hong Kong, Hong Kong SAR jaimie.academic@gmail.com ; †Xiao: Department of Economics, Lingnan University, Hong Kong SAR, junji.xiao@gmail.com ; For helpful comments and encouragement we thank Sumit Agarwal, Xinyu Hua, Kohei Kawaguchi, Wooyoung Lim, Yatang Lin, Neale Mahoney, Sujata Visaria, Yasutora Watanabe, seminar participants at Hong Kong University of Science and Technology, and session participants at the Asia Meeting of the Econometric Society, Xiamen University. We gratefully acknowledge research funding and support from the Chinese University of Hong Kong, European University Institute, Fudan University, Hong Kong Research Grants Council, University of Technology, Sydney, and Lingnan University. All errors are our own.

1. Introduction

A broad variety of consumer services, including cellular phone and internet providers (Miravete, 2003), health clubs (DellaVigna and Malmendier, 2006), credit cards (Gathergood, Sakaguchi, Stewart and Weber, 2017) and other financial services implicitly ask consumers to predict their future usage when making their initial contract choice. A standard assumption in the literature of profit-maximizing contract design is that consumers have rational expectations about their future consumption and so they will choose the utility-maximizing contract (DellaVigna and Malmendier, 2006). However, estimating one's own future actions can be a challenging task, prone to various inaccuracies and biases (Shen, 2014; Grubb, 2009, 2012, 2015b; Grubb and Osborne, 2015; Stango & Zinman, 2009). Such contracts typically penalize the consumer either directly or implicitly for inaccurate assessments of their future usage (Kim and Smith, 2005).

In this study, we examine consumers' credit card choices and spending behavior in a large-scale credit card program which offers two possible fee structures. One contract is ideal for consumers who expect to spend at least a threshold amount on the card in a year, while the other contract is ideal for consumers whose expected spending on the card is lower than the aforementioned threshold. These two types of contracts, with fee structures of an annual fee payment with conditional waiver, and one-time upfront fee payment respectively, are representative of a class of prevalent menus of contracts whose pricing for service conditions on consumers' realized usage (Lambrecht and Skiera, 2006; Miravete, 2003; Grubb, 2015b).

For their part, firms face corresponding challenges in structuring contracts that can help distinguish among different types of consumers, while simultaneously being able to earn consumer satisfaction and loyalty. The same contract structures which can give firms valuable information about consumers anticipated needs can result in consumer learning (Agarwal, Chomsisengphet, Liu and Souleles, 2015) and attrition if consumers are eventually penalized for their contract selection (Gathergood et al., 2017). In the credit card context, we examine how consumers initially sort themselves into two common types of contracts in the marketplace, as well as the consequences of consumers' learning processes through spending adjustments and attrition after potential penalties are imposed.

We find that in accordance with the contract incentives, higher average spenders tend to sign up for the annual fee card with the potential rebate, while lower average spenders tend to sign up for the one-time upfront fee card. However, a substantial fraction of consumers do not follow this pattern. At least 20 percent of cardholders who signed up for the annual fee contract with the conditional fee waiver did not earn a waiver in each observed year in the data, with around 13 percent of annual fee cardholders not earning the waiver for the first two observed years in a row. Among those choosing the one-time upfront fee card, over 55 percent of them reached the threshold spending for the annual fee card for all three observed years in the data. In addition, over 85 percent exceeded the spending threshold in their first year of holding the card.

Given the substantial uncertainty consumers may have about their future expenses, it can be understandable that consumers do not necessarily choose the contract that matches their future spending pattern. A natural follow-up and more important question is whether consumers learn from their experiences of fees imposed, and their subsequent choices. We find that consumers' choices after facing penalty fees are consistent with learning from their experiences of being penalized. In the spending domain, we find that consumers do not tend to change their credit card usage behavior in order to avoid future penalties; instead, they opt to avoid future penalties by terminating their contract. This empirical finding suggests that it may be difficult for consumers to change their spending behavior and so they intend to

terminate their card ownership rather than increase their card usage to avoid fee penalties. This suggests that firms may themselves be harmed by consumers' challenges in predicting future spending, as the same consumers are sensitive to monetary penalties. As can be expected, cardholders who chose the upfront fee contract had a high retention given that they face no future risks of further fees.

We also find that cardholder education levels play a significant role in determining membership choices. In the aggregate, a mismatch between contract choice and subsequent spending is negatively associated with the cardholder's education level, controlling for spending levels and variances and other demographic characteristics. While college education positively predicts selection into the lump sum fee contract in our data, education is more mildly but still negatively associated with mismatch in the annual fee contract. These two seemingly contradictory correlations suggest that well-educated consumers are in general, more risk-averse. Our findings thus also contribute to the literature on the relationship between education and financial behavior (e.g., Bertaut and Starr-McCluer, 2001; Campbell, 2006; Bernheim, Garrett and Maki, 2001; and others). Some prior studies have considered a behavioral contract design problem from the perspective of credit card firms facing heterogeneously educated consumers. In an empirical analysis, Ru and Schoar (2016) find that consistently with the predictions of behavioral contract theory, credit card companies tend to target less-educated consumers with back-loaded fees, while targeting highly educated consumers with benefits such as mileage programs. In another study, Heidhues and Koszegi (2010) theoretically examine behavior and welfare consequences of time inconsistent consumers' adoption of credit card contracts.

Our study also makes a contribution to the line of literature providing evidence that predicting one's future behavior is a difficult task for many consumers. In particular, Grubb (2009) finds that consumers overconfidently choose cellular phone pricing contracts which are too restrictive for their needs, succumbing to high tariffs for exceeding the usage allotment included in their contract.² DellaVigna and Malmendier (2006) finds that health club members overpay for their memberships by choosing the financially disadvantageous annual membership contract over the limited-use pass system which for many consumers is optimal, given the actual number of times they visit the gym. Also studying the credit card market, Agarwal *et al* (2015) find that when offered a choice between a credit card with an annual fee but a lower interest rate, and a credit card with no annual fee but a higher interest rate, consumers tended to choose their financially optimal contract on average, although about 40 percent of consumers chose the suboptimal contract for their needs.

The literature has debated the issue of whether consumers have persistent and systematic biases in their contract choices, and whether they are resistant to correction through learning and experience. Miravete (2003), Narayanan, Chintagunta and Miravete (2007), and Miravete and Palacios-Huerta (2014) examine consumers' telephone plan choice and learning from prior costs incurred. They argue that in contrast to a biased preference for flat rate pricing, consumers generally make accurate initial contract choices for their needs, and that those who make errors learn over time to correct their choices. This contrasts to some extent with the perspective in Dellavigna and Malmendier (2006) which proposes that the bias stems from a sophisticated consumer who wants to control his future exercising behavior, but systematically fails to live up to his commitment due to self-control challenges.

Related to the types of contracts we study here, Lambrecht and Skiera (2006) survey prior evidence on the so-called flat rate bias issue and conduct a survey-based experiment on consumers' choices of internet service plans. They conclude that the desire to insure against future usage fluctuations, the greater enjoyment of usage when not having to think about costs, and overestimation of internet needs, all

² See also Grubb (2015a) for a survey of studies on consumer overconfidence.

contribute to consumers' flat rate bias. The marketing literature has modeled consumers' attractions to flat fee unlimited use contracts as overpaying per use, such as in Nunes (2000). Our study adds evidence to the debate about whether consumers prefer flat fee pricing options over tiered tariff contracts which condition on usage (Train, McFadden, and Ben-Akiva, 1987; Train, Ben-Akiva, and Atherton, 1989). However, our research differs from prior work in terms of the structure of the contracts in our data, which can help answer some of the open questions and debates in the literature. Firstly, in contrast to much of the literature on fixed fee versus tiered tariff contracts, in our setting the suitable choice of the fixed fee contract corresponds to consumers who will be consuming *less* rather than consuming more. This is due to the tariff decreasing with usage in the annual fee contract, rather than exhibiting an increasing schedule as in many two-part tariff settings. In such a setting, we find that consumers who use their credit cards less intensively do gravitate towards the fixed fee contract, all else equal, although this contract is only an eighth as popular as the annual fee contract. Our study suggests that the overall popularity of flat fee contracts may be setting-specific, rather than due to a higher inherent enjoyment of consumption under a flat payment scheme (see Lambrecht and Skiera, 2006 for a discussion).

Finally, our study also contributes to the literature on understanding consumers' behavior and learning in the credit card market specifically (Ausubel, 1999). Agarwal, Driscoll, Gabaix and Laibson (2013) find evidence of consumer learning to avoid monetary penalties through their previous experiences with such penalties. They find that higher income borrowers tend to have a higher speed of learning and slower speed of forgetting compared to lower income borrowers. Agarwal *et al* (2015) find that in spite of the high rate of suboptimal contract choice, credit card holders eventually switch into their optimal contract. Examining the effects of reward programs on credit card spending, Agarwal, Chakravorti and Lunn (2010) find that credit card customers spend more and increase their debt when offered cash-back rewards. In addition, they find that consumers offered cash rewards on a particular credit card tend to increase their use of that credit card, while reducing their spending on other credit cards. Their finding suggests that consumers may indeed have a reasonable degree of control in the exact amount they spend on a particular credit card, a flexibility which consumers in our data did not seem to implement, at least on average.

The remainder of our paper is organized as follows: Section 2 describes the background of the credit card industry in China where our data originate and describe our data; Section 3 contains our hypotheses on consumers' contract choices, their subsequent spending behavior; Section 4 describes our empirical approaches and results for each hypothesis; Section 5 discusses and concludes.

2. Background and Data

2.1 Credit Card Industry in China

The credit card industry in China has grown tremendously in recent years and given its historical relative under-utilization in one of the world's largest economies, it could potentially find its greatest growth ahead. Credit cards in China are issued by the member bank association UnionPay, which is now the largest credit card provider in the world, ahead of Visa and MasterCard.³

Chinese consumers' credit card debt reached a record high level of 2.55 trillion RMB in early 2015, which corresponds to an over 35% growth rate compared to in early 2014. While historically, Chinese consumers have not utilized credit cards or credit more generally, to the extent common among US consumers (see Campbell and Hercowitz, 2009, for a welfare analysis of household debt in the US), recent

³ <http://www.bankingmyway.com/credit-center/credit-cards/chinese-credit-card-issuer-now-worlds-biggest>

statistics show that consumer credit card debt of at least 6 months accounted for over 1.5% of total outstanding credit in 2014. Although a loyalty to debit cards, especially among older generations, limits the current proportion of credit cards to 9% of all card types issued by UnionPay, credit cards accounted for 34% of all China's card-based purchases, amounting to \$2.3 trillion USD in 2014.⁴ Although debit-type payment methods should be less attractive to consumers due to requiring immediate payment, perhaps the greatest competition to credit card usage in the present day comes from primarily debit-driven mechanisms (including e-payment systems WeChat Pay and AliPay).

Earlier survey-based research on the credit card industry in China has found a traditionally cash-driven culture as a barrier to online banking (Laforet and Li, 2005). In adopting new payment technology, researchers also note network effects or the collective preference as a determinant for adoption (Worthington, Stewart and Lu, 2007). Worthington, Thompson and Stewart (2011) find that early credit card adopters in China viewed the service as offering greater convenience but expressed fear regarding potential loss of financial control when using credit cards. In research on the factors related to credit card adoption, Sharpe, Yao and Liao (2012) find that credit card ownership was relatively more concentrated among the younger aged population, and among the more educated. Wang, Lu and Malhotra (2011) found that personality characteristics better predict credit card usage variables among Chinese consumers compared to demographic variables. Liu and Brock (2009a,b) conducted telephone interviews to investigate the comprehension of credit card reward programs by consumers in China, finding generally low awareness and redemption rates of these programs. Because of strict interest rate regulations and consumer thrift, sixty-eight percent of credit card revenues in China are derived from fee income, including annual subscription fees and interchange fees (Bansal, Bruno, Istace, & Niederkorn, 2013).

Given China's rapidly evolving consumer financial system, we take note of these previous research findings from the Chinese context as the background in this marketplace. Meanwhile, our study focuses primarily on consumer responses to the financial incentives of contract structures which should be generalizable to credit card and consumer contracts more broadly than the Chinese context.

2.2 Data

Our analysis utilizes a dataset from a major national bank based in Shanghai, China, whose customers are approximately representative of credit card customers nationwide. The data include credit card contract choice, monthly transactions in broad categories, demographic characteristics, and the date of joining the credit card program and leaving the program (if applicable). The sample contains all newly signed accounts between the months of January 2008 and April 2008, following these customers' transactions through August 2011 (ie. for over three years). In total there are 14,534 individual accounts observed.

The key feature of the credit card program we examine is the fee structure. Customers have the choice of two possible fee structures when signing up for the credit card: A card which has an upfront lump-sum fee of 260 yuan for all future services and no future fees required, and a card which has an annual fee of 180 RMB, which is waived for the first year, and is waived for subsequent years only if the cumulative spending during the previous year is 2000 RMB or above. Other than the fee structure, other features of the two credit card contracts and subsequent services provided to consumers are the same. The magnitude of the fees involved is comparable in purchasing power terms to those studied in Stango and Zinman (2009) for US credit card consumers. In addition to purchasing on credit, the card also allows

⁴ <http://www.chinaeconomicreview.com/chinas-consumers-embrace-credit-cards-regulators-rebuff-new-industry-entrants>

cash advance withdrawals for a 3% charge, as well as installment plans. The details of the fee plans and other features of the credit card programs are provided in Table 1.

Table 1: Credit Card Plan Descriptions

	Credit card with lump-sum membership fee	Credit card with annual fee
		Regular
Lump-sum fee (RMB)	260	0
Annual fee (RMB)	Not applicable	180
Condition for annual fee waiving	Not applicable	<ul style="list-style-type: none"> • Annual fee waived for first year • Annual fee for subsequent years waived if the cumulative qualified card spending is RMB 2,000.
Late-payment fee	5% of overdue amount	
Over-limit fee	5% of over-limit amount	
Cash-advance service fee	3% of cash-advance amount (minimum charge of RMB 30)	
Installment service fee	Installment period can be 6, 12, 15, 18, or 24 months. Monthly service fee for six months is 0.78% per month of total principal transaction amount; 12 months, 0.72% per month; 15 months, 0.75% per month; and 18 or 24 months, 0.76% per month.	

Summary statistics of our sample at the cardholder level are provided in Table 2. The average monthly retail spending in the data was about 983 RMB, the average monthly installment amount was about 26 RMB, and the average cash advance amount was 107 RMB. In terms of basic demographics, 73 percent of customers have some level of post-secondary education, and 48 percent of customers are male. The cardholders remained credit card customers with the bank for an average of 33 months.

Table 2: Summary Statistics

Consumer level

	Obs	mean	Std dev	min	max
Contract type (lump sum fee = 1)	16749	0.16	0.36	0.00	1.00
Referral Status (referred = 1)	16749	0.12	0.33	0.00	1.00
College	16749	0.73	0.44	0.00	1.00
Male	16749	0.48	0.50	0.00	1.00
Months of membership	16749	33.43	13.75	2.00	44.00

Monthly level

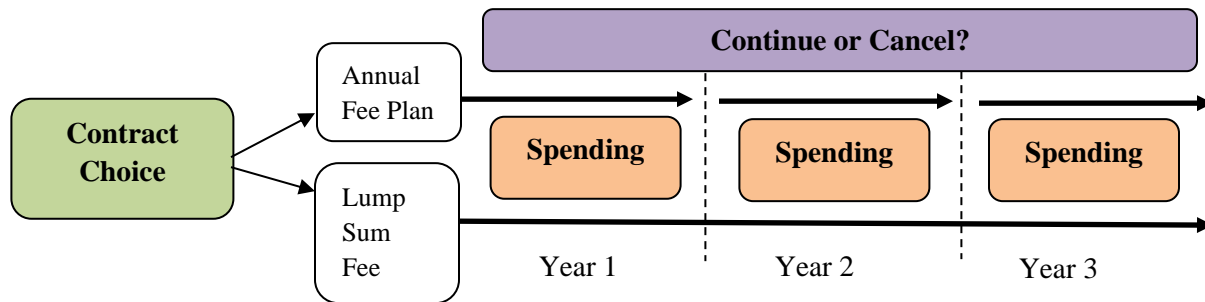
	Obs	mean	Std dev	min	max
Number of months in debt	370955	12.49	6.94	0.00	31.00
Probability of annual fee threshold reached	370955	0.86	0.21	0.27	1.00
Std dev in retail spending	370955	1302.72	4496.19	0.00	574222.06
Std dev in installment spending	370955	35.58	113.99	0.00	3049.77
Std dev in cash advance	370955	172.83	301.49	0.00	10017.23
Average spending in retail	370955	982.99	1873.81	0.00	181240.14
Average spending in installment	370955	25.90	89.64	0.00	2620.50
Average spending in cash advance	370955	106.80	240.72	0.00	5038.46

3. Hypotheses on Cardholder Decisions and Behavior

We use classical economic theory as our baseline framework for predictions about consumer’s choice of contract, relative over-spending/under-spending and subsequent behaviors in the credit card program. In hypothesizing about the reasonable choices of consumers for each decision they make in the credit card program, we focus on the forward-looking monetary incentives of the two contract options.

Figure 1 provides a timeline of the consumer’s decisions in the credit card program. We focus on three key decisions of the consumers: A. the initial contract choice, B. the subsequent spending on the card in future years, and C. the decision to continue or cancel membership in the card during this time.

Figure 1: Decision Timeline of Credit Card Program



A. Contract Choice

In making their initial contract choice, classical economic theory proposes that consumers are forward-looking and form predictions about their own future credit card usage, in turn basing their contract choice on this prediction. Furthermore, under a common formulation of the rational expectations assumption, consumers are unbiased in their expectations of the distribution of the variable they wish to forecast (see Lovell, 1986 for discussion).⁵

This allows us to formulate Hypotheses 1A and 1B about the relationship between contract choice and individual consumer spending distributions. Consumers who expect to spend more annually than the threshold amount proposed by the annual fee contract will find it advantageous to choose that contract under the stated policy that the fee itself is waived upon reaching the spending requirement. This means that membership in the credit card has no monetary cost in expectation to such a consumer. Consumers who expect to spend less than this threshold on an annual basis will gravitate to the Lump Sum Fee contract, which only requires a fixed fee for indefinite membership. This reasoning is summarized in Hypothesis 1A.

Hypothesis 1A: (Contract Choice, Average Spending) Assuming consumers have foresight about their future spending, all else equal, consumers with higher annual spending are more likely to choose the

⁵ While the original formulations of rational expectations (Muth, 1961; Lucas, 1972) did not impose explicit constraints on individual beliefs, a large subsequent literature making use of the framework assumed individual forecasting and choice consistency under the rational expectations approach using the assumption that forecasting errors are zero in expectation, and other assumptions of accuracy on the stochastic characteristics of individual beliefs. For further discussion and evidence, see Lovell (1986) and Frydman (1982).

Annual Fee contract, while consumers with lower annual spending are more likely to choose the Lump Sum Fee contract.

While Hypothesis 1A addresses the relation between expected annual spending and contract choice, another feature of the spending distribution is important for the attractiveness of the two contracts. This is reflected in the “insurance motive” for fixed fee contracts (see Lambrecht and Skiera, 2006). For consumers who anticipate a high variance in their spending and are risk averse over potential costs, the Lump Sum Fee contract offers the security of never having to incur any additional cost of membership in the future. Risk aversion serves as a standard assumption in many financial modeling contexts (Hansen and Singleton, 1983, and many others), it is natural to hypothesize that other characteristics equal, consumers with higher spending variance are more likely to choose the Lump Sum Fee contract.

Hypothesis 1B: (Contract Choice, Spending Variance) Assuming consumers have foresight about their future spending, all else equal, consumers with higher variance in spending are more likely to choose the Lump Sum Fee contract, while consumers with lower spending variance more likely to choose the Annual Fee contract.

B. Spending Behavior

The classical economic framework also holds predictions about consumers’ spending patterns conditional on the contract choice they have made. If consumers have long-run rational expectations about their true future usage of a product, then their choice of contract should be correct on average, subject to their incentives to be correct after selecting a contract. In other words, notice that after the initial contract choice is made, the financial incentives for validating the ex-ante choice of contract are quite different for the Lump Sum Fee consumers compared to the Annual Fee consumers. While Annual Fee consumers face the possibility of paying the annual fee in each subsequent year of membership if they cannot match their ex-post behavior to the ex-ante choice, the Lump Sum Fee customers will never have to pay any subsequent fees regardless of how they utilize the credit card. This creates different forward-looking incentives for spending patterns post-contract selection throughout subsequent years.

However, in practice, unexpected situations may arise which alter the usage of a product compared to consumers’ original plan. These include factors such as changes in consumer budgets, taste shifts or other needs.

In spite of these unexpected factors, which can be conceptualized as being distributed evenly across the cardholder sample, annual-fee cardholders have the greater monetary incentive to adhere to the spending level that matches their contract choice, compared to Lump Sum Fee cardholders, who face no future incentives. As such, we can expect to observe higher frequency of forecasting mistakes among Lump Sum Fee customers compared to Annual Fee customers, which we propose in Hypothesis 2.

Hypothesis 2: (Relative Mismatch) Under the possibility of subsequent spending which does not match the original contract choice, mismatch is more prevalent among Lump Sum Fee customers compared to Annual Fee customers.

By a similar argument, in subsequent years after the first year of card membership, it is only the Annual Fee customers who have a forward-looking monetary incentive to make adjustments to their spending to achieve consistency with their initial contract choice. Lump Sum Fee customers face no future monetary penalties, regardless of their card usage. We note that based upon some behavioral theories, such as the sunk cost fallacy (Arkes and Blumer, 1985), consumers may be adaptive rather than forward-looking in their spending response to prior fees paid (see McAfee, Mialon and Mialon, 2010, and Friedman, Pommerenke, Lukose, Milam and Huberman, 2007, for some discussions). In our setting of the Lump

Sum Fee contract, such thinking could correspond to behaviors such as avoiding spending over the Annual Fee threshold given that one already chose the Lump Sum Fee contract, in order to ‘justify’ one’s prior choice. Based on purely classical motives however, both Annual Fee consumers and Lump Sum Fee consumers look only to the future costs and benefits, and therefore, only the Annual Fee consumers have incentive to adjust spending patterns in subsequent years. This is summarized in Hypothesis 3, which describes the differences in spending adjustments in each type of contract after a prior experience of contract mismatch.

Hypothesis 3: (Learning by Spending Adjustment) The magnitude of spending adjustment towards matching between contract and spending among mismatched consumers is greater for the Annual Fee consumers than for the Lump Sum Fee consumers.

C. Attrition Decisions

Consumers’ forward-looking incentives also hold predictions for the extrinsic margin of credit card use, in other words retention decisions. Other than adjusting their spending to conform to the financial incentives of the contract, another choice for consumers is ending their membership with the card altogether (Kim and Smith 2005; Fram and Callahan, 2001). Here, as in the case of spending behavior, our hypothesis is guided by the presence of future monetary incentives. Since Annual Fee customers face potentially repeated future penalties in subsequent years, if there is a mismatch between their contract and prior spending, we expect their reaction in the attrition domain to be greater than for the Lump Sum Fee customers. At the same time, since each contract group may have different levels of overall responsiveness to incentives, we compare the quitting decisions to the relative responsiveness in the domain of spending adjustments.

Hypothesis 4: (Learning by Quitting) The fraction of mismatched consumers who cancel their credit card altogether as compared to adjusting their spending towards matching between contract and spending, is higher among Annual Fee customers as compared to the Lump Sum Fee customers.

D. Origins of Mismatch

Our final two hypotheses address the potential distribution of mismatch between contract and spending based on population characteristics. Does mismatch merely occur randomly, such that the financial penalties are evenly distributed among demographic groups, or are they indicative of broader financial literacy and well-being?

The literature on the relationship between education and financial behavior has produced mixed results. On the one hand, studies tend to find that financial literacy and financial outcomes such as savings levels are positively associated with the consumer’s general education level (see for example, Lusardi, 2008). Studies have found differing effectiveness of targeted financial education programs, for example, in the savings domain. Bernheim, Garrett and Maki (2001) find a positive effect of financial curriculum mandates in high schools on asset accumulation and financial education exposure. Similarly, Bayer, Bernheim and Scholz (2009) find that retirement seminars offered by employers increase participation and contributions to retirement savings programs, especially among lower wage employees. However, Choi, Laibson and Madrian (2011) find that financial information and education in itself is unsuccessful in moving employees to participate in highly advantageous savings programs, and that there is a persistent gap between employees’ stated intentions and actions.

Our ability to test the relationship between education and behavior in the credit card program is limited to a general education measure as provided in the data. Given the positive correlation between general education and financial literacy frequently found in the literature, it is reasonable to hypothesize

a positive relationship between general education level and the consistency between contract choice and spending patterns.

Hypothesis 5: (Education and Mismatch) Controlling for other observable factors including spending levels, college educated consumers will have a lower incidence of mismatch in contract choice.

Our final hypothesis concerns the correlation between contract mismatch and other financial behaviors that could indicate difficulty in financial management. Prior literature has attributed financial behaviors to fundamental underlying behavioral parameters. For example, Meier and Sprenger (2010) show that credit card debt is correlated with incentivized experimental measures of present-biased time preference. Although our findings could be attributed to some behavioral attributes besides time preferences alone, it is reasonable to hypothesize that the same attributes which contribute to mismatch between contract and spending also produce consequences in other financial decisions. In particular, we examine the correlation between mismatch and presence of credit card debt, as well as use of the cash-in-advance withdrawal service, both of which are indicators of financial planning difficulties or lower financial well-being.

Hypothesis 6: (Financial Management) Consumers with a mismatch between contract choice and spending are more likely to hold debt and to use the credit card as a source of cash in advance withdrawal, which are both negative indicators of financial well-being.

4. Empirical Results

We now analyze the data with the goal of testing the previously formulated hypotheses about consumers' choice of credit card plan and their subsequent spending and membership choices.

A. Contract Choice

We begin with the basic question of contract choice in the credit card contract problem. Hypotheses 1A and 1B stated that the two-contract menu should drive higher spending, low variance consumers towards the Annual Fee contract, while the Lump Sum fee contract should hold relatively more appeal among lower and more uncertain spenders.

To test these hypotheses, we apply a Probit model to contract choice, spending-related variables and control variables as follows. The probability that consumer i chooses card type j is given by,

$$Pr_i(\text{lump sum} = 1) = \Phi(x_i'\beta)$$

where Φ is the cumulative density function of a standard normal distribution; x_i is a vector of consumer characteristics and β is a parameter vector of marginal contributions of consumer characteristics to their final choice of the Lump Sum fee card. Specifically, $x_i\beta$ is given by,

$$x_i'\beta = \alpha + \beta_1 \cdot frthresh_i + \beta_2 \cdot retailavg_i + \beta_3 \cdot retailsd_i + \beta_4 \cdot othusechar_i + \beta_5 \cdot demogr_i$$

where i indexes consumers, $frthresh_i$ denotes the proportion of years (ranging from 0 to 1) during the observed period that the consumer reached the annual fee spending threshold (ie. frequency threshold), $demogr_i$ and $othusechar_i$ are control variables for demographic features and features of other uses of the credit card program (ie. cash advance and installment). Our main variables of interest for Hypothesis 1 are $retailavg_i$ which is the average monthly retail spending of the consumer, and $retailsd_i$ which is the standard deviation of monthly retail spending. By progressively adding these variables into the model, we have three specifications: specification (1) contains only $demogr_i$ while specification (2) adds the average spending features of the consumer; Specification (3) adds the variance

of spending features. We apply the maximum likelihood estimation (MLE) method to estimate the parameters in our model.

Table 3: Probit Regression, Dependent Variable: Contract
Contract = 1 for lump sum contract, Contract = 0 for annual fee contract

	(1) Contract	(2) Contract	(3) Contract
Freq. threshold reached		-1.6751*** (-22.94)	-1.3551*** (-16.34)
log avg spending, retail		0.1511*** (21.68)	-0.1142*** (-3.64)
log avg spending, cash advance		0.0139** (2.49)	0.0320 (1.11)
log avg spending, installment		0.0633*** (8.81)	0.0457 (0.78)
log var, retail			0.2517*** (8.74)
log var, cash advance			-0.0253 (-1.04)
log var, installment			0.0172 (0.33)
referral status (1 = yes)	0.6643*** (20.84)	0.5993*** (18.26)	0.5999*** (18.23)
College (1 = yes)	0.4806*** (15.79)	0.4667*** (14.74)	0.4597*** (14.46)
Male (1 = yes)	0.1785*** (7.39)	0.1412*** (5.54)	0.1286*** (5.02)
Constant	-1.5841*** (-50.89)	-0.9899*** (-17.20)	-1.2763*** (-18.67)
Obs	16,749	16,749	16,749
log likelihood	-6859	-6414	-6375

z-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The regression results controlling for all variables (Column 3) indicate that the predictions of Hypothesis 1A and 1B hold. Table 3 shows that as expected, the proportion of years in which a consumer met the spending threshold for annual fee waiver corresponds to a lower likelihood of choosing the Lump Sum fee contract. Controlling for this variable, consumers who had higher average spending were significantly less likely to choose the lump sum contract, meaning more likely to choose the annual fee contract. The analogous coefficients on control variables cash advances and installment payments are insignificantly different than zero. Variance in retail spending was positively predictive of selection of the lump sum fee contract, which is consistent with Hypothesis 1B and the assurance of no future fees that the lump sum fee contract provides.

In addition to the spending characteristics of the individual consumers, we also include the available control variables of consumer characteristics. A customer's referral status indicates whether he or she was referred for the credit card by either another customer or a bank employee. The results indicate that all else equal, customers who were referred are significantly more likely to choose the lump sum

contract. We also observe that controlling for spending characteristics, college-educated consumers were more likely to choose the lump sum contract. This may be slightly surprising given that college-educated consumers might be expected to have not only higher spending, but more flexibility and control in their future spending using the card, and thus they may find the insurance motive less appealing than non-college educated consumers. Finally, male customers were significantly more likely to select into the lump sum fee contract than female customers.

B. Spending Behavior

Next, we examine which contract would have been the best match for the consumer from an ex-post perspective, given the actual credit card use by that consumer. Following DellaVigna and Malmendier (2006), Grubb (2009), Miravete (2003) and related papers which examine similar issues, we use financial measure as the main indicator, which allows an objective benchmark for the comparison of contract choice and subsequent behavior.⁶

Given the contract fee structures, a consumer's spending matches their annual fee contract if their spending in a year exceeds the annual fee threshold for fee waiver, and is otherwise considered an ex-post match with the lump sum fee contract. The other consideration in our evaluation of consumers' contract match is the magnitude of each type of fee. The lump sum fee is 260 RMB while the annual fee is 180 RMB. Thus, based on using financial measure as a criteria, we consider it a mismatch if the threshold for the annual fee customer is not reached for at least two years.

Table 4 shows the percentages of consumers in the annual fee category who did not meet the contract spending threshold by year. For the definition of mismatch as described above, we examine the row labeled Two Years. Approximately 13% of annual fee customers did not spend enough to obtain the annual fee waiver during the first and second years of the contract. Almost 10% of the annual fee consumers did not meet the threshold during the second and third year of observation specifically. Another 2.5% of annual fee customers did not meet the threshold in the first year, met it in the second year and again did not meet it in the third year. However, the number of customers who did not meet the threshold during all 3 years of observation is small at just 1.37%.

The qualification of mismatch is slightly trickier for the case of the lump sum fee consumers. Here, the counterfactual is what the consumer could have gained by being an annual fee customer instead. The detail is that the lump sum fee technically (ie. according to rules specified at the time of contract signing) allows the consumer to use the card indefinitely, so to truly observe mismatch under these conditions we would need to observe consumers forever or until they cancel the card. Since the data limit our observations to the three years in question, we use this to infer about consumers' baseline spending tendencies. Arguably, the first few years after signing up for the card are the most relevant for understanding consumers' reactions to promotions, because with the rapid development and change of China's financial system and credit market, consumers may not be likely to believe that the lump sum card can *actually* be held forever in practice. Thus, it is reasonable if the consumer considers their medium-term credit card needs rather than their indefinite needs.

Table 5 shows the proportion of lump sum fee cardholders that exceeded the annual fee card threshold in each year observed. Around 56% of lump sum fee cardholders exceeded the annual fee card spending threshold in all three observed years, which corresponds to their most immediate annual spending realizations after signing up for the card. In other words, at least 56% of lump sum fee consumers'

⁶ For example, we do not have access to measures of utility resulting from each contract ex-post.

spending pattern match better with the annual fee card over the observed period, and this fraction is raised to 66% when considering just the first two years of observation.

Table 4: Annual fee cardholders not meeting spending threshold (by years)

Total number of consumers in parentheses

	1 st year	2 nd year	3 rd year
One Year	20.13% (20,026)	26.23% (17,511)	20.57% (13,746)
Two Years	12.89% (17,511)	9.53% (13,746)	2.42% (13,746)
	All 3 years		
Three Years	1.37% (13,746)		

Table 5: Lump-sum fee cardholders exceeding the annual spending threshold (by years)

Total number of consumers in parentheses

	1 st year	2 nd year	3 rd year
One Year	86.54% (2,482)	69.35% (2,437)	62.70% (2,338)
Two Years	66.39% (2,437)	57.70% (2,338)	59.88% (2,238)
	All 3 years		
Three Years	55.82% (2,238)		

To review our previously discussed intuition, Hypothesis 2 can be understood through the fixed initial cost nature of the Lump Sum Fee contract, meaning no cost incurred regardless of future choices made. While Lump Sum Fee consumers have no marginal cost of mismatch incurred after the contract choice, Annual Fee customers face a monetary penalty for each year that the spending threshold is not met. Since card membership could persist for an unspecified number of years, Annual Fee customers have a greater incentive to pay attention to their credit card usage.

Although Tables 4 and 5 provide raw data on proportions of mistakes which provide preliminary support for Hypothesis 2, we test the relationship between contract choice and mistakes more thoroughly using a probit model as follows.

$$Pr_i(\text{mismatch} = 1) = \Phi(x_i'\beta).$$

Specifically, $x_i'\beta = \alpha_1 + \beta_1 \cdot \text{demogr}_i + \beta_2 \cdot \text{spendchar}_i$, where spendchar_i consists of both average and variance in spending categories. Table 6 reports the result from this probit regression model with three different specifications with progressive incorporations of additional explanatory variables.

Table 6: Probit Regression: Dependent Variable: Contract Mismatch

(Mismatch = 1 if Annual Fee Cardholder did not reach spending threshold for at least 2 years, or Lump Sum Fee Cardholder exceeded spending threshold for at least 2 years; Mismatch = 0 otherwise)

	(1)	(2)	(3)
	mismatch	mismatch	mismatch
log var, retail			0.5302*** (18.72)
log var, installment			0.0261 (0.39)
log var, cash advance			0.2799*** (10.24)
log avg, retail		0.0138** (2.21)	-0.5206*** (-18.08)
log avg, installment		-0.0221** (-2.47)	-0.0322 (-0.43)
log avg, cash advance		0.0781*** (12.42)	-0.2640*** (-8.17)
Contract (1 = lump sum)	2.2001*** (67.65)	2.2153*** (66.41)	2.1624*** (65.18)
Referral status (1 = yes)	0.0677* (1.69)	0.0450 (1.11)	0.0570 (1.38)
College (1 = yes)	-0.1133*** (-3.59)	-0.0880*** (-2.74)	-0.0930*** (-2.78)
Male (1 = yes)	0.2558*** (9.15)	0.1899*** (6.59)	0.1457*** (4.88)
Constant	-1.5475*** (-48.99)	-1.7429*** (-40.83)	-2.0164*** (-40.79)
Obs	16,749	16,749	16,749
Log likelihood	-4923	-4834	-4589

z-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The aggregate results indicate that overall, mismatch was more likely in the case of the lump sum fee contract, which is consistent with the prediction of Hypothesis 2.

A potential identification issue with the above estimation results is the endogeneity problem in contract choice. Our discussion of Hypothesis 2 proposes that the financial incentives for matching the choice of contract are greater for the Annual Fee consumers compared to the Lump Sum Fee consumers, generating endogeneity of the contract choice variable. To help resolve this problem, we apply a bivariate probit estimation (Greene, 2003). This approach recursively estimates the choice of contracts, and then the effect of contract choices on mismatch, while allowing spending and demographic characteristics to influence both the likelihood of mismatch and the contract choice. Xiao and Ju (2016) use a similar approach in modeling automobile manufacturers' exclusive territory and brand agreements with dealerships. In our setting, we estimate the following recursive model of mismatch in contract choice:

$$M_i = \alpha \cdot Contract_i + x_i' \beta_1 + \varepsilon_{1i}, \text{ Mismatch}_i = 1 \text{ if } M_i > 0; 0 \text{ otherwise,}$$

$$C_i = x_i' \beta_2 + \varepsilon_{2i}, \text{ Contract}_i = 1 \text{ if } C_i > 0; 0 \text{ otherwise,}$$

$$\begin{pmatrix} \varepsilon_{1i} \\ \varepsilon_{2i} \end{pmatrix} | x_i \sim N \begin{bmatrix} 0 & \rho \\ \rho & 1 \end{bmatrix}.$$

where the first equation is the condition for the occurrence of contract and spending mismatch. Specifically, $x_i' \beta_1 = \beta_{1,d} \cdot demogr_i + \beta_{1,s} \cdot spendchar_i$, where *demogr* and *spendchar* are demographic and spending characteristics of individuals, including the same sets of variables as those in previous regressions. The second equation models the contract choice, where $x_i' \beta_2 = \beta_{2,d} \cdot demogr_i + \beta_{2,s} \cdot spendchar_i$. Demographic and spending characteristics of the consumer may influence both the propensity towards mismatch, as well as influencing the contract choice itself directly. Unobservable characteristics, ε_1 and ε_2 are correlated in the sense that some unobservable individual characteristics may affect both contract choice and *ex-post* choices; therefore, we assume they follow a bivariate normal distribution as described in the third equation.

Table 7: Bivariate Probit: Dependent Variables: Mismatch and Contract Choice

(*Contract = 1 for lump sum contract, Contract = 0 for annual fee contract;*

Mismatch = 1 if Annual Fee Cardholder did not reach spending threshold for at least 2 years, or Lump Sum Fee Cardholder exceeded spending threshold for at least 2 years; Mismatch = 0 otherwise)

	(1)	(1*)	(2)	(2*)
	Mismatch	Contract	Mismatch	Contract
Contract	3.3745*** (115.93)		0.8662*** (4.09)	
log avg, retail	-0.0003 (-0.05)	0.0812*** (15.92)	-0.6036*** (-21.80)	-0.5041*** (-17.88)
log avg, installment	-0.0372*** (-4.58)	0.0643*** (9.47)	-0.0230 (-0.34)	0.0161 (0.27)
log avg, cash advance	0.0688*** (11.88)	-0.0040 (-0.75)	-0.2555*** (-8.31)	-0.0948*** (-3.29)
log var, retail			0.6345*** (22.36)	0.5694*** (20.77)
log var, installment			0.0396 (0.65)	0.0395 (0.74)
log var, cash advance			0.2605*** (9.72)	0.0674*** (2.76)
Referral status (1 = yes)	-0.2145*** (-5.71)	0.5664*** (17.63)	0.2891*** (5.59)	0.6125*** (18.73)
College (1 = yes)	-0.1913*** (-6.55)	0.4373*** (14.75)	0.0616 (1.45)	0.4372*** (13.99)
Male (1 = yes)	0.0947*** (3.62)	0.1192*** (4.94)	0.1775*** (6.36)	0.1412*** (5.57)
Constant	-1.5807*** (-39.60)	-1.9823*** (-49.21)	0.2891*** (5.59)	0.6125*** (18.73)
Obs		16,749		16,749
Log likelihood		-11,464		-11,076

z-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The regression results in Table 7 show that under specification (1 and 1*), which omits the spending variation variables, mismatch has a positive and significant relationship with choice of the lump

sum contract, which is consistent with the earlier results in Table 6 that do not attempt to address the endogeneity problem with contract choice, supporting the prediction of Hypothesis 2. While controlling for individual variation in spending variables, as specification (2 and 2*) shows, the positive relationship between contract choice and mismatch is still supported by our data, although the magnitude is much smaller. The difference in the magnitude of this coefficient between specifications (1) and (2) can be interpreted as the difference in effort to avoid mismatch between the lump-sum fee cardholders and annual fee cardholders. Intuitively, any efforts to correct prediction error will lead to unusual spending compared to the usual pattern, leading to higher variation in spending. Without controlling for this variation (specification 1), a choice of the lump-sum fee card could indicate both *ex-ante* lower capability of estimating future usage and *ex-post* less effort to match their contract choice; therefore, the correlation between card choice and mismatch is stronger. After controlling for the *ex-post* matching efforts, the coefficient simply indicates the *ex-ante* effect, and so its impact is lower.

The estimates of the other parameters in this regression are also informative in understanding the contract mismatch. The results suggest that college education was negatively associated with mismatch, males were more likely to generate mismatch, and intuitively, average spending volume was negatively related with mismatch while variance in spending volume and frequency were positively related.

While the bivariate probit approach allows mismatch and contract choice to enter the recursive estimation, it may also be useful to examine the basic probit estimation separately by contract choice. Table 8 shows results from the same specification as in Table 6, however exclusive to lump sum fee cardholders in Columns (1) and (2) and exclusive to annual fee cardholders in Columns (3) and (4). We can observe that the relationships between mismatch and the two contract types are on average in opposite directions.

Referring to the complete specification in Table 8, Column (2), for lump sum fee customers only, average spending was positively associated with the mismatch while variance in spending was negatively associated with it. Intuitively, for lump sum fee cardholders, the more they eventually spend, the more likelihood they are generating mismatch with their card choice since choosing an annual fee card is optimal for a high spending user; therefore, we observe a positive correlation between usage and mismatch. On the other hand, when the variance in usage is higher (which indicates more *ex-ante* uncertainty in usage since they do not need to spend efforts to avoid mismatch *ex-post*), it is optimal to choose a lump-sum fee card, and so the correlation between mismatch and variance of usage is negatively correlated for the lump-sum fee cardholders. Furthermore, when restricted to the lump sum fee customers, college education is positively associated with the contract-usage mismatch. In other words, college educated consumers tended to underestimate the amount of spending they would accumulate on the lump sum fee credit card. Also, when exclusively examining the lump sum fee contract, gender no longer significantly predicts mismatch. Mismatch by lump sum customers was also positively associated with the number of months in debt by the cardholder.

Column (4) shows the analogous results for annual fee cardholders only. Average spending and variance in spending take negative and positive relationships to mismatch, respectively. The reasoning is similar to that for lump sum fee cardholders. The only difference is that now the variance in usage more heavily measures the *ex-post* effort to avoid mismatch, since if they expect higher uncertainty in usage, they would have ideally chosen the lump-sum fee card; therefore, we observe a negative correlation between variance in usage and mismatch. Consistent with the aggregate result, college education is once again negatively associated with mismatch, while males were significantly more likely to generate mismatch under the annual fee plan. An interesting observation is the relationship between college education, contract choice and mismatch. Although college education significantly predicts choice of the

lump sum contract, the college educated were in fact more likely to exhibit mismatch as compared to in the annual fee contract, which was less popular among those with college education. Similar to the case of the lump sum fee cardholders, the number of months in debt is significantly predictive of mismatch.

Table 8: Probit Regression: Dependent Variable: Mismatch, by Contract Type
(Lump Sum Fee Cardholders: Mismatch = 1 if exceeded spending threshold for at least 2 years; Mismatch = 0 otherwise;
Annual Fee Cardholders: Mismatch = 1 if did not reach spending threshold for at least 2 years; Mismatch = 0 otherwise)

	(1)	(2)	(3)	(4)
	mismatch	mismatch	mismatch	mismatch
	lump sum	lump sum	annual fee	annual fee
log avg, retail	0.2443*** (16.90)	2.8316*** (24.53)	-0.0343*** (-5.14)	-2.1296*** (-38.01)
log avg, installment	0.1001*** (5.08)	1.1643*** (4.21)	-0.1117*** (-8.02)	-0.8488*** (-4.40)
log avg, cash advance	0.0781*** (5.67)	0.7684*** (7.34)	0.0862*** (11.52)	-0.7460*** (-14.59)
log var, retail		-2.4851*** (-23.87)		1.9617*** (38.73)
log var, installment		-0.9264*** (-3.96)		0.6364*** (3.90)
log var, cash advance		-0.5390*** (-6.32)		0.6406*** (15.15)
Referral status (1 = yes)	0.0070 (0.10)	-0.0222 (-0.24)	0.0813 (1.52)	0.1543** (2.24)
College (1 = yes)	0.0757 (0.92)	0.2347** (2.15)	-0.1180*** (-3.35)	-0.1354*** (-3.03)
Male (1 = yes)	-0.0295 (-0.49)	0.1167 (1.47)	0.2719*** (7.96)	0.1399*** (3.21)
Constant	-0.8713*** (-7.90)	0.3693** (2.48)	-1.5242*** (-34.86)	-2.0957*** (-34.02)
Obs	2,599	2,599	14,150	14,150
Log likelihood	-1174	-667.5	-3381	-2167

z-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Our next two hypotheses specifically address the spending behavior of those consumers whose contract choice and spending were mismatched as defined previously.

Hypothesis 3 addresses the adjustment of spending amounts in subsequent years in response to the initial mismatch in the first year. As mentioned earlier, the key asymmetry between the annual fee contract and the lump sum fee contract is in the cost of continued mismatch. In the annual fee contract case, each year that the consumer does not meet the spending threshold will result in an additional annual fee incurred. In the lump sum fee contract case, although the consumer could have some psychological regrets when looking back in time, the monetary cost has already been sunk. Therefore, we would expect that annual fee consumers have more incentive to adjust their spending amounts in years following an initial mismatch compared to lump sum fee consumers.

We test Hypothesis 3 using an ordinary least squares specification with the increase in spending as the dependent variable, as follows:

$$spendinginc_{it} = \alpha + \beta_1 \cdot constype_i + \beta_2 \cdot demogr_i + \varepsilon_i$$

where all spending variables are in log amounts, and *constype* are indicator variables for the combinations of contract choice and spending outcome in the first year: annual fee, threshold not met; lump sum fee, threshold not met; and lump sum fee, threshold met. The comparison group is annual fee, threshold met. We omit the spending characteristics variables here as explanatory variables since here we are interested in consumers' decisions about their adjustment of spending.

Table 9 shows the results for regression of increased spending the subsequent year on customer types and control variables, using the annual fee customers as benchmark for comparison. Lump sum fee customers who exceeded the threshold decreased their spending the most in the subsequent year, followed by lump sum fee customers who met the threshold. Annual fee customers who did not meet the spending threshold decreased their spending the subsequent year instead of increasing it, relative to their counterparts who met the threshold. Based on these results, our Hypothesis 3 does not seem to be supported. However, an issue remains regarding individual consumer heterogeneity in this specification. The OLS specification controls for basic observed demographic variables but is unable to measure the change in spending at the individual consumer level. In order to address this issue, we implement a fixed effects specification as described below.

Table 9: Ordinary Least Squares Regression: Dependent Variable: Log Spending Increase
(Consumer types: comparison group: annual fee, threshold met)

	(1) Log spending increase
Consumer type: Annual Fee, threshold not met	-496.6854*** (-3.53)
Consumer type: Lump Sum Fee, threshold not met	-709.1329*** (-3.65)
Consumer type: Lump Sum Fee, threshold met	-1,142.5159*** (-4.20)
Referral status (1 = yes)	212.0545 (0.55)
College (1 = yes)	1,171.8164*** (5.60)
Male (1 = yes)	-477.2776** (-2.13)
Constant	-82.5594 (-0.41)
Obs	37,311
R-squared	0.000

Robust t-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1

To address the unobserved heterogeneity among consumers, we estimate the autocorrelation between the current year's spending and the previous year's spending by consumer type, allowing for individual consumer fixed effects, and report the results by consumer types in Table 10. The results

indicate that all types decreased their spending on average from one year to the next. Furthermore, contrary to our hypothesis, annual fee customers facing the possibility of a repeat financial penalty for not meeting the spending threshold did not generally increase their spending. In other words, spending does not appear to be the margin of adjustment for consumers in the credit card program, at least in the aggregate. Consumers may be unable or unwilling to change their spending patterns in response to the financial incentives of the program.

Table 10: Dependent variable: Log spending, Fixed Effects Autocorrelation, by consumer type

	(1)	(2)	(3)	(4)
	Annual fee, threshold not reached	Annual fee, threshold reached	Lump sum fee, threshold not reached	Lump sum fee, threshold reached
Lag of log spending	-0.1280**	-0.0426***	-0.1357**	-0.1122***
	(-2.07)	(-4.48)	(-2.28)	(-5.75)
Constant	0.2473***	7.8887***	1.9528***	7.9356***
	(6.08)	(101.89)	(14.67)	(52.26)
Obs	1,667	16,326	429	4,343
R-sq	0.038	0.003	0.026	0.015
N (cardholders)	1,557	8,794	235	2,202

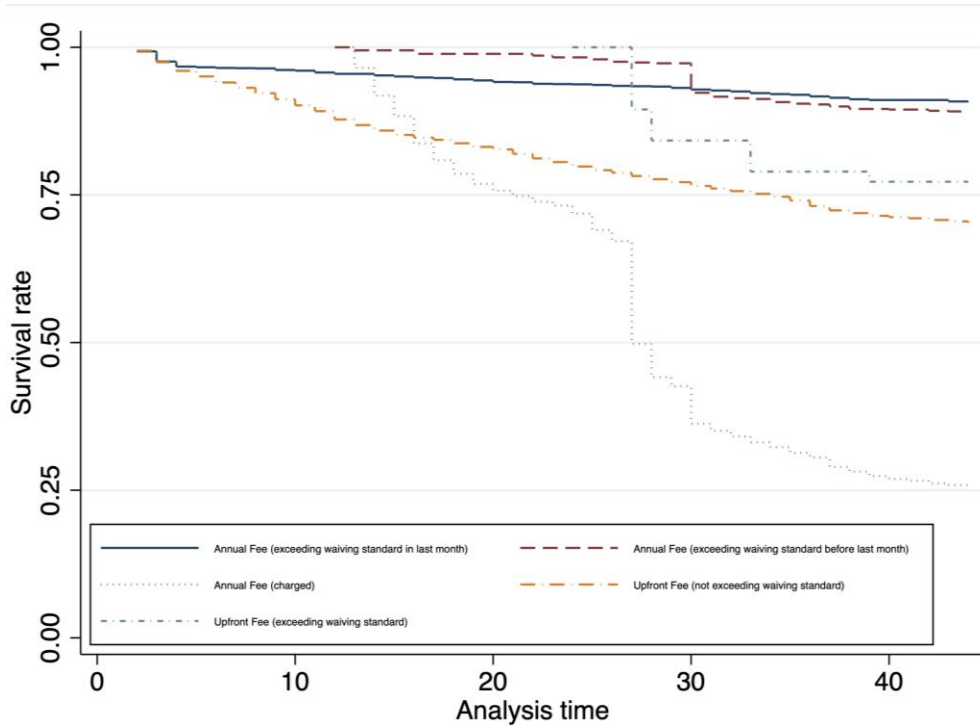
t-statistics in parentheses ; *** p<0.01, ** p<0.05, * p<0.1

C. Attrition

Next, we examine another potential margin for adjustment in response to incentives, which is the membership continuation decision. Hypothesis 4 is similar to Hypothesis 3, except that the learning is on the margin of cancelling the credit card program altogether, rather than on the margin of spending adjustments. Just as in Hypothesis 3, lump sum consumers do not have forward-looking incentives to alter their behavior, so we do not expect them to have any special cancellation behavior after their initial realization indicating mismatch.

Indeed, we can observe this pattern from Figure 2, which plots the survival functions of each consumer type. When comparing the red dotted line (lump sum fee, mismatch) and the blue solid line (lump sum fee, no mismatch). In fact, the lump sum fee consumers under mismatch had the highest survival trend and exceeding those who did not generate mismatch. The dotted green lines in Figure 1 compare the survival rates of consumers in the annual fee group with mismatch (light green, small dots) to those who fulfilled their spending threshold fairly evenly over the year (dark green). Consistent with incentives, the consumers who were mismatched under the annual fee contract cancelled their membership at the steepest rates. An additional comparison group can be seen from the orange dotted line, which is comprised of those annual fee consumers who fulfilled the spending threshold but did so by increasing their spending levels in the months leading up to the annual spending threshold deadline. This group starts out having the highest survival rate, then over time falls between the smoothly fulfilled group and those not reaching the threshold.

Figure 2: Kaplan-Meier survival estimates, by consumer type



We test the robustness of the pattern in Figure 2, controlling for other variables using the Cox proportional hazards model (Cox 1972). Specifically, the hazard is assumed to be

$$h_i(t) = h_0(t)exp(x_i'\beta)$$

where, $h_0(t)$ is the baseline hazard at time t , and x_i is a vector of variables that determines the individuals' idiosyncratic hazard rates.

Table 11 shows the results from this specification, which largely replicate the pattern in Figure 1. Compared to Annual Fee consumers who met the spending threshold, Annual Fee consumers who did not meet the threshold were more likely to cancel. Lump Sum Fee consumers, regardless of whether they met the threshold or not, were significantly less likely to quit compared to the Annual Fee consumers. Spending levels on retail and cash advances are negatively associated with attrition, while variance in these two spending categories were positively correlated with attrition. Consumers with some college education were more likely to cancel, while male consumers were less likely to cancel.

Table 11: Duration Analysis: Dependent Variable: Hazard Rate
(Customer types: comparison group: annual fee, threshold met)

	(1)	(2)
	hazard rate	hazard rate
Consumer type: Annual Fee, threshold not met	0.4293*** (6.15)	0.4293*** (6.15)
Consumer type: Lump Sum Fee, threshold not met	-1.8666*** (-12.13)	-1.8682*** (-12.14)
Consumer type: Lump Sum Fee, threshold met	-1.8059*** (-19.33)	-1.8066*** (-19.33)
Annual fee charged		0.2606*** (3.81)
log avg, retail	-0.8225*** (-24.31)	-0.8227*** (-24.32)
log avg, cash advance	-0.2504*** (-5.79)	-0.2507*** (-5.80)
log avg, installment	-0.0190 (-0.18)	-0.0208 (-0.19)
log var, retailing	0.5417*** (17.08)	0.5418*** (17.08)
log var, cash advance	0.1246*** (3.38)	0.1249*** (3.39)
log var, installment	-0.0242 (-0.25)	-0.0227 (-0.23)
Referral status (1 = yes)	-0.0853 (-1.64)	-0.0851 (-1.63)
College (1 = yes)	0.0693** (2.24)	0.0696** (2.25)
Male (1 = yes)	-0.1052*** (-3.63)	-0.1055*** (-3.65)
Obs	370,955	370,955
AIC	88816	88804
BIC	88946	88945

z-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1

D. Origins of Mismatch

Finally, we test our final hypotheses about the sources of contract and usage mismatch. Our first hypothesis on this question (H5) is that education negatively predicts mismatch in the contract choice and usage domains.

Tables 6, 7 and 8 displayed earlier provide the evidence on this hypothesis, controlling for all observable spending characteristics. The regressions show that the relationship between education and mismatch depends on the contract type. When considering both the lump sum contract and the annual fee contract altogether, college education is indeed negatively associated with mismatch. However, controlling for spending characteristics, the negative relationship is maintained among the annual fee consumers but is reversed among the lump sum contract consumers. In light of the relative popularity of

the lump sum contract among the college educated (see Table 3), it implies that as a whole, the college-educated tend to be relatively conservative about their future spending on the card, while the non-college educated tend to be more optimistic about having high spending.

Our final hypothesis is about the correlation between mismatch and other observable measures of financial well-being. If mismatch is indicative of difficulties in financial planning and management more generally, then we should observe a significant positive correlation between these mismatch and traits such as months carrying debt.

We test this hypothesis using an ordered probit specification with number of months carrying debt as the dependent variable as follows:

$$Y_i = \alpha + \beta_1 \cdot demogr_i + \beta_2 \cdot spendchar_i + \beta_3 \cdot mistake_i + \varepsilon_i$$

$$Dt_i = \begin{cases} 0 & \text{if } Y_i \leq 0 \\ 1 & \text{if } 0 < Y_i \leq \mu_1 \\ \vdots & \\ N & \text{if } \mu_{N-1} < Y_i \leq \mu_N \end{cases}$$

where, Y_i is a latent variable which is a function of consumer demographic characteristics, spending patterns and their mistakes. Dt_i is the observed number of months in debt; ε_i follows a standard normal distribution. We limit our analysis to the Annual Fee consumers for this specification, because the definition of mismatch for this group takes the form of under-spending rather than over-spending, therefore the occurrence of mismatch is on average not itself contributing to the consumer's standing debt on the credit card.

Table 12 shows that once controlling for observed spending characteristics, incidence of the contract choice mismatch is significantly positively associated with the number of months the consumer held debt on the credit card. The magnitude of the coefficient is increased substantially once variance in spending measures are accounted for. In addition, months of debt is positively associated with cash advance withdrawals and variation in cash advance withdrawals. More educated individuals hold less debt, and consumers who spend more tend to hold more debt. The results suggest that mismatch in the contract choice problem may not merely be inconsistencies between choice and behavior in this domain alone, but are more broadly indicative of other financial planning challenges.

Table 12: Ordered Probit: Dependent Variable: Number of Months in Debt

	<i>Annual Fee Consumers only</i>		
	(1)	(2)	(3)
	debtmonths	debtmonths	debtmonths
Mismatch	-0.2817*** (-8.32)	0.0971*** (2.70)	0.3731*** (9.72)
log avg, retail		0.7360*** (101.44)	1.2658*** (52.89)
log avg, installment		0.0913*** (15.63)	0.0608 (1.26)
log avg, cash advance		0.1237*** (29.21)	0.0809*** (3.86)
log var, retail			-0.5427*** (-23.44)
log var, installment			0.0339 (0.78)
log var, cash advance			0.0506*** (2.83)
Referral status (1 = yes)	0.3551*** (12.40)	0.0507* (1.69)	0.0457 (1.53)
College (1 = yes)	0.0614*** (3.21)	-0.1227*** (-5.82)	-0.1089*** (-5.21)
Male (1 = yes)	0.0281 (1.61)	-0.0238 (-1.22)	-0.0036 (-0.18)
Obs	14,150	14,150	14,150
Log likelihood	-41860	-31867	-31587

z-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1

5. Conclusion and Discussion

Research on contract choices of consumers when choosing between fixed fee and per-use payment schemes has generated a debate about the prevalence of ex-post mismatch between contract choice and usage, as well as consumers' abilities to learn and adapt from their previous experiences. Our study provides new evidence along both these dimensions using consumer's contract choices and subsequent spending in a credit card program which implicitly asks them to estimate their future usage.

We find that consumers on average, tend to sort themselves into the appropriate contract choice, consistently with the findings in Agarwal et al (2015) within the credit card fee and interest rate domains. However, we also find that based on monetary fees paid, a sizeable fraction of consumers, at least 12% of annual fee consumers and 55% of lump sum fee consumers, could have benefitted financially by initially choosing the other contract. While the financial consequence is not particularly large in magnitude, the cancellation patterns indicate that these amounts do matter to consumers and influence their membership choices. .

Our credit card setting differs from some of the other studies (*e.g.*, DellaVigna and Malmendier, 2006, and others) in that the financially advantageous choice of the lump sum contract is tied with lower

use of the credit card, while higher spending makes the annual fee contract more advantageous for the consumer. The greater overall appeal of the annual fee contract in our data suggests that the advantage of lump sum contracts may depend on the consumption utility associated with the product but may not be purely driven by an intrinsic attraction for pre-paid lump sum payment schemes as suggested in prior literature (see Lambrecht and Skiera, 2006).

Following consumers for the three years after their initial contract choices, our empirical results show that following the first realization of contract-usage mismatch, consumers adjust their choices in a manner predicted by their future monetary incentives to do so. The impact of future monetary incentives has not been a focus of prior discussions about consumers' contract choices and their tendency to behave consistently with previous choices and/or commitments made (Dellavigna and Malmendier, 2006; Lambrecht and Skiera, 2006; Grubb, 2015, and others). However, the result is reasonable in the sense that for consumers who have no future monetary incentive to adjust their behavior based on prior errors, we would expect a weaker tendency to implement changes in that direction.

However, the ability or desire to adjust behavior on the margin of spending amounts appears to be limited for the credit card consumers (see Beshears, Milkman and Schwartzstein, 2016 for a discussion of personal plans), and they instead 'learn' by terminating their card membership. In other words, credit card companies can lose permanently from their customer base by imposing penalties consumers who were 'mistaken' about their future usage. For companies who offer a range of contracts to consumers expecting to successfully cater to consumers' heterogeneous needs, even small to moderate monetary penalties, as imposed in our setting, can result in significant cancellation and loss of market share. In this case, a welfare improving policy from a behavioral standpoint may be to offer fee-forgiveness for the first year of 'mistakes'. The lack of learning in the spending adjustment domain found in the aggregate after fees were imposed, could relatedly be due to a dominating desire to stop being a customer altogether, or a type of penalty aversion.

Finally, our study contributes to the discussion about the relationship between education levels and financial choices (e.g., Bernheim et al., 2001; Choi et al., 2011). While college-educated consumers tended to underestimate their credit card usage, non-college educated consumers were more prone to overestimation of future spending. Overall, higher education is associated with a reduced incidence of mistakes in the contract choice and spending domains. Our analysis also shows that mismatched contract choice is positively correlated with number of months of carried debt on the consumer's account. This feature, combined with the positive association between months in debt and use of the cash-in-advance service of the card, suggests that mismatches in the contract choice domain are not isolated errors, but are more likely indicative of broader individual financial planning abilities.

Our study leaves open some remaining directions for future research. One direction is to more specifically evaluate and suggest improvements regarding credit card companies' policies in response to distributions of consumer types. Some recent studies examining firms' sophistication of responses to behavioral consumers include Lien and Yuan (2015) in the lottery sales domain, and Ru and Schoar (2016) in the credit card domain. In our current setting, the results do not seem to suggest that the credit card companies during this time period have particularly catered to behavioral consumer types. Further work can consider whether commercial finance products, especially in the evolving financial markets in China, have made advancements with regard to this issue.

Our study and other studies on consumers' responses to contract experiences, also show that consumer heterogeneity is influential in these settings. Although on an average or majority basis, consumers may choose appropriately for themselves, the distribution of errors made is not uniform across

the education and financial status spectrums. Thus, another dimension for further research may be needed to learn more about the cognitive and socio-economic determinants of well-matched contract choices by consumers. For example, is less accurate prediction about credit card spending based on contract choices made among consumers of lower education levels due to greater challenges in the prediction task itself, or lower levels of consideration regarding the contract decision? To address such questions, additional data collection in the experimental or survey domain can assist with identifying the underlying source of performance heterogeneity. We leave these possibilities for future research.

References:

- Agarwal, Sumit, Sujit Chakravorti and Anna Lunn, “Why Do Banks Reward their Customers to Use their Credit Cards?” *Federal Reserve Bank of Chicago Working Paper*, WP 2010-19, December 2010. (Available at <https://ssrn.com/abstract=1719054>)
- Agarwal, Sumit, John C. Driscoll, Xavier Gabaix and David Laibson, “Learning in the Credit Card Market”, *SSRN Working Paper*, April 2013. (Available at <https://ssrn.com/abstract=1091623>)
- Agarwal, Sumit, Souphala Chomsisengphet, Chunlin Liu and Nicholas S. Souleles (2015), “Do Consumers Choose the Right Credit Contracts?” *Review of Corporate Finance Studies*, Vol. 4, Issue 2, p. 239 – 257.
- Arkes, Hal R. and Catherine Blumer (1985). “The Psychology of Sunk Cost,” *Organizational Behavior and Human Decision Processes*, 35, 124-140.
- Ausubel, Lawrence M., “Adverse Selection in the Credit Card Market”, *Working Paper, Department of Economics, University of Maryland*, June 1999.
- Bansal, S., Bruno, P., Istace, F., & Niederkorn, M. 2013. Global Payments Trends: Challenges Amid Rebounding Revenues, *McKinsey Quarterly*: 34-39: McKinsey.
- Bayer, Patrick J., B. Douglas Bernheim, and John Karl Scholz, “The Effects of Financial Education in the Workplace: Evidence from a Survey of Employers”, *Economic Inquiry*, Vol. 47 (2009), Issue 4, p. 605 – 624.
- Bernheim, B. Douglas, Daniel M. Garrett, and Dean M. Maki, “Education and saving: The long-term effects of high school financial curriculum mandates”, *Journal of Public Economics*, Vol. 80 (2001), Issue 3, p. 435 – 465.
- Bertaut, Carol C., and Martha Starr-McCluer, 2001, Household Portfolios in the United States, in Luigi Guiso, Michael Haliassos, and Tullio Jappelli eds.: Household Portfolios. (MIT Press, Cambridge and London) 181-217.
- Beshears, John, Katherine L. Milkman, and Joshua Schwartzstein, “Beyond Beta-Delta: The Emerging Economics of Personal Plans”, *American Economic Review: Papers and Proceedings*, Vol. 106 (2016), No. 5, p. 430 – 434.
- Campbell, Jeffrey R., and Zvi Hercowitz, “Welfare implications of the transition to high household debt”, *Journal of Monetary Economics*, Vol. 56 (2009), p. 1 – 16.
- Campbell, John Y., 2006, “Household Finance”, *Journal of Finance*, 61, 1553-1604.
- Choi, James J., David Laibson and Brigitte C. Madrian, “\$100 Bills on the Sidewalk: Suboptimal Investment in 401(k) Plans”, *Review of Economics and Statistics*, Vol. 93 (2011), No. 3, p. 748 – 763.
- Cox, D. R. 1972. Regression models and life-tables (with discussion). *Journal of the Royal Statistical Society, Series B* 34: 187–220.
- DellaVigna, Stefano and Ulrike Malmendier, “Paying Not to Go to the Gym”, *American Economic Review*, Vol. 96 (2006), No. 3, p. 694 – 719.
- Friedman, Daniel, Kai Pommerenke, Rajan Lukose, Garrett Milam, and Bernardo A. Huberman, “Searching for the sunk cost fallacy”, *Experimental Economics*, Vol. 10 (2007), Issue 1, p. 79 – 104.

- Fram, Eugene H., Andrew Callahan (2001), Do you know what the customer you penalized yesterday is doing today? A pilot analysis. *Journal of Services Marketing*, 15(6): 496-509,
- Frydman, Roman, “Towards and Understanding of Market Processes: Individual Expectations, Learning, and Convergence to Rational Expectations Equilibrium”, *American Economic Review*, Vol. 72 (1982) No. 4, p. 652 – 668.
- Gathergood, J., Sakaguchi, H., Stewart, N. & Weber, J. 2017. Learning, Liquidity and Credit Card Fees. *SSRN working paper* (Available at SSRN: <https://ssrn.com/abstract=2960004>)
- Greene, William H., *Econometric Analysis*, 5th edition, Pearson Education, Inc., New Jersey, 2003.
- Grubb, Michael D., “Overconfident Consumers in the Marketplace”, *Journal of Economic Perspectives*, Vol. 29 (2015a), No. 4, p. 9 – 36.
- Grubb, Michael D., “Consumer Inattention and Bill-Shock Regulation”, *Review of Economic Studies*, Vol. 82 (2015b), p. 219 – 257.
- Grubb, Michael D., and Matthew Osborne, “Cellular Service Demand: Biased Beliefs, Learning, and Bill Shock”, *American Economic Review*, Vol. 105 (2015), No. 1, p. 234 – 271.
- Grubb, Michael D., “Dynamic nonlinear pricing: Biased expectations, inattention, and bill shock”, *International Journal of Industrial Organization*, Vol. 30 (2012), p. 287 – 290.
- Grubb, Michael D., “Selling to Overconfident Consumers”, *American Economic Review*, Vol. 99 (2009), No. 5, p. 1770 – 1807.
- Hansen, Lars Peter and Kenneth J. Singleton, “Stochastic Consumption, Risk Aversion, and the Temporal Behavior of Asset Returns”, *Journal of Political Economy*, Vol. 91 (1983), No. 2, p. 249 – 265.
- Kim, Y.S.K. & Smith, A.K. 2005. Crime and Punishment: Examining Customers’ Responses to Service Organizations’ Penalties, *Journal of Service Research*, 8(2), 162-180.
- Laforet, Sylvie and Xiaoyan Li, “Consumers’ attitudes towards online and mobile banking in China”, *International Journal of Bank Marketing*, Vol. 23 (2005), Issue 5, p. 362 – 380.
- Lambrecht, Anja and Bernd Skiera, “Paying Too Much and Being Happy about It: Existence, Causes, and Consequences of Tariff-Choice Biases”, *Journal of Marketing Research*, Vol. 43, No. 2 (May 2006), p. 212 – 223.
- Lien, Jaimie W. and Jia Yuan, “Selling to Biased Believers: Strategies of Online Lottery Ticket Vendors”, *Economic Inquiry*, Vol. 53 (2015), Issue 3, p. 1506 – 1521.
- Liu, Matthew Tingchi and James L. Brock, “Antecedents of Redemption of Reward Points: Credit Card Market in China and International Comparison”, *Journal of International Consumer Marketing*, Vol. 22 (2009a), No. 1, p. 33 – 45.
- Liu, Matthew Tingchi and James L. Brock, “Redemption behavior for credit card reward programs in China”, *International Journal of Bank Marketing*, Vol. 27 (2009b), No. 2, p. 150- 166.
- Lovell, Michael C., “Tests of the Rational Expectations Hypothesis”, *American Economic Review*, Vol. 76 (1986), No. 1, p. 110 – 124.
- Lucas, Robert E., “Expectations and the Neutrality of Money”, *Journal of Economic Theory*, Vol. 4 (1972), p. 103 – 124.

- Lusardi, Annamaria, “Household Saving Behavior: The Role of Financial Literacy, Information, and Financial Education Programs”, *NBER Working Paper, No. 13824* (February 2008).
- McAfee, Preston R., Hugo M. Mialon and Sue H. Mialon, “Do Sunk Costs Matter?” *Economic Inquiry*, Vol. 48 (2010), Issue 2, p. 323 – 336.
- Meier, Stephan and Charles Sprenger, “Present-Biased Preferences and Credit Card Borrowing”, *American Economic Journal: Applied Economics*, Vol. 2, No. 1 (January 2010), p. 193 – 210.
- Miravete, Eugenio J., “Choosing the Wrong Calling Plan? Ignorance and Learning”, *American Economic Review*, Vol. 93 (2003), No. 1, p. 297 – 310.
- Miravete, Eugenio J., and Ignacio Palacios-Huerta, “Consumer Inertia, Choice Dependence, and Learning from Experience in a Repeated Decision Problem”, *Review of Economics and Statistics*, Vol. 96 (2014), No. 3, p. 524 – 537.
- Muth, John F., “Rational Expectations and the Theory of Price Movements”, *Econometrica*, Vol. 29 (1961), No. 3, p. 315 – 335.
- Narayanan, Sridhar, Pradeep K. Chintagunta, and Eugenio J. Miravete, “The role of self selection, usage uncertainty and learning in the demand for local telephone service”, *Quantitative Marketing and Economics*, Vol. 5 (2007) p. 1 – 34.
- Nunes, Joseph C., “A Cognitive Model of People’s Usage Estimations”, *Journal of Marketing Research*, Vol. 37 (2000), p. 397 – 409.
- Ru, Hong and Antoinette Schoar, “Do Credit Card Companies Screen for Behavioral Biases?” *NBER Working Paper 22360*, June 2016.
- Sharpe, Deanna L., Rui Yao and Li Liao, “Correlates of Credit Card Adoption in Urban China”, *Journal of Family Economic Issues*, Vol. 33 (2012), p. 156 – 166.
- Shen, N. 2014. Consumer rationality/irrationality and financial literacy in the credit card market: Implications from an integrative review. *Journal of Financial Services Marketing*, 19(1): 29-42.
- Stango, Victor and Jonathan Zinman, “What Do Consumers Really Pay on Their Checking and Credit Card Accounts? Explicit, Implicit, and Avoidable Costs”, *American Economic Review: Papers and Proceedings*, Vol. 99 (2009), No. 2, p. 424 – 429.
- Train, Kenneth E., Daniel L. McFadden, and Moshe Ben-Akiva, “The Demand for Local Telephone Service: A Fully Discrete Model of Residential Calling Patterns and Service Choices”, *Rand Journal of Economics*, Vol. 18 (1987), No. 1, p. 109 – 123.
- Train, Kenneth E., Moshe Ben-Akiva, and Terry Atherton, “Consumption Patterns and Self-Selecting Tariffs”, *Review of Economics and Statistics*, Vol. 71 (1989), No. 1, p. 62 – 73.
- Wang, Lili, Wei Lu and Naresh K. Malhotra, “Demographics, attitudes, personality and credit card features correlate with credit card debt: A view from China”, *Journal of Economic Psychology*, Vol. 32 (2011), p. 179 – 193.
- Worthington, Steve, David Stewart, and Xiongwen Lu, “The adoption and usage of credit cards by urban-affluent consumers in China”, *International Journal of Bank Marketing*, Vol. 25 (2007), Issue 4, p. 238 – 252.

Worthington, Steve, Frauke Mattison Thompson, and David B. Stewart, “Credit cards in a Chinese cultural context – The young, affluent Chinese as early adopters”, *Journal of Retailing and Consumer Services*, Vol. 18 (2011), p. 534 – 541.

Xiao, Junji and Heng Ju, “The determinants of dealership structure: Empirical analysis of the Chinese auto market”, *Journal of Comparative Economics*, Vol. 44 (2016), p. 961 – 981.

Appendix:

Table A1: Correlation between variables

	mismatch	contract choice	frequency of exceeding threshold	months in debt	Avg retail	Avg cash	Avg installment	SD retail	SD cash	SD installment	Referral status	college	male
mismatch	1												
contract choice	0.622***	1											
frequency of exceeding threshold	-0.150***	-0.0854***	1										
months in debt	-0.0126***	0.0352***	0.662***	1									
Average retail	0.0147***	0.0419***	0.245***	0.292***	1								
Average cash	0.0601***	0.0261***	0.110***	0.0906***	-0.0165***	1							
Average installment	0.0654***	0.0824***	0.118***	0.164***	0.107***	0.0864***	1						
SD retail	0.0261***	0.0422***	0.123***	0.135***	0.789***	-0.00866***	0.0710***	1					
SD cash	0.0858***	0.0352***	0.119***	0.115***	-0.0107***	0.816***	0.134***	0.0109***	1				
SD installment	0.0691***	0.0851***	0.118***	0.162***	0.104***	0.0723***	0.866***	0.0752***	0.129***	1			
Referral status	0.121***	0.173***	0.0405***	0.0796***	0.0548***	0.0450***	0.0220***	0.0340***	0.0451***	0.0257***	1		
college	0.0538***	0.127***	0.0489***	0.0390***	0.0414***	-0.0513***	0.0205***	0.0308***	-0.0446***	0.0288***	-0.00388***	1	
male	0.0983***	0.0620***	-0.0463***	-0.0275***	-0.0286***	0.140***	0.0461***	-0.00657***	0.157***	0.0428***	0.0571***	-0.0321***	1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$