

Payment Card Rewards Programs and Consumer Payment Choice*

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Abstract

By using a unique data set that contains detailed information on consumer perceived attributes of payment methods and consumer perceived acceptance of payment methods by merchants, we estimate the direct effects of rewards card programs on consumer payment choice for in-store transactions. Our estimation approach, which follows Harris and Keane [1999], allows us to alleviate the endogeneity problem of rewards. To shed light on the public policy debate on payment card fee structures, we conduct counterfactual experiments to examine the effects of removing rewards from credit and/or debit cards, and find that only a small percentage of consumers would switch from electronic to paper-based payment methods, and removing rewards from both credit and debit cards would reduce credit card transactions but increase debit card transactions.

Keywords: Consumer Choice, Payment Methods, Rewards Programs, Interchange fees

JEL code: C35, D12, M31

I. INTRODUCTION

Credit and debit card payments have been growing rapidly. To continue the growth, payment card networks keep adding new merchants to their networks. But adding new cardholders is becoming more difficult because most consumers in the United States already have both credit and debit cards.¹ To increase their market shares and card usage by existing customers, many U.S. card issuers have been offering attractive rewards programs. Since launching the new rewards programs, many issuers have seen increases in spending on both credit and debit cards.²

However, we know little about the sources of these increases. It is unlikely that rewards card users simply increase their spending on their credit and debit cards without changing their spending habits involving other payment methods. What payment methods are replaced by rewards credit and debit cards? To what extent do rewards card transactions replace other forms of payment transactions, such as cash and check transactions?

The answers to these questions would have important implications for the public policy debates on the current fee structure of payment cards. A typical fee structure for a credit or debit card transaction requires a merchant to pay a merchant discount fee to its acquirer, who processes card transactions for the merchant. The major part of the merchant discount fee covers the interchange fee, which is transferred from acquirers to card issuers. In some countries, including the United States, card issuers typically pass part of their interchange fee revenue to their cardholders as rewards. But in several countries, public authorities require the interchange fees to be set based on the cost-based benchmark that excludes the cost of providing rewards. After these regulations have been implemented, rewards values become significantly lower in these countries. The reasons for

¹ According to 2001 Survey of Consumer Finance (SCF) conducted by the Federal Reserve, 76 percent of U.S. households hold at least one credit card and 70 percent hold an ATM/debit card.

² See, for example, *ATM&Debit News*, August 25, 2005 and December 22, 2005.

these regulations are that rewards lead to distorted price signals to consumers, and may cause some consumers to choose socially less efficient payment methods (e.g., Simon [2005]). Rewards might have other negative impacts on the society. For example, if most consumers simply substitute rewards credit (debit) card transactions for non-rewards credit (debit) card transactions, rewards might be just monetary transfers among merchants and consumers. In this case, rewards would not improve their total welfare, but the society would incur additional costs to maintain rewards programs. Moreover, more generous rewards may lead to higher merchant fees, which in turn cause merchants to set higher prices for final goods and services. Thus, rewards may potentially harm consumer welfare by raising prices. In contrast, proponents of payment card rewards argue that rewards can reduce total costs to the economy by inducing enough consumers to switch from a more costly payment method, such as checks, to a less costly (and/or more beneficial) payment method, such as credit and debit cards.³ They may also increase the gross benefits of merchants and card issuers by increasing the total number/value of transactions.⁴ The exact welfare consequences of rewards programs depend on both the social costs of various payment methods and how rewards programs affect consumers' choice of payment methods. This paper will focus on the latter—providing empirical evidence on how rewards programs influence consumer payment choice.

To the best of our knowledge, this is one of the first studies that empirically examine the effects of rewards on consumer payment choice. We exploit a unique consumer survey data set and estimate a series of multinomial logit models that explain how the following consumer characteristics are related to the payment choice across retail types: demographics, income, technology adoption, and most importantly, the presence or absence of rewards with credit cards

³ Reserve Bank of Australia [2007] found that checks are most expensive payment methods in Australia. According to Garcia-Swartz, et. al. [2006], resource costs of checks are generally higher than those of cards in the United States.

⁴ Several studies suggest that payment methods may affect consumers' willingness-to-pay for goods they purchase at the point of sale. See for example, Prelec and Simester [2001] and Soman [2001].

and/or debit cards. By using the parameter estimates, we conduct policy experiments to quantify the effects of removing reward features from payment cards on consumer payment choice. According to the experiences of some countries, card issuers would likely reduce the value of rewards dramatically under the cost-based interchange fees that exclude rewards costs. Our policy experiments allow us to shed light on the current policy debates about the payment card fee structure along this direction.

Our unique data set allows us to alleviate two problems when estimating the direct effects of rewards programs.⁵ The first problem is deciding whether to obtain rewards payment cards could be endogenous. It is likely that a typical individual who chooses to obtain a rewards credit/debit card would use it relatively more often, regardless of whether the card offers rewards. To handle this problem, we adopt the method proposed by Harris and Keane [1999], who used attitudinal data to control for unobserved consumer heterogeneity. Our data set provides detailed measures of individual perceptions toward each payment method. We use these measures to control for unobserved consumer heterogeneity in preferences for various payment methods.

The second problem is that some consumers may perceive that only a subset of payment methods is available to them at a retail store, and thus, the choice set of payment methods may vary across consumers. Ignoring the variation of choice sets could lead to biased estimates of the parameters (Bronnenberg and Vanhonor [1996]). Our data set, which provides information on each individual's choice set, allows us to control this factor in the estimation. Without this information, one would need to use panel data and make strong assumptions about the process of choice set formation in order to take choice set heterogeneity into account (e.g., Mehta, Rajiv, and

⁵ By direct effects, we mean the presence of rewards on credit/debit cards could change consumers' current utility of using credit/debit cards. Rewards could also induce consumers to experiment and learn the attributes of credit/debit cards – we will refer this to indirect effects of rewards. Section V will give more detailed explanations about direct and indirect effects.

Srinivasan [2003]). In contrast, we are able to bypass this hurdle and avoid the possibility of misspecifying the endogenous process of how individuals form their choice sets.

Our results indicate that including attitudinal data (i.e., consumer perceived payment method attributes) and controlling for choice set variation produces a substantial improvement in model fit and interpretation of estimated parameters, particularly the effects of rewards programs. The results from the policy experiments suggest that although removing rewards today would cause some consumers to switch from electronic payment methods (credit/debit cards) to paper-based methods (cash/check), the percentage of those consumers are relatively small. The majority of consumers who currently receive rewards on credit and/or debit cards would continue to use those payment methods even if rewards were no longer offered. We also find that removing rewards would reduce credit card transactions but increase debit card transactions at a given type of stores. The paper-based transactions would also be increased but the size of the increase might be small. Although there are some variations, these results are consistent across five types of retail stores we examine in the paper.

The rest of the paper is organized as follows. Section II provides the industry background. Section III reviews previous literature. Section IV describes the data set. Section V discusses the empirical model. Section VI presents the results and discusses their implications. Section VII concludes the paper.

II. INDUSTRY BACKGROUND

Credit card rewards have more than twenty years of history. In 1984, Diner's Club first introduced a reward program which offered airline miles to cardholding customers. In the early 1990s, rewards programs have become more diversified. For example, some issuers offer a cash-back bonus based on the purchase volume; some offer discounts on product sold by co-branded card

issuers; and some let their cardholders donate rewards points to organizations, such as charities, alumni associations, or environmental groups. As competition for cardholders intensified, issuers started offering more generous rewards. Today, some large issuers offer three to five percent of cash back bonus on purchases at certain types of retailers and one percent on other purchases. Payment card networks, such as MasterCard and Visa, recently introduced a new credit card product category called World and Signature, respectively, that offers much more generous rewards than traditional product categories, such as Gold and Platinum.

In contrast, debit card rewards are relatively new. There are two types of debit card products in the United States. One is called PIN debit—consumers type personal identification number at the point of sale to authorize the transaction, and the other is called signature debit—consumers sign the receipt to authorize the transaction. A typical U.S. debit card can carry out both PIN and signature debit transactions. However, consumers are more likely to receive rewards when they make signature debit transactions. According to a study by Dove Consulting [2007], 37 percent of depository institutions surveyed offer debit card rewards in 2006. Among them, 63 percent offer rewards for signature debit transactions only and the rest of them offer rewards for both PIN and signature debit transactions.

Payment card rewards are partly (if not fully) financed by fees charged to merchants. One of the fees merchants pay is interchange fees, which are received by card issuers. The total annual interchange fee revenue of MasterCard and Visa card issuers was estimated around \$30 billion in 2006;⁶ and according to Dawson and Hugener [2006], rewards account for 44 percent of interchange fees in the United States. A merchant pays different interchange fee rates for credit card transactions: non-rewards cards have the lowest fee rates, while high-end rewards cards have the highest rates. For example, MasterCard and Visa set the interchange fee rates for a non-rewards

credit card transaction at a retail store between 1.43 and 1.58 percent, while they set the interchange fee rates for a high-end rewards credit card transaction at a retail store between 1.53 and 2.2 percent. In contrast, interchange fee rates for debit card transactions do not vary by whether the card offers rewards or not. PIN debits have the lowest interchange fee rates, which range from around 0.3 to 0.75 percent, and they have an interchange fee cap around 65 cents. Interchange fee rates for a signature debit transaction range between 0.62 and 1.05 percent, which are lower than interchange fee rates for a credit card transaction, but higher than those for a PIN debit transactions. This likely reflects the level of signature debit rewards: They are less generous than those of credit cards but more generous than those of PIN-debit cards.

Because of the variety of rewards programs and complexity of reward structure, it is difficult to obtain the average reward rates for credit cards and debit cards. But, according to the industry experts, the value of the rewards received by cardholders in a typical credit card rewards program is about one percent of the purchase value, while that in a typical debit card rewards programs is about a quarter of one percent.⁷

III. PREVIOUS LITERATURE

The previous studies highlighted three important sets of factors that affect consumer payment choice: consumer characteristics, transaction characteristics, and payment method attributes. Some studies (e.g., Kennickell and Kwast [1997], Stavins [2001], and Klee [2006a]) found that demographic and financial characteristics of consumers are correlated with the use of payment methods. Hayashi and Klee [2003] found that adoption of new technologies, such as online purchases and direct deposits, influences consumer's new payment method adoption decision

⁶ Green [2007] estimated around \$23 billion and other sources, such as finextra.com, estimated more than \$30 billion.

⁷ According to the remarks by Tony Hayes at the “*Consumer Behavior and Payment Choice*” conference at the Federal Reserve Bank of Boston in 2006. See page 23 of Carten et. al. [2007].

of debit cards and online bill payments. They also found that transaction characteristics, such as value of transaction and physical environment, likely influence consumer payment choice. Hirschman [1982], Mantel [2000], Jonker [2005], and Klee [2006b] found that payment method attributes or those perceived by consumers are strongly correlated with consumer payment choice. When estimating the effects of rewards on consumer payment choice, our study will control for these three sets of factors.

Another important factor that could affect payment choice is the price of payment methods. Most previous studies did not include this factor because very few data sets contain price information in conjunction with consumer payment choice. There are a few exceptions: Humphrey, Kim, and Vale [2001] estimated price elasticity for various payment methods by using Norwegian aggregate level data; Amromin, Jankowski, and Poter [2005] examined how consumers respond to differentiated pricing of cash and electronic toll payment on the Illinois tollway; and Borzekowski, Kiser, and Ahmed [2006] examined how fees assessed by banks on debit card transactions affect consumer payment choice. All of them suggest that consumers are price sensitive. Our paper investigates the impact of rewards programs on consumer payment choice. Although whether a consumer receives rewards is not price information per se, it can be viewed as a proxy for negative per-transaction fees of credit and/or debit cards. Thus, to some extent, our study estimates how sensitive consumers are with respect to the price of using a payment method.

Merchant acceptance of payment methods is also an important factor that could affect consumer payment choice, but due to data limitation, previous studies did not consider this factor. Rysman [2007] is an exception. He found that a consumer's favorite card network is positively correlated with the number of local merchants who accept that network's cards. Our paper considers this factor in a different way. Since our data includes information on consumer perceived

acceptance of payment methods by retail type, we control for heterogeneity in consumer choice set of payment methods by using this information.

IV. DATA

Our data set is the 2005/2006 Study of Consumer Payment Preferences conducted by the American Bankers Association and Dove Consulting. Data were collected using paper and Web-based surveys sent to U.S. consumers in 2005 and a total of 3,008 completed surveys (2,350 via the Web and 658 on paper) were received. Although the survey sample is not nationally representative, the survey contains rich information about consumer payments, which is usually not available in the nationally representative data sources.⁸ Key features of our data are as follows.

First, our data set includes information on whether a consumer received rewards for using credit card and debit card, respectively. This allows us to examine whether credit/debit rewards receivers' payment choice is different from non-rewards receivers'.

Second, in addition to individual demographic characteristics, the survey asked each respondent to provide his/her perceptions toward each in-store payment method. Typically, a consumer's perceptions are not easily observed. Even when they are observed, empirical researchers rarely incorporate them into their econometric analysis. We will argue that this type of data allows us to control for the unobserved consumer heterogeneity that could lead to severe bias in estimates of the effect of rewards programs.

Third, the survey asked about the most frequently used payment method by retail type, which includes grocery stores, department stores, fast food restaurants, discount stores, and drug stores. A respondent chooses one out of five payment methods—cash, check, credit card, PIN-debit card, and signature-debit card. We interpret the most frequently used payment method as the

payment method chosen by the consumer when estimating an individual level discrete choice model. Although our data set does not contain information on transaction characteristics, the variation of transaction characteristics may be limited conditioning on the retail type. For example, transaction values made in fast food restaurants are typically quite small. To some extent, this type of data allows us to control for the transaction characteristics.

Lastly, the survey asked about which payment method the respondent believes is accepted by merchants in each retail type. We assume that a payment method belongs to a consumer's choice set in a particular retail type if the consumer believes it is accepted by merchants of that retail type. This allows us to control for consumer heterogeneity of choice set, which could also lead to bias in parameter estimates.

We construct our sample by excluding consumers who have missing information regarding consumer characteristics, perceptions toward in-store payment methods, and card-related status, such as a balance on credit card and rewards on credit and/or on debit cards. We also exclude consumers who do not have a bank account or do not hold either a credit or debit card because our focus is to examine the difference in payment choice between rewards receivers and non-rewards receivers, not between cardholders and non-cardholders. This process leaves a total of 1,979 responses. Compared with the general U.S. population, income, educational levels, and technology adoption rates are relatively higher in our sample (Table I). The bottom of Table I show statistics regarding rewards. About 36 percent of consumers receive rewards via either credit card, debit card, or both.⁹ Approximately 32 percent of our sample receive rewards on credit cards and 14 percent receive rewards on debit cards. About 9 percent of our sample receive rewards on both

⁸ For instance, Survey of Consumer Finance (SCF), which is conducted triennially by the Federal Reserve, contains much less information on consumer payment than our data.

⁹ We will discuss if the share of consumers who receive rewards in our sample is too low or too high and how it affects our results in Appendix A.

credit and debit cards. Almost all consumers who receive rewards on debit cards receive rewards when they make signature-debit transactions and only half of them receive rewards when they make PIN-debit transactions.

Table I also compares the characteristics of rewards receivers (either on credit cards or debit cards) with those of the entire sample. Consumers who have higher income, higher educational levels, and tendency to adopt new technology are more likely to hold rewards cards. Rewards card holdings also vary by gender, ethnicity, and residential region, but not by age.

Table II provides summary statistics on consumer perceived payment method attributes. 11 attributes of each payment method perceived by consumers are reported. They are: Comfortable, Fast, Convenient, Easy to use, Preferred by stores, Safe, (money) Taken right away, Help me budget, For small amounts, Control over money, and Easy-to-get refund. The average scores for cash and check are calculated using all consumers in the sample, and those for credit, PIN-debit, and signature-debit cards are calculated separately for reward card holders and for non-reward card holders. Cash tends to be perceived more positively, while check tends not to. Not surprisingly, credit and signature-debit cards are perceived more positively by consumers with credit card rewards and signature-debit rewards, respectively, than consumers without those rewards. Compared with these two cards, the differences in perceptions for PIN-debit cards by consumers with and without PIN-debit rewards are less clear.

Table III presents the percentage of consumers who perceive each payment method to be accepted by retail type. Cash is perceived to be the most widely accepted by grocery stores, discount stores, drug stores, and fast food restaurants. Credit card is perceived to be the most accepted by department stores. PIN-debit cards are perceived to be less widely accepted than credit cards but more widely accepted than signature-debit cards. Interestingly, some consumers are not

aware that almost all stores that accept credit cards also accept signature-debit cards—their differences in perceived acceptance rates range from 20 to 30 percentage points across retail types. The perceived acceptance rates of checks lie between those of cash and credit cards except at fast food restaurants, at which only 11 percent of them perceive checks to be accepted.

Figure I presents the share of consumers who chose a particular payment instrument as their most frequently used payment method by retail type. Panel (A) shows the overall share by retail type. It is clear that consumer payment choice varies by store type, which likely implies that transaction characteristics significantly affect consumer payment choice. Panel (B) shows more detailed share for grocery store transactions. Consumers are grouped into eight groups, according to their credit card balance, debit card rewards, and credit card rewards status. These card rewards and credit card balance status appear to be highly correlated with consumer payment choice. In particular, consumers in Group 6, which consists of individuals without a credit card balance, without debit card rewards, and with credit card rewards, are more likely to choose credit card as their most frequently used payment method than consumers in any other groups. Although we do not show them here, we observe similar patterns of consumer payment choice in the other four retail types.

V. ESTIMATION

This section discusses the econometric model specifications. For each retail type, we estimate four specifications of a multinomial logit model that explains which payment method is chosen by the consumers as the most frequently used method.

We first discuss a specification by assuming a typical situation faced by econometricians, where the data on consumer perceptions toward each payment method were not available. This specification will help us explain the endogeneity problem of the rewards program. We assume that

utility to consumer i from using payment method j when making a transaction at retail type h is defined as follows:

$$(1) \quad U_{ijh} = \alpha_{jh} + X_i \beta_{jh} + C_{ij} \delta_{jh} + \varepsilon_{ijh} + e_{ijh},$$

where X_i is a vector of consumer characteristics; C_{ij} is a vector of card-related dummies; ε_{ijh} captures the unobserved consumer preferences for payment method j at retail type h ; and e_{ijh} captures the measurement errors and is assumed to be *i.i.d.* α_{jh} measures the mean utility from payment method j at retail type h , regardless of consumer characteristics and card-related status. β and δ are vectors of utility weight for X_i and C_{ij} , respectively. In particular, δ captures the direct effect of the card-related dummies (including the rewards dummies). For each retail type h , consumer i chooses a payment method j to maximize his/her utility. There are five payment options: credit card, PIN-debit card, signature-debit card, check, and cash.

If C_{ij} is uncorrelated with ε_{ijh} and e_{ijh} , one can estimate this specification using a multinomial logit or probit model and obtain consistent estimates on the reward dummies. However, it is likely that the dummies for rewards programs are positively correlated with ε_{ijh} . This could be due to three reasons. First, some consumers choose to get a rewards credit/debit card because they had been using this payment method relatively more often due to higher ε_{ijh} . The benefits of obtaining rewards cards for them are relatively higher and hence they are more likely to spend search costs (or in some cases they may pay an annual fee) to join a rewards program that suits them well. Second, in order to compete for market shares, card issuers may send pre-approved rewards credit/debit card invitations to consumers who have been heavily using credit/debit cards. It is very likely that these consumers have higher ε_{ijh} . Third, rewards programs may have an indirect effect on consumers' choice of credit/debit cards by improving consumers' attitudes toward those

cards. Some consumers may have had seldom used credit/debit cards prior to receiving a rewards card, but the incentive of earning rewards may have induced them to use the card more often. Since then they may have learned the good features of credit/debit cards and changed their attitudes toward credit/debit cards more favorably (i.e., improving ε_{ijh}). Thus, consumers who have a rewards credit/debit card may have higher ε_{ijh} than consumers who do not have a rewards card. Because of this positive correlation between C_{ij} and ε_{ijh} , the effects of the reward dummies in the specification defined as equation (1) would probably be overestimated.

To handle this positive correlation, our approach here is to use the data on consumer perceptions toward payment methods as a proxy for ε_{ijh} . The idea is that if we can control for ε_{ijh} , then it is possible to obtain consistent estimates of the effect of rewards programs. As pointed out by Harris and Keane [1999], using consumer attitudinal data to control for unobserved consumer heterogeneity is an alternative to the conventional econometric approach of using instrumental variables.¹⁰ But, unlike instrumental variables, this approach works in non-linear models, such as the multinomial logit model considered here. As attitudinal data, we use 11 consumer perceived attributes of each payment method discussed in section IV. It is important to note that (i) this type of attitudinal data is not typically observed and (ii) all of them are subjective measures reported by individual consumers, which could potentially capture a significant amount of consumer heterogeneity in preferences. In the full specification of our model, utility to consumer i from using payment method j when making a transaction at retail type h is defined as follows:

$$(2) \quad U_{ijh} = \alpha_{jh} + X_i \beta_{jh} + C_{ij} \delta_{jh} + Z_{ij} \gamma_h + e_{ijh},$$

¹⁰ Horsky, et. al. [2006] also show that one can improve parameter estimates of brand choice models after incorporating consumer attitudinal data. Also see Louviere, et. al. [2000] for discussions of merging market and consumer self-stated attitudinal/preference data in choice modeling.

where Z_{ij} is a vector of attributes of payment method j evaluated by consumer i . We normalize the utility of choosing cash as:

$$(3) \quad U_{i \text{ cash } h} = Z_{i \text{ cash } h} \gamma_h + e_{i \text{ cash } h}.$$

It is worth pointing out that we do not assume a priori that the attitudinal data are a good proxy for individual level preferences. Instead, we will let the choice model tell us whether the attitudinal data is informative or not. As shown in the next section, the attitudinal data improve the fit of our model significantly.

There are two limitations in our approach. First, the full specification does not capture the indirect effect of rewards, which improves ε_{ijh} . As discussed above, this indirect effect could be due to consumer learning of the good features of credit/debit card, and therefore, the panel data which follows the individual consumer's perception changes over time may be required to identify this indirect effect. Since our data is cross-sectional, we cannot explicitly estimate the indirect effect of rewards here. Another limitation of our econometric specification is that the coefficients for reward dummies (δ_{jh}) are assumed to be homogeneous across consumers. Conceivably, they could be heterogeneous and another selection problem may exist. Consumers who choose to obtain a rewards card are likely to be more sensitive to rewards (i.e., they have relatively high value of δ_{ijh}). This heterogeneity in δ_{ijh} , however, cannot be controlled for by using consumer perceptions because none of the survey questions asked about how they value rewards.¹¹ If this selection problem is important, we may overestimate the mean effects of rewards. We therefore note that it is more appropriate to interpret our estimates on the reward dummies as the upper bound of the mean effect of rewards on payment choice.

¹¹ One way to address this selection problem is to make a distributional assumption on δ_{ijh} and model the consumer decision to get a rewards card explicitly by using a two-stage model. In the first stage consumers decide whether to hold rewards cards and in the second stage they choose which payment method to use. One could use simulation-based

We estimate four model specifications. They depend on whether the specification includes consumer attitudinal data, and whether the set of payment methods available to consumers is homogeneous or heterogeneous across consumers. As for the homogeneous choice set, we assume that all consumers can select from five payment methods: credit card, PIN-debit card, signature-debit card, check, and cash. As for the heterogeneous choice set, we assume that an individual's choice set consists of payment methods that the individual believed are accepted at a given type of store.

Controlling the variation of individual's choice set is potentially important, but it is difficult to tell which specification—homogeneous or heterogeneous choice set—is more appropriate a priori. If a consumer's decision about which retail stores to visit does not depend on the payment methods accepted by the stores, modeling choice sets to be heterogeneous will be more accurate and help avoid misspecification bias. If, on the other hand, consumers choose which payment method to use before choosing which stores to visit (i.e., they only visit stores that accept their most preferred payment method), then the homogeneous choice set will be more appropriate in capturing the consumer's choice behavior over payment methods. In general, the reality probably lies somewhere between these two extreme situations. This is why we estimate both specifications to see how robust the results are.

VI. RESULTS

VI.A. Estimation of the Most Frequently Used Payment Method by Retail Type

estimation methods, but this is computationally very demanding (more than 300 parameters need to be estimated jointly) and beyond the scope of this paper.

The estimation results are reported in Tables IV and V.¹² Because of the missing information about the most frequently used payment method in a given type of store, the sample size reduces to 1,915 for grocery stores; 1,798 for department stores; 1,761 for discount stores; 1,846 for drug store; and 1,813 for fast food restaurants. Table IV shows the log-likelihood of all four specifications for the five types of retail stores. The table confirms that including attitudinal data improves the fit of our model significantly. Under the homogeneous choice set, including attitudinal data improves the log-likelihood the most for grocery stores (by 920) and the least for fast food restaurants (by 230). For department, discount, and drug stores, the log-likelihood is improved by about 600 to 700. This is also true when the choice set is allowed to vary by individual, although the magnitude of improvement is smaller. These results suggest that the consumer's perceptions toward each payment method capture a large amount of consumer heterogeneity in preferences for payment method at all five types of stores. The table also reveals that allowing for heterogeneous choice set improves log-likelihood significantly: Without consumer perception variables (specifications 1 and 3), the improvement in log-likelihood ranges from 442 (fast food restaurants) to 856 (discount stores); with consumer perception variables (specifications 2 and 4), the improvement in log-likelihood ranges from 281 (grocery stores) to 607 (discount stores). This indicates that including the information on choice set has also improved the goodness-of-fit significantly.

Table V presents coefficients for reward dummies as well as for a dummy that indicates whether a consumer has zero balance on credit cards or not. The results are consistent with our endogeneity arguments discussed in the previous section. Regardless of whether we model choice sets to be homogeneous or heterogeneous, these dummies have consistently become less significant

¹² Due to the space constraint and the focus of this paper, we do not report the estimates of the consumer characteristics and perceptions. We report them in Appendix B.

across retail types after incorporating the perception variables (see specification 1 vs. 2 and 3 vs. 4). In particular, rewards on PIN-debit are significant in specifications 1 and 3 for grocery and drug stores, but they become insignificant in specifications 2 and 4. This suggests that the endogeneity problem is not merely a theoretical concern. The point estimates of the reward dummies have also consistently reduced after incorporating the perception variables. However, due to the non-linear nature of the multinomial logit model, we cannot interpret this as evidence that the reward dummies are overestimated if the perception variables are missing. In the following subsection, we will demonstrate the magnitude of the bias by showing how the choice probabilities change as we move from specifications without perception variables to ones with perception variables.

Although the estimates have become less significant after controlling for the perception variables, the credit card reward dummy remains statistically significant for all types of retail stores and the signature-debit reward dummy remains significant for all retail types but fast food restaurants.¹³ We interpret this as evidence that the rewards on credit and signature-debit cards increase consumers' likelihood of choosing these payment methods. After incorporating the perception variables, the dummy indicating zero balance on credit cards remains positive and significant for grocery stores, drug stores and fast food restaurants. This suggests that although carrying a credit card balance discourages consumers to use a credit card at these three retail types, it does not have any significant effects on their choice at department and discount stores. This may be because the transaction value at department and discount stores is typically larger than that at other retail types and consumers may feel natural to use a credit card to borrow from their future incomes when purchasing items that are relatively more expensive.

¹³ It seems reasonable that rewards on debit cards are insignificant at fast food restaurants because rewards on debit cards are typically less generous and the dollar value of transactions at fast food restaurants is usually small.

The results confirm that the perception variables are able to control for a large extent of consumer heterogeneity in their preferences for payment methods. The coefficients in the specification with homogeneous choice set (i.e., specification 2) are remarkably similar to those in the specification with heterogeneous choice set (specification 4). This indicates that our results are robust regardless of how we model consumers' choice sets.

VI.B. Effects of Removing Rewards

One of our goals is to address the following question: how would consumers change their payment choice if their payment cards no longer offer rewards? The answer to this question is relevant to the current policy debates on interchange fees or payment card fee structures. Recently, public authorities in several countries have regulated or scrutinized interchange fees.¹⁴ Most notably, in 2003 the Reserve Bank of Australia mandated three credit card networks to set interchange fees based on the cost-based benchmark, which excludes the costs of providing rewards. As a result, interchange fees have been lowered substantially and the value of rewards has also been greatly reduced in Australia.¹⁵ Since a substantial portion of the interchange fees is used to cover the costs of rewards programs in the United States, the policy experiments conducted here allow us to shed light on the consequences of the same policy as in Australia or a policy of disallowing card issuers to provide rewards to their card customers.¹⁶

To quantify the effects of payment card rewards on payment choice, we conduct two policy experiments that remove the reward features of 1) credit cards and 2) both credit and debit cards. We use specification 4, which includes perception variables and assumes heterogeneous consumer choice set, because of its superior goodness-of-fit. We note that the results are robust even if we

¹⁴ See Bradford and Hayashi [2008].

¹⁵ See Table 7 (p.12) of the 2006 Payments System Board Annual Report by the Reserve Bank of Australia.

¹⁶ In 2008, two bills regarding interchange fees and other network rules were introduced in the U.S. Congress.

use specification 2, which includes perception variables and assumes homogeneous consumer choice set. Our key identification assumption is that consumer perceptions toward payment methods would remain unchanged after rewards were removed. We believe that this is a reasonable assumption. Some consumers may have improved their perceptions toward payment cards after joining a rewards program, which induces them to use payment cards more frequently. However, once they learned the cards' features, their attitudes toward payment cards (such as Comfortable, Fast, etc) would likely remain unchanged even if consumers no longer receive rewards.

VI.B.1. Effects of Removing Rewards on Credit Cards

We now discuss the results from our first policy experiment: what would happen if rewards on credit cards were removed today? Obviously, this policy experiment only affects consumers who currently receive rewards on credit cards. We divide these consumers into two groups: (i) consumers who receive rewards on credit card only (CC rewards only) and (ii) consumers who receive rewards on both credit and debit cards (CC&DC rewards). For each group, we calculate the average probability of choosing each of the five payment methods before and after the policy is implemented. Figure II shows the effect of the policy on these two groups of consumers in five types of retail stores separately: grocery (G), department (De), discount (Di), drug (Dr), and fast food (F). Each retail type is represented by a bar. The height of the entire bar represents the probability of choosing credit cards before the policy is implemented, and the blue area represents the probability of choosing credit cards after the policy is implemented. The red and yellow areas represent the increases in the probability of choosing either type of debit cards and the probability of choosing paper-based methods (cash and checks), respectively, after the policy is implemented. The left five bars show the effects on the first group of consumers and the right five bars show the effects on the second group.

Both groups of consumers would reduce their probabilities of choosing to pay with a credit card at all types of stores if rewards on credit cards were removed. The reductions range from 3.3 (F) to 11.4 (G) percentage points for consumers with CC rewards only, and from 2.5 (F) to 10.1 (De) percentage points for consumers with CC&DC rewards. Grocery and department stores have the largest percentage point reduction (around 10 percentage points), while fast food restaurants have the smallest. This is probably because rewards are typically expressed in terms of percentage of the transaction value. The average transaction value at department store is typically larger while that at fast food restaurants is much smaller. Thus, the effect of rewards on consumer's payment choice is greater at the stores where the average transaction value is higher. Overall, although the reductions in probability of choosing credit cards vary across retail types, their magnitudes are moderate. Assuming that reward credit cardholders always use the rewards credit card before the policy is implemented, and the number of transactions made by each consumer remains unchanged under this policy experiment, our results indicate that the majority of rewards credit card transactions would be replaced by non-rewards credit card transactions if rewards on credit cards were removed.

How do the substitution patterns vary between two groups of reward credit card holders and across types of stores? For consumers with CC&DC rewards, the likelihood of switching to debit cards is much higher than that to paper-based methods except at fast food restaurants. In contrast, for consumers with CC rewards only, the likelihood of switching to debit cards is slightly lower than that to paper-based methods except at department stores. This is quite intuitive because consumers with CC&DC rewards have more incentives to use a debit card than consumers with CC rewards only. These results are consistent with the common beliefs that consumers prefer cash for small value transactions and they prefer payment cards for large value of transactions.

It would be worth discussing what happens if we conduct the same policy experiment by using specification 3, which does not include perception variables (but assumes heterogeneous consumer choice set). By comparing the policy experiment results from specifications 3 and 4, we are able to quantify the importance of controlling for consumer heterogeneity in consumers' attitudes toward payment methods when examining the effect of removing rewards. Figure III shows the effects of the policy using specification 3. It is clear that the predicted reductions in the probability of choosing credit cards due to the policy are much larger when using specification 3. For example, at grocery stores, specification 3 predicts that more than half of the rewards credit card transactions would be replaced by debit cards and paper-based methods, almost double the prediction of specification 4. This implies that the estimated increases in the likelihood of choosing paper-based methods and debit cards are both likely to be higher under specification 3. These findings confirm the importance of incorporating consumer perceptions toward payment methods: the policy experiments based on a model without perception variables could generate misleading policy implications. It is possible that specification 4, which incorporates perception variables, would suggest the policy of removing credit card rewards today would result in cost-saving for the society, while specification 3, which does not incorporate perception variables, would suggest that the same policy would be more costly because it over-predicts consumer's substitution of paper-based transactions for card transactions.

VI.B.2. Effects of Removing Rewards on both Credit and Debit Cards

Second, we consider the policy that removes rewards on both credit and debit cards. This policy affects three groups of consumers: (i) consumers with rewards on credit cards only, (ii) consumers with rewards on debit cards only, and (iii) consumers with rewards on both credit and debit cards. Because the effects of this policy on the first group of consumers are the same as those

of the first policy analyzed in the previous subsection, we will consider the effects on the second and third groups here.

Figure IV shows the effects on the consumers with rewards on debit cards only. In this figure, the height of the bar (measured from 0 percent) represents the probability of choosing debit cards before the policy is implemented. At all types of stores except fast food restaurants, they would reduce their probability of choosing debit cards if rewards on debit cards were removed.¹⁷ In general, the reductions are very small and they range from 2.1 (Di) to 6 (Dr) percentage points. This may reflect the fact that rewards on debit cards are typically less generous. The probability of choosing paper-based methods would slightly increase and it ranges from 1.4 (Di) to 4.3 (Dr).

Figure V shows the effects on the consumers with rewards on both credit and debit cards. In the figure, two bars are shown for each type of stores: the left bar represents the probabilities of choosing credit cards, debit cards, and paper-based methods before the policy is implemented, and the right bar represents the probabilities after the policy is implemented. These consumers would reduce their probability of choosing credit cards at all types of stores; however, the reductions in the probability of choosing credit cards under this policy are much smaller than those under the first policy. For example, the probability of choosing credit cards at grocery store would be reduced by 6.9 percentage points under the first policy, while it would be reduced by 4.8 percentage points under this policy. On average, the probabilities of choosing debit cards would decrease at grocery and drug stores, while they would increase at department stores, discount stores, and fast food restaurants. The probability of choosing paper-based methods would increase at all types of stores, and the increases range from 1.0 (F) to 6.3 (Dr) percentage points.

VI.B.3. Overall Effects of Removing Rewards

We have shown how the policies that remove rewards on payment cards affect consumers who currently receive rewards. How to interpret these results? Policymakers would want to know the overall effects of the policies—how the changes in these consumers’ payment choice affect the entire payments market. However, aggregating the effects is very difficult. First, our analysis is limited to consumer payment choice for in-store transactions, but consumers also make payments for bills and online purchases. Second, even among the five retail types, it is still difficult to aggregate the effects of the policies because the number of transactions each consumer makes at each type of stores is not observed. Therefore, instead of examining the aggregate effects on the entire payments market, we focus on examining the aggregate effects at each of the five retail types. The analysis may still be useful for policymakers because transactions at these five retail types are likely to account for a large share of in-store transactions. For each retail type, we calculate the average probabilities of choosing certain payment methods (credit cards, debit cards, or cash and checks) of all consumers in our sample before and after implementing the policy. If we assume that all consumers make the same number of transactions at a given type of stores, then the average probabilities can be translated into the share of certain payment methods at each type of stores. Although this is a strong assumption, this gives us an idea of how the policies impact the payment transaction share at each type of stores. Combined with costs of various payment methods at each type of stores, one could extend our results to measure the end-users’ welfare changes due to the policies of removing rewards.

Table VI presents how the average probabilities of choosing credit cards, debit cards, and paper-based methods would change after the policy is implemented. Removing rewards on credit cards (policy 1) would reduce the credit card share by just above 3 percentage points at grocery and

¹⁷ Debit reward dummies for fast food restaurants are estimated to be negative, although they are statistically insignificant.

department stores, by about 2 and 2.4 percentage points at drug and discount stores, respectively, and by 1 percentage point at fast food restaurants. The reductions in credit card transactions are distributed almost equally between debit card and paper-based transactions at grocery and discount stores, while they are replaced more by debit card transactions at department stores and by paper-based transactions at drug stores and fast food restaurants. The share of paper-based transactions would increase by at most 1.65 percentage points. Removing rewards on both credit and debit cards (policy 2) would decrease the credit card shares but increase debit card share at all types of stores. The reduction in credit card share would be no more than 3 percentage points and the increase in paper-based methods share would be slightly over 2 percentage points at most.

Overall, our results suggest that removing rewards today would not reduce the aggregate share of payment cards transactions very much. At a given type of stores, the percentage of transactions that would be switched from electronic payment method to paper-based method is likely quite small (at most slightly over 2 percentage points).

Three limitations of this analysis should be noted. First, our sample excludes consumers who do not hold any bank accounts, credit cards, or debit cards. Since these consumers are mainly cash users, if we include them in the analysis, the aggregate effects of removing rewards would likely be even smaller. Second, it seems implausible that all consumers distribute their transactions across the five retail types in one common way. If rewards card holders tend to make more transactions than the rest of consumers at certain types of stores, then the effect at those types of stores may potentially be underestimated. Third, the share of rewards card holders in our sample may relatively be small compared with other surveys. It is possible that some respondents who hold rewards cards reported otherwise. If this is the case, the effect could be underestimated. We address

this measurement issue and conduct robustness check in the Appendix A. Our robustness check suggests that the underestimation caused by this measurement problem would be quite small.

VII. CONCLUSION

This paper estimated the effect of credit and debit card rewards on consumer choice of payment methods. By using a unique data set that contains rich information on consumer perceived attributes of each payment method and consumer perceived payment method acceptance by each type of retail stores, we are able to control for the consumer heterogeneity in preferences and choice sets. Our results show that including perceived payment method attributes produces a substantial improvement in model fit and allows us to alleviate the endogeneity problem of rewards.

Our policy experiments suggest that removing rewards today would cause a small percentage of consumers to switch from electronic payment methods (credit/debit cards) to paper-based methods (cash/checks) at five types of retail stores. The majority of consumers who currently receive rewards on credit/debit cards would continue to use credit/debit cards even if rewards were no longer offered. As noted, our estimated average direct effect of rewards might be upward biased, and therefore the policy simulation results might potentially be upward biased. In other words, the actual effects of removing rewards on payment choice could be smaller than what we reported here.

More comprehensive analysis is needed to fully understand the effects of rewards on consumer payment choice. The focus of this paper was the consumers' payment choice at the point-of-sale; however, understanding how removing rewards affects consumer payment choice for internet transactions and bill payments is also important. Another important future research question is whether removing rewards changes consumers' willingness-to-pay. Previous research has been focused on the effects of payment methods on spending behavior (e.g., Feinberg [1986], Hirschman [1979], Prelec and Simester [2001], Soman [2001]). As far as we know, there has been

no research on investigating how rewards on credit/debit cards might influence spending behavior. More detailed information on the value of rewards and fees may allow us to quantify the price elasticity of demand for a certain payment method. Combined with studies that measure the social costs of payment methods, our results could also be extended to analyze the cost effectiveness and social welfare of removing rewards programs.

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TABLE I: Summary Statistics on Consumer Characteristics

	Census	Our sample	
		All	Reward receivers
Demographic			
Female	.514	.491	.458
Race			
African American	.123	.117	.100
Asian	.042	.067	.090
Caucasian	.669	.703	.725
Hispanic	.144	.070	.055
Other	.022	.043	.029
Age			
18-34	.312	.269	.282
35-44	.197	.253	.259
45-54	.191	.174	.161
55-64	.136	.208	.196
65 and over	.165	.096	.103
Education			
Less than high school	.160	.011	.006
High school	.510	.536	.429
College	.250	.311	.359
Some graduate school	.080	.142	.207
Financial (income)			
\$0 - \$40,000	.463	.352	.244
\$40,000 - \$59,999	.178	.240	.219
\$60,000 - \$99,999	.209	.282	.333
\$100,000 and over	.151	.126	.204
Census division			
New England	.051	.050	.065
Mid-Atlantic	.142	.118	.141
South Atlantic	.191	.209	.200
ES Central	.061	.050	.037
EN Central	.105	.106	.087
WS Central	.160	.168	.180
WN Central	.069	.072	.074
Mountain	.058	.070	.067
Pacific	.163	.158	.148
Technology adoption			
Direct deposit	.673 ^a	.776	.816
Online banking	.370 ^b	.573	.642
Rewards			
Either Credit or Debit	n.a.	.364	1.00
Credit	n.a.	.320	.879
Debit	n.a.	.136	.373
PIN debit	n.a.	.066	.182
Signature debit	n.a.	.123	.336
Credit & Debit	n.a.	.092	.252
		N=1979	N=721

Notes: ^a2001 Survey of Consumer Finance. ^bOnline Banking Report March 2005. n.a.=not available.

TABLE II: Summary Statistics on Consumer Perceived Payment Method Attributes

Attribute	Cash	Check	Credit card		PIN-debit		Signature-debit	
	All consumers	All consumers	w/ rewards	w/o rewards	w/ rewards	w/o rewards	w/ rewards	w/o rewards
Comfortable (0-5) [*]	4.63	3.69	4.49	3.74	4.18	3.45	4.43	3.27
Fast (0-5) ^{**}	4.53	2.42	4.13	3.66	3.99	3.29	4.03	2.98
Convenient ^{***}	0.84	0.21	0.82	0.61	0.54	0.57	0.61	0.44
Easy to use ^{***}	0.85	0.22	0.84	0.61	0.55	0.55	0.62	0.44
Preferred by stores ^{***}	0.76	0.07	0.65	0.54	0.38	0.41	0.43	0.30
Safe ^{***}	0.56	0.22	0.54	0.33	0.39	0.38	0.46	0.28
Taken right away ^{***}	0.26	0.12	0.12	0.13	0.72	0.75	0.58	0.48
Helps me budget ^{***}	0.60	0.30	0.27	0.14	0.50	0.43	0.50	0.31
For small amounts ^{***}	0.89	0.11	0.14	0.10	0.29	0.28	0.27	0.18
Control ^{***}	0.62	0.34	0.39	0.18	0.51	0.47	0.53	0.35
Easy-to-get refund ^{***}	0.57	0.17	0.80	0.59	0.33	0.41	0.53	0.34

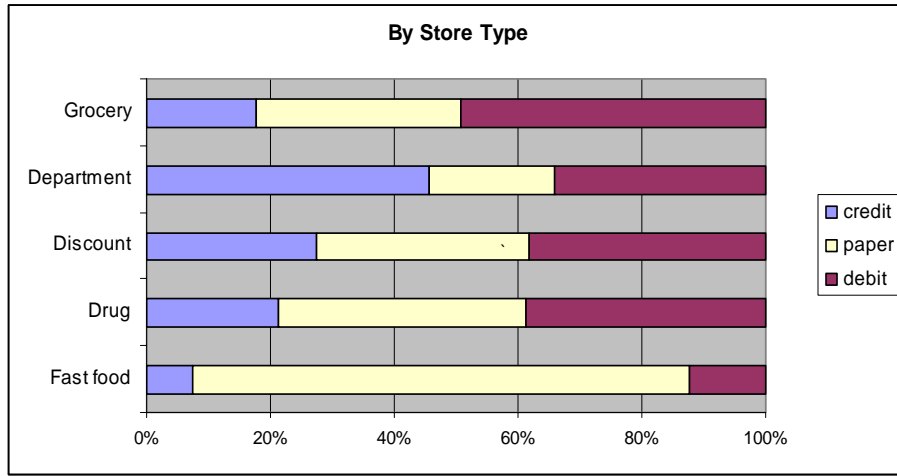
Notes: ^{*} Scale 0: not use; 1: not comfortable, 5: completely comfortable. ^{**} Scale 0: not use; 1: very slow, 5: very fast. ^{***} Scale 0: no; 1: yes.

TABLE III: Consumer Perceived Acceptance of Payment Methods by Retail Type

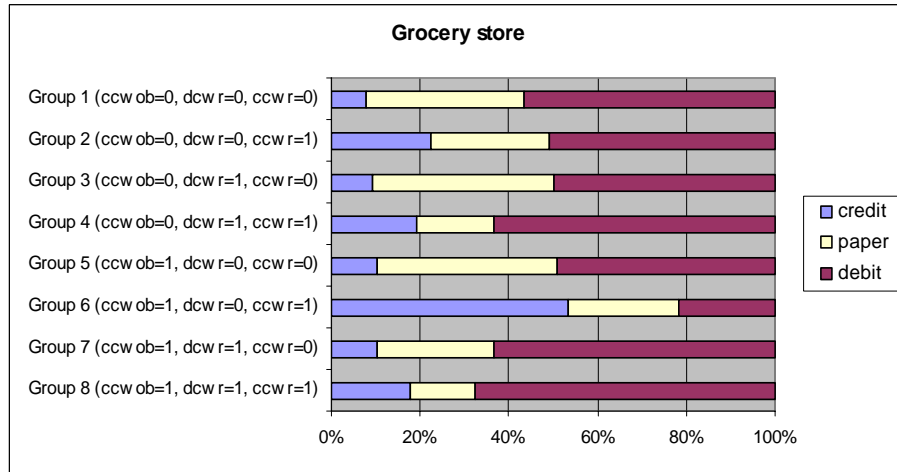
Type of stores	Cash	Check	Credit card	PIN-debit	Signature-debit
Grocery	89.3%	77.0%	81.0%	81.6%	58.1%
Department	84.9%	72.3%	90.3%	64.7%	60.2%
Discount	85.3%	64.9%	74.0%	63.4%	44.1%
Drug	88.8%	65.8%	81.6%	67.9%	52.8%
Fast food restaurants	96.1%	11.2%	55.5%	35.7%	34.1%

FIGURE I: Share of the Payment Method as the Most Frequently Used Method

Panel (A)



Panel (B)



Notes: ccwob=1, if consumers do not carry a credit card balance; ccwob=0, otherwise.
 dcwr=1, if consumers receive debit card rewards (either PIN-based, signature-based, or both);
 dcwr=0, otherwise. ccwr=1, if consumers receive credit card rewards; ccwr=0, otherwise.

TABLE IV: Multinomial Logit Model: Log-likelihood

		Specifications			
		1	2	3	4
	Perceptions	no	yes	no	yes
	Choice set	homogeneous	homogeneous	heterogeneous	heterogeneous
Retail types	Grocery	-2570.88	-1650.80	-2008.14	-1369.60
	Department	-2266.67	-1637.62	-1733.26	-1336.83
	Discount	-2487.85	-1885.18	-1631.47	-1278.67
	Drug	-2559.81	-1856.88	-1883.21	-1479.99
	Fast food	-1242.72	-1010.97	-800.77	-682.24

TABLE V: Multinomial Logit Model: Coefficients for Reward Dummies

		Specifications			
		1	2	3	4
	Perceptions	no	yes	no	yes
	Choice set	homogeneous	homogeneous	heterogeneous	heterogeneous
Grocery	Rewards on credit	1.632 ^{***} (0.145)	1.013 ^{***} (0.174)	1.579 ^{***} (0.159)	1.019 ^{***} (0.192)
	on PIN-debit	0.563 ^{***} (0.201)	0.150 (0.237)	0.452 ^{**} (0.225)	0.085 (0.253)
	on signature-debit	1.626 ^{***} (0.174)	1.187 ^{***} (0.208)	1.507 ^{***} (0.199)	1.092 ^{***} (0.231)
	Zero balance on credit	0.800 ^{***} (0.147)	0.516 ^{***} (0.175)	0.847 ^{***} (0.161)	0.558 ^{***} (0.191)
	Department	Rewards on credit	1.324 ^{***} (0.123)	0.720 ^{***} (0.145)	1.203 ^{***} (0.135)
	on PIN-debit	0.469 [*] (0.258)	0.034 (0.287)	0.343 (0.304)	0.007 (0.313)
	on signature-debit	1.434 ^{***} (0.176)	0.821 ^{***} (0.204)	1.344 ^{***} (0.198)	0.843 ^{***} (0.222)
	Zero balance on credit	-0.061 (0.107)	-0.049 (0.125)	0.020 (0.120)	-0.008 (0.138)
Discount	Rewards on credit	1.094 ^{***} (0.125)	0.516 ^{***} (0.145)	0.991 ^{***} (0.152)	0.541 ^{***} (0.179)
	on PIN-debit	0.195 (0.225)	-0.241 (0.246)	0.174 (0.302)	-0.226 (0.300)
	on signature-debit	1.244 ^{***} (0.192)	0.656 ^{***} (0.207)	1.063 ^{***} (0.228)	0.658 ^{***} (0.245)
	Zero balance on credit	0.114 (0.120)	-0.009 (0.134)	0.210 (0.142)	0.052 (0.161)
	Drug	Rewards on credit	1.284 ^{***} (0.136)	0.656 ^{***} (0.164)	1.136 ^{***} (0.151)
on PIN-debit		0.499 ^{**} (0.216)	0.233 (0.237)	0.573 ^{**} (0.271)	0.388 (0.292)
on signature-debit		1.299 ^{***} (0.181)	0.808 ^{***} (0.207)	1.198 ^{***} (0.207)	0.771 ^{***} (0.228)
Zero balance on credit		0.717 ^{***} (0.134)	0.593 ^{***} (0.156)	0.769 ^{***} (0.147)	0.571 ^{***} (0.169)
Fast food		Rewards on credit	1.008 ^{***} (0.202)	0.614 ^{***} (0.227)	0.825 ^{***} (0.238)
	on PIN-debit	0.354 (0.348)	0.241 (0.389)	-0.291 (0.466)	-0.170 (0.465)
	on signature-debit	0.555 ^{**} (0.268)	0.100 (0.295)	0.147 (0.325)	-0.120 (0.346)
	Zero balance on credit	0.604 ^{***} (0.225)	0.539 ^{**} (0.245)	0.759 ^{***} (0.253)	0.559 ^{**} (0.279)

Note: ***, **, * : Significant at .01, .05, and .1 level, respectively.

FIGURE II: The Effects of Removing Credit Card Rewards Using Specification 4 (with Perception Variables)

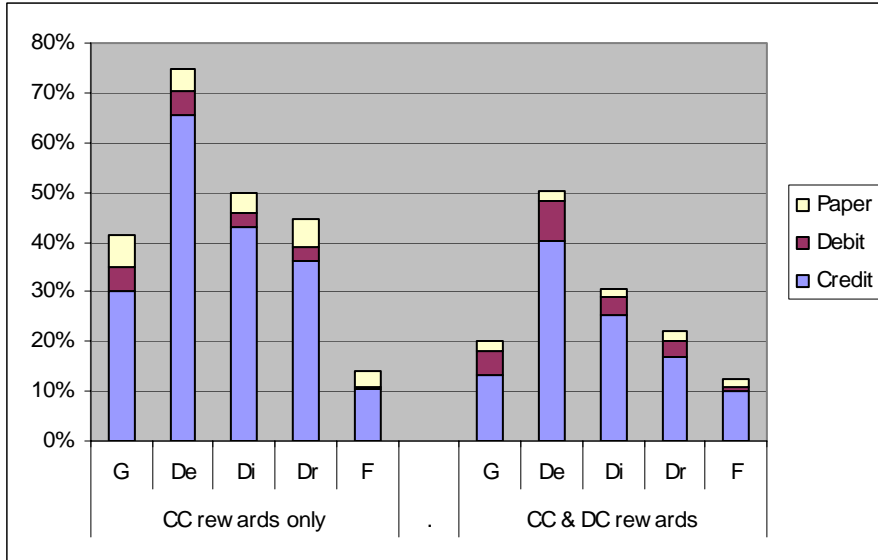


FIGURE III: The Effects of Removing Credit Card Rewards Using Specification 3 (without Perception Variables)

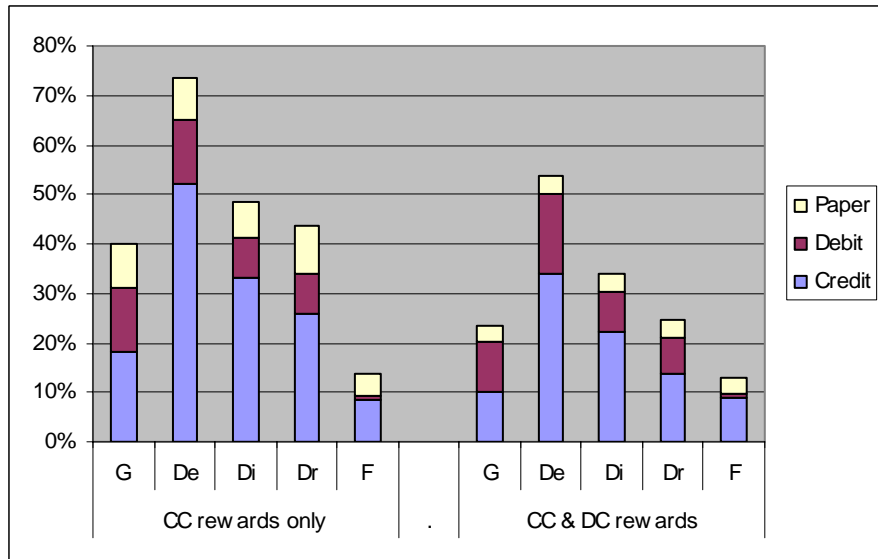


FIGURE IV: The Effects of Removing Credit and Debit Card Rewards on Consumers with Debit Card Rewards only

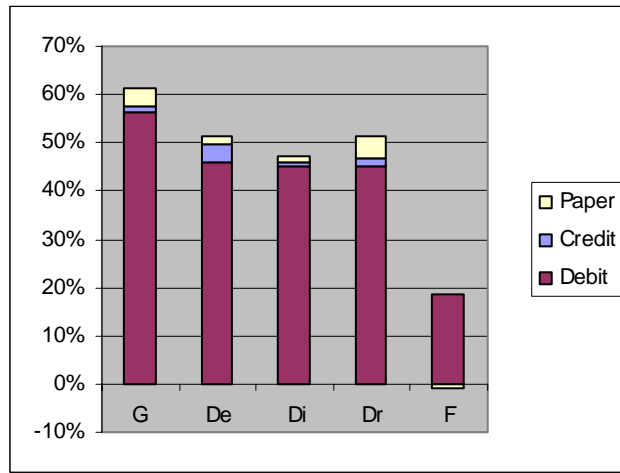


FIGURE V: The Effects of Removing Credit and Debit Card Rewards on Consumers with Credit and Debit Rewards

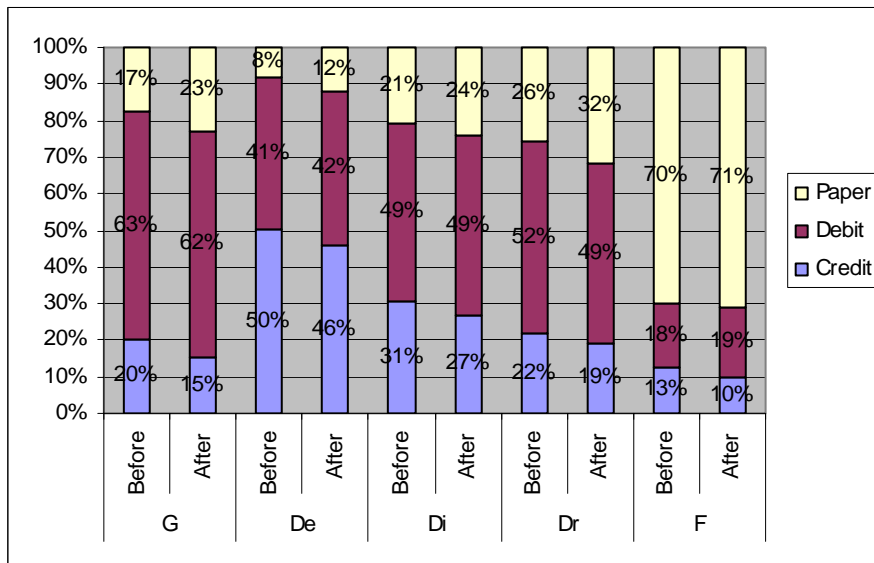


TABLE VI: Overall Effects of Removing Rewards

(Unit: percentage points)

	Policy 1 Removing credit card rewards			Policy 2 Removing both credit and debit card rewards		
	credit	debit	paper	credit	debit	paper
Grocery	-3.25	1.60	1.65	-3.00	0.86	2.14
Department	-3.12	1.93	1.18	-2.42	0.98	1.44
Discount	-2.02	1.00	1.02	-1.83	0.60	1.23
Drug	-2.43	0.99	1.44	-2.17	0.12	2.04
Fast food	-1.01	0.16	0.85	-1.03	0.27	0.75

APPENDIX

A. A potential measurement issue in credit card rewards receivers

In our sample, about 32 percent replied that they receive rewards on credit cards, which seems to be lower than that in three other surveys: 1996 Survey of Consumer Attitudes and Behavior (56 percent), 2003/2004 Study of Consumer Payment Preferences (53 percent), and 2006 Visa Payment System Panel Study (69 percent). However, Armstrong [2003] reported, “According to *the Nilson Report*, only 35 million of the 300 million active credit and debit card holders in the U.S. participate in a rewards program (in 2003),” and Kiviat [2004] reported that the number of credit card accounts offering rewards jumped from 35 million to 56 million in 2004. Therefore, it is hard to tell if the share of consumers who receive rewards on credit cards in our sample is too small or too large.

We believe it is very unlikely that our sample is subject to severe measurement errors in the data on whether the respondent receives rewards. Below are the actual survey question and a table (Table VII) comparing average in our sample and “national” average from various sources.

Which of the following statements are true? (Check all that apply)

- I have funds deposited electronically into my account by an employer or government agency (direct deposit).*
- I receive rewards (e.g., miles, points, cash-rebate) for using my credit card for purchases.*
- I regularly carry a balance on my credit card (do not pay off the balance in full).*
- I have internet access at home.*
- I have internet access at work.*
- I use online banking with my bank/credit union.*
- I have a mobile phone.*

Five out of seven questions were checked more than national average. Those questions are about direct debit, internet at home, internet at work, online banking and mobile phone. One question—credit card with balance—was checked less than national average, but since our

sample includes more affluent consumers than national average, this may be a natural outcome. By taking these responses into consideration, it seems very unlikely that the respondents in our sample missed to check only the question about credit card rewards.

Table VII: Comparison between Our Sample and National Average

	Our sample	National average
Direct deposit	.780	.700
Credit card rewards	.322	n.a.
Credit card with balance	.429	.442
Internet at home	.865	.589
Internet at work	.477	.423
Online banking	.560	.370
Mobile phone	.762	.573

As a robustness check, we estimate payment choice by using the 2003 Dove sample, in which the share of consumers with rewards credit cards is 53 percent. Because there are a lot of missing values in perceived attributes and acceptance of payment methods in the 2003 sample, only specification 1 can be estimated. Then, we conduct a policy experiment that removes rewards on credit cards. Table VIII compares specification 1 results of the 2003 and 2005 samples at grocery stores. It also presents the 2005 results of specification 4, which is more appropriate than specification 1.

TABLE VIII: Effects of Removing Rewards

(Unit: percentage points)

	2003 Specification 1			2005 Specification 1			2005 Specification 4		
	credit	debit	paper	credit	debit	paper	credit	debit	paper
Overall	-11.51	6.15	5.36	-7.36	4.91	2.74	-3.25	1.60	1.65
CC rewards only	-21.88	11.51	10.37	-26.01	15.78	10.23	-11.35	4.92	6.43
CC&DC rewards	-17.20	10.78	6.42	-18.10	13.93	4.17	-6.92	5.03	1.88

The effect of removing credit card rewards on consumers who receive credit card rewards is smaller for the 2003 sample: The percentage point reduction by consumers who receive rewards on credit cards only is estimated to be 22 for the 2003 sample and 26 for the 2005 sample, and that by consumers who receive rewards on both credit and debit cards is estimated to be 17 for the 2003 sample and 18 for the 2005 sample. However, the overall effect of removing credit card rewards is greater for the 2003 sample, because of the greater share of consumers who receive rewards on credit cards. As the results for the 2005 sample suggest, the percentage point reduction in probability of choosing credit cards for the 2003 sample would be at least halved if we could use specification 4. That is, the reduction in the share of credit cards would be no more than 6 percentage points and the increase in the share of paper-based methods would likely be no more than 3 percentage points.

These suggest that our main results are robust even if our sample measures the share of consumers who receive rewards on credit cards lower than actual—removing rewards today would only cause a small percentage of consumers switching from electronic payment methods to paper-based methods at least at five types of retail stores.

B. Estimation results: coefficients for consumer characteristics and perceptions

Tables IX shows the coefficients for consumer characteristics under specification 4. Age, race, and technology adoption variables seem to be more important than education and income variables. Tables X shows the coefficients for consumer perceived payment method attributes under specifications 2 and 4. For both specifications, all of these variables have expected signs and most of them are highly statistically significant across retail types except fast food restaurants.

**TABLE IX: Multinomial Logit Model: Coefficients for Consumer Characteristics
(Specification 4)**

		Grocery		Department		Discount	
Credit	Constant	2.393	(1.695)	-0.103	(1.535)	1.174	(1.369)
	Female	0.482**	(0.217)	0.386*	(0.222)	-0.043	(0.201)
	Education	-0.185	(0.747)	1.415*	(0.734)	-0.051	(0.643)
	Education ²	0.073	(0.105)	-0.160	(0.113)	0.054	(0.097)
	Income	0.033	(0.079)	0.012	(0.116)	0.003	(0.078)
	Income ²	-0.001	(0.004)	0.004	(0.008)	0.003	(0.005)
	Age	-0.126***	(0.046)	-0.051	(0.048)	-0.026	(0.041)
	Age ²	0.001**	(0.000)	0.001	(0.001)	0.000	(0.000)
	Direct deposit	0.717***	(0.266)	0.454*	(0.246)	0.584**	(0.250)
	Online banking	0.420*	(0.224)	0.439**	(0.223)	0.428**	(0.205)
	Asian	-0.098	(0.370)	0.909	(0.651)	0.507	(0.447)
Other race	-0.829***	(0.295)	-1.071***	(0.250)	-1.183***	(0.247)	
PIN debit	Constant	2.344	(1.396)	-0.983	(1.715)	0.055	(1.557)
	Female	0.482***	(0.179)	0.157	(0.237)	0.019	(0.203)
	Education	0.266	(0.616)	1.211	(0.798)	0.493	(0.738)
	Education ²	0.011	(0.090)	-0.152	(0.121)	-0.011	(0.110)
	Income	0.028	(0.068)	-0.008	(0.119)	0.028	(0.082)
	Income ²	0.000	(0.004)	0.003	(0.008)	0.002	(0.005)
	Age	-0.058	(0.042)	0.024	(0.053)	-0.026	(0.043)
	Age ²	0.000	(0.000)	0.000	(0.001)	0.000	(0.000)
	Direct deposit	0.638***	(0.205)	0.382	(0.268)	1.035***	(0.244)
	Online banking	0.351*	(0.183)	0.633***	(0.249)	0.317	(0.210)
	Asian	-1.489***	(0.423)	0.163	(0.717)	0.037	(0.555)
Other race	-0.735***	(0.203)	-0.771***	(0.258)	-0.812***	(0.224)	
Signature debit	Constant	-1.793	(1.937)	-2.462	(1.988)	-2.935	(2.055)
	Female	0.591***	(0.229)	0.407	(0.252)	0.171	(0.248)
	Education	1.136	(0.861)	1.000	(0.905)	1.119	(0.907)
	Education ²	-0.111	(0.126)	-0.094	(0.137)	-0.088	(0.132)
	Income	0.057	(0.101)	-0.003	(0.132)	-0.039	(0.096)
	Income ²	-0.003	(0.006)	0.000	(0.009)	0.003	(0.005)
	Age	0.005	(0.059)	0.089	(0.066)	0.055	(0.064)
	Age ²	0.000	(0.001)	-0.001*	(0.001)	-0.001	(0.001)
	Direct deposit	0.868***	(0.300)	0.850***	(0.293)	1.001***	(0.298)
	Online banking	0.327	(0.242)	0.374	(0.258)	0.382	(0.262)
	Asian	-1.255*	(0.645)	0.476	(0.753)	-0.250	(0.738)
Other race	-0.907***	(0.257)	-1.045***	(0.272)	-1.001***	(0.280)	
Check	Constant	0.148	(1.685)	-1.316	(1.901)	-2.435	(1.849)
	Female	1.012***	(0.227)	0.203	(0.275)	0.646***	(0.234)
	Education	-0.124	(0.674)	0.415	(0.844)	0.470	(0.816)
	Education ²	0.046	(0.101)	-0.037	(0.129)	-0.041	(0.118)
	Income	0.221**	(0.092)	-0.054	(0.133)	0.034	(0.089)
	Income ²	-0.010*	(0.006)	0.005	(0.010)	0.003	(0.005)
	Age	0.024	(0.058)	0.099	(0.065)	0.098*	(0.059)
	Age ²	0.000	(0.001)	-0.001	(0.001)	-0.001*	(0.001)
	Direct deposit	0.253	(0.262)	0.351	(0.312)	0.605**	(0.276)
	Online banking	0.041	(0.240)	0.309	(0.284)	0.545**	(0.244)
	Asian	-0.284	(0.562)	1.052	(0.757)	-0.193	(0.685)
Other race	-0.750**	(0.303)	-0.807**	(0.341)	-1.258***	(0.330)	

Note: ***, **, *: Significant at .01, .05, and .1 level, respectively.

**TABLE IX: Multinomial Logit Model: Coefficients for Consumer Characteristics (Cont.)
(Specification 4)**

		Drug	Fast Food
Credit	Constant	0.479 (1.470)	0.428 (2.134)
	Female	0.153 (0.185)	-0.391 (0.290)
	Education	0.403 (0.641)	-0.532 (0.958)
	Education ²	-0.006 (0.090)	0.101 (0.131)
	Income	0.102 (0.068)	-0.144 (0.089)
	Income ²	-0.004 (0.004)	0.007* (0.004)
	Age	-0.112*** (0.040)	0.086 (0.053)
	Age ²	0.001*** (0.000)	0.001 (0.001)
	Direct deposit	0.282 (0.233)	0.543 (0.359)
	Online banking	0.123 (0.192)	0.254 (0.312)
	Asian	0.379 (0.389)	0.351 (0.399)
Other race	-0.244 (0.243)	1.163*** (0.335)	
PIN debit	Constant	1.762 (1.342)	-0.751 (2.033)
	Female	0.259 (0.170)	0.078 (0.251)
	Education	0.451 (0.582)	0.546 (0.813)
	Education ²	-0.036 (0.085)	-0.092 (0.121)
	Income	0.159** (0.064)	0.216 (0.152)
	Income ²	-0.006* (0.003)	-0.011 (0.010)
	Age	-0.101*** (0.039)	-0.100* (0.060)
	Age ²	0.001** (0.000)	0.001 (0.001)
	Direct deposit	0.304 (0.210)	0.201 (0.319)
	Online banking	0.015 (0.177)	0.029 (0.286)
	Asian	-0.719* (0.409)	0.135 (0.644)
Other race	-0.369* (0.200)	0.596** (0.282)	
Signature debit	Constant	-1.237 (1.590)	-4.332* (2.386)
	Female	0.306 (0.204)	-0.241 (0.286)
	Education	1.007 (0.695)	2.391** (1.108)
	Education ²	-0.109 (0.103)	-0.261* (0.159)
	Income	0.118 (0.080)	-0.048 (0.118)
	Income ²	-0.006 (0.004)	0.000 (0.006)
	Age	-0.039 (0.051)	-0.075 (0.067)
	Age ²	0.000 (0.001)	0.001 (0.001)
	Direct deposit	0.981*** (0.264)	1.014** (0.460)
	Online banking	0.020 (0.217)	-0.193 (0.300)
	Asian	-0.900 (0.636)	-1.313 (1.143)
Other race	-0.696*** (0.251)	0.253 (0.306)	
Check	Constant	-0.965 (1.937)	-13.200 (10.268)
	Female	0.379* (0.222)	-0.233 (0.831)
	Education	0.278 (0.762)	5.861 (5.222)
	Education ²	-0.015 (0.112)	-0.904 (0.882)
	Income	0.095 (0.093)	0.211 (1.171)
	Income ²	-0.006 (0.006)	-0.104 (0.190)
	Age	0.044 (0.059)	0.200 (0.200)
	Age ²	0.000 (0.001)	-0.002 (0.002)
	Direct deposit	0.209 (0.262)	0.943 (1.029)
	Online banking	-0.365 (0.231)	-0.748 (0.879)
	Asian	-1.325 (0.881)	0.972 (3.253)
Other race	-0.775*** (0.336)	-0.905 (1.656)	

Note: ***, **, *: Significant at .01, .05, and .1 level, respectively.

TABLE X: Multinomial Logit Model: Coefficients for Perceptions

		Specifications	
		2	4
	Perceptions	yes	
	Choice set	homogeneous	heterogeneous
Grocery	Comfortable	0.670 ^{***} (0.060)	0.680 ^{***} (0.066)
	Fast	0.323 ^{***} (0.052)	0.308 ^{***} (0.060)
	Convenient	0.809 ^{***} (0.129)	0.702 ^{***} (0.143)
	Easy-to-use	0.650 ^{***} (0.131)	0.618 ^{***} (0.148)
	Preferred by stores	0.275 ^{***} (0.090)	0.337 ^{***} (0.099)
	Safe	0.132 [*] (0.080)	0.125 (0.088)
	Money taken right away	-0.041 (0.093)	-0.113 (0.100)
	Help me budget	0.328 ^{***} (0.090)	0.279 ^{***} (0.098)
	For small amount	0.239 ^{**} (0.098)	0.301 ^{***} (0.108)
	Control over money	0.567 ^{***} (0.095)	0.565 ^{***} (0.104)
	Easy-to-get refund	0.153 [*] (0.085)	0.113 (0.093)
Department	Comfortable	0.585 ^{***} (0.055)	0.557 ^{**} (0.064)
	Fast	0.281 ^{***} (0.056)	0.292 ^{***} (0.066)
	Convenient	0.511 ^{***} (0.129)	0.421 ^{***} (0.143)
	Easy-to-use	0.429 ^{***} (0.131)	0.504 ^{***} (0.146)
	Preferred by stores	0.318 ^{***} (0.095)	0.225 ^{**} (0.105)
	Safe	0.175 ^{**} (0.086)	0.131 [*] (0.095)
	Money taken right away	-0.115 (0.100)	-0.142 (0.107)
	Help me budget	0.232 ^{**} (0.097)	0.136 (0.107)
	Small amount	0.020 (0.102)	0.096 (0.112)
	Control over money	0.565 ^{***} (0.105)	0.543 ^{***} (0.115)
	Easy-to-get refund	0.385 ^{***} (0.089)	0.400 ^{***} (0.098)
Discount	Comfortable	0.548 ^{***} (0.053)	0.557 ^{***} (0.065)
	Fast	0.161 ^{***} (0.046)	0.204 ^{***} (0.058)
	Convenient	0.541 ^{***} (0.120)	0.437 ^{***} (0.144)
	Easy-to-use	0.288 ^{**} (0.120)	0.346 ^{**} (0.150)
	Preferred by stores	0.319 ^{***} (0.088)	0.219 ^{**} (0.108)
	Safe	0.158 ^{**} (0.075)	0.123 (0.094)
	Money taken right away	0.020 (0.090)	-0.075 (0.105)
	Help me budget	0.301 ^{***} (0.085)	0.319 ^{**} (0.102)
	For small amount	0.143 (0.095)	0.205 [*] (0.115)
	Control over money	0.407 ^{***} (0.090)	0.449 ^{***} (0.108)
	Easy-to-get refund	0.169 ^{**} (0.080)	0.225 ^{**} (0.095)
Drug	Comfortable	0.649 ^{***} (0.060)	0.648 ^{***} (0.069)
	Fast	0.203 ^{***} (0.049)	0.186 ^{***} (0.057)
	Convenient	0.667 ^{***} (0.120)	0.577 ^{***} (0.132)
	Easy-to-use	0.395 ^{***} (0.125)	0.320 ^{**} (0.138)
	Preferred by stores	0.309 ^{***} (0.082)	0.292 ^{**} (0.091)
	Safe	0.243 ^{***} (0.070)	0.204 ^{***} (0.079)
	Money taken right away	-0.031 (0.086)	-0.060 (0.096)
	Help me budget	0.158 [*] (0.084)	0.096 (0.094)
	For small amount	0.316 ^{***} (0.089)	0.356 ^{***} (0.100)
	Control over money	0.398 ^{***} (0.086)	0.392 ^{***} (0.096)
	Easy-to-get refund	0.274 ^{***} (0.076)	0.227 ^{***} (0.085)
Fast food	Comfortable	0.341 ^{***} (0.063)	0.368 ^{***} (0.081)
	Fast	0.223 ^{***} (0.065)	0.234 ^{***} (0.077)
	Convenient	0.466 ^{***} (0.168)	0.547 ^{***} (0.199)
	Easy-to-use	0.199 (0.186)	-0.047 (0.224)
	Preferred by stores	0.158 (0.120)	0.156 (0.139)
	Safe	0.110 (0.102)	0.062 (0.117)
	Money taken right away	-0.134 (0.122)	-0.088 (0.136)
	Help me budget	0.241 ^{**} (0.116)	0.267 ^{**} (0.134)
	For small amount	0.706 ^{***} (0.108)	0.614 ^{***} (0.136)
	Control over money	0.197 (0.121)	0.138 (0.142)
	Easy-to-get refund	0.207 [*] (0.114)	0.295 [*] (0.132)

Note: ^{***}, ^{**}, ^{*}: Significant at .01, .05, and .1 level, respectively.