

Payment Card Rewards Programs and Consumer Payment Choice

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Abstract

This paper estimates the effects of payment card rewards programs on consumer payment choice for in-store transactions. By using a unique data set that contains rich information on consumer perceived attributes of payment methods and consumers' perception about which payment method is accepted by merchants, we are able to control for consumer heterogeneity in preferences and choice sets. Our estimation 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. Using our parameter estimates, we conduct several policy experiments to examine the effects of removing rewards from credit cards or debit cards on consumer payment choice. Our results indicate that only a small percentage of consumers would switch from electronic payment methods (credit/debit card) to paper-based payment methods (cash/check) if rewards were removed.

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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 difficult because most consumers already have both credit and debit cards.¹ To increase their market shares and card use by existing customers, many card issuers have been offering attractive rewards/loyalty programs, which appear to be successful. 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 reward 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 reward credit and debit cards? To what extent do reward card transactions replace other forms of payment transactions? How do the substitution patterns vary across consumers' characteristics and across retail stores? In this paper, we seek to answer these questions.

The answers to these questions are important for card issuers. Rewards have become a common marketing tool for them to attract new customers and retain existing ones. To evaluate the tradeoffs of promoting rewards cards to certain types of customers, it is useful to know how the substitution patterns vary with consumers' types. For example, if consumers significantly replace *credit* card transactions with rewards *debit* card transactions, then card issuers who offer both credit and debit cards may want to avoid promoting rewards debit cards to their own credit card customers. Instead, they may want to target consumers who do not hold credit cards issued

¹ According to the 2001 Survey of Consumer Finance (SCF) conducted by the Federal Reserve, 75 percent of U.S. households hold at least one credit card. Statistics on debit card penetration is hard to obtain, but many large banks reported that 80 to 100 percent of their checking account holders hold a debit card.

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

by them. It would also be valuable if card issuers could identify what types of consumers mainly substitute reward card transactions for cash and check transactions. Presumably, these customers would be worth targeting.

Understanding the influence of rewards on payment choice is also important for the public policy debate on the current fee structure of payment card networks. Rewards programs seemingly benefit consumers who use rewards payment cards, and rewards could potentially induce more consumers to switch from more costly paper-based payment methods to less costly electronic payment methods. But when combined with interchange fees, rewards could have negative impacts upon the economy in several ways.³ First, the efficiency of payments system could be harmed if most consumers simply substitute reward card transactions for non-reward card transactions—because offering rewards use extra resources. Second, the current fee structure could create income inequality. The costs of rewards programs account for a substantial portion of interchange fees.⁴ Because of the honor-all-cards rule and the no-surcharge rule set by payment card networks, merchants may pass along the increase in interchange fees to consumers by marking up their uniform retail prices. Although reward credit card holders are partly compensated for the higher retail prices through rewards, other consumers are not. Consumers who do not use rewards payment cards, therefore, subsidize those who use rewards cards. Because reward credit card holders are relatively high-income earners, rewards programs may work as a tool that distributes income from low-income to high-income earners. Third, critics of rewards programs claim that some consumers who carry credit card debts may make more credit card transactions due to rewards. This may increase their credit card debts further and reduce their welfare. Obviously, whether the rewards programs and interchange fees

³ Interchange fees are paid by merchants to card issuers when credit and debit cards are used.

are welfare enhancing or diminishing will depend at least partly on the extent to which reward card transactions substitute for cash and checks—an empirical question that we will address here.

To the best of our knowledge, this is the first study that empirically examines the effects of rewards programs on consumer payment choice. We use consumer survey data to estimate a series of multinomial logit models that explain how consumer characteristics, such as demographic, income, technology adoption, and most importantly, whether receiving rewards on credit cards and/or debit cards, relate to the payment choice across retail types. We also use the parameter estimates to conduct several policy experiments to quantify the effect of removing reward features from payment cards on consumers' payment choice across retail types.

Our unique data set allows us to alleviate two problems when estimating the effects of rewards programs. The first problem is that deciding whether to obtain rewards payment cards could be endogenous. It is likely that a typical individual who chooses to obtain a reward credit/debit card would use it relatively more often, regardless of whether the card offers rewards. In other words, the dummy variable indicating whether the card carried rewards may be positively correlated with the unobserved consumer heterogeneity, such as, for instance, an individual's perception of how convenient a credit/debit card is. If our intuition is correct, this selection problem will cause the effect of the rewards program to be overestimated. To handle this problem, we adopt the method proposed by Harris and Keane [1999], who used attitudinal data to control for unobserved consumer heterogeneity.⁵ Our data set provides detailed measures of individual perceptions toward each payment method in terms of speed, convenience, safety,

⁴ Dawson and Hugener [2006] report that rewards account for 44 percent of interchange fees in the United States. The annual amount paid for interchange fees is estimated to be \$30 billion in the United States in 2005.

⁵ Horsky et al. [2006] also show that one can improve parameter estimates of brand choice models after incorporating consumer attitudinal data.

whether it helps the budget, etc. We use this data 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. In other words, the choice set may vary across consumers. Ignoring the variation of choice sets could lead to biased estimates of the parameters (Bronnenberg and Vanhonacker [1996]). Still, the economics and marketing literature has typically assumed that all alternatives are available for consumers to choose because choice sets are usually unobserved to researchers. If researchers have access to panel data, it is possible to take the choice set variation into account at the expense of making strong assumptions about the process of choice set formation (e.g., Mehta, Rajiv, and Srinivasan [2003]). Our data set, which provides information on each individual's choice set, allows us to bypass this hurdle and avoid the possibility of misspecifying a model of choice set formation.

Our results indicate that including attitudinal data produces a substantial improvement in model fit and in the substantive interpretation of estimated parameters, particularly the effects of rewards programs. After controlling for the heterogeneity of choice sets, we find that the goodness-of-fit of our model has been improved further. We also find that our results are similar regardless of whether consumers' choice sets are homogeneous or heterogeneous. The main results from the policy experiments are: (i) The majority of consumers who use rewards credit (debit) cards would keep using credit (debit) cards even if rewards were not offered, although some credit (debit) card transactions would be replaced by debit (credit) card and paper-based transactions; (ii) The effect of removing credit card rewards on the consumers' use of credit cards is greater than the effect of removing debit card rewards on the use of debit cards; (iii) The effects vary by retail type; (iv) Regardless of whether carrying a credit card balance, consumers

would reduce their use of credit cards if rewards were removed from credit cards. These results suggest that rewards programs may have negative effects for the cost effectiveness of the payment system and for the financial soundness of consumers. To card issuers, credit card rewards programs are likely to be beneficial, while debit card rewards programs may not: Some card issuers might cannibalize their own products by offering rewards *debit* cards to their *credit* card customers.

The rest of the paper is organized as follows. Section II provides some background on consumer payment choice. Section III describes our data set. Section IV describes the empirical model. Section V presents the results and discusses their implications. Section VI concludes the paper.

II. BACKGROUND AND PREVIOUS LITERATURE

Consumer payment choice is influenced by various factors. Previous research has highlighted three important sets of factors: consumer characteristics, payment method attributes, and transaction characteristics.

Consumer characteristics, such as age, income, and educational level, have shown to be correlated with the use of payment methods in the previous literature (e.g., Kennickell and Kwast [1997], Stavins [2001], and Klee [2006a]). Adoption of new technologies, such as purchases over the internet and direct deposits, also influences consumer's new payment method adoption (Hayashi and Klee [2003]). These factors could be proxy for preferences (checks are preferred more by women than by men), for availability of payment methods (consumers with higher income are more likely to have credit cards than those with lower income), and for familiarity with new payment technologies (people who use new technologies are more likely to use debit cards).

Payment method attributes may also be important determinants when consumers choose a payment method. Some payment instruments have distinctive attributes. For example, cash gives consumers anonymity, and credit cards provide liquidity at least until the next billing date. Other attributes, such as transaction time, security, ease of use, control spending, and so on, also vary by payment method. Previous studies, such as Hirschman [1982], Mantel [2000] and Jonker [2005], used survey data and found strong correlations between payment method attributes perceived by consumers and consumer payment choice. Klee [2006b] concluded that the difference in transaction time of payment methods significantly affects consumer payment choice at grocery stores. The literature on behavioral economics suggests that consumer payment choice, especially the use of debit cards, can be explained by behavioral motives, such as to avoid overspending on credit cards (Ausubel [1991], Prelec and Simester [2001], and Bertaut and Haliassos [2002]). This is closely related to the difference in payment card attributes, e.g., whether the card has “credit” function or not. Zinman [2005], on the other hand, suggested that although debit card use can be partly explained by behavioral motives, it is also explained by consumers’ cost minimization—consumers who carry a credit card balance use debit in order to reduce their interest costs on credit cards.

Transaction characteristics, such as value of the transaction and physical environment, may also influence consumer payment choice (Hayashi and Klee [2003]). For example, consumers tend to pay with cash for a smaller value transaction, while they tend to use a credit card or a check for a larger value transaction. The effects of physical environment on the use of payment may partly be supply side effects. Some types of retail stores may not accept all types of payment cards. Only cash may be accepted when consumers use public transportation systems, such as a city bus or the subway. Even when merchants accept all payment methods, some

payments may be less convenient to use than the others. For example, at a restaurant consumers cannot make a PIN-based debit payment at their seat unless the restaurant carries a portable PIN pad. At a gas station, consumers may not need to go to the cashier if they pay with cards, while they need to do so if they pay with cash or checks.

Another important factor is the price of payment methods. Most previous studies did not include this factor in the analysis because 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 Porter [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. The results of these studies suggest that consumers are price sensitive.

As far as we know, there have been no studies that investigate the impact of payment card rewards programs on consumer payment choice. Although it is not price information per se, whether a consumer receives rewards on credit and/or debit cards can be seen as a proxy for negative per-transaction fees of credit and/or debit cards. Thus, to some extent, our study takes the effects of price into consideration. To examine the effects of rewards on payment choice, it is important to control other factors. To do so, we make use of a unique survey data set that contains rich information on consumer characteristics, consumer perceived payment method attributes, consumer perceived payment method acceptance, and physical transaction environments. Following is a discussion about the details of our data.

III. 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. A total of 3,008 completed surveys were received. Of those, 2,350 were submitted via the Web, and 658 were submitted on paper. Although the survey sample is not nationally representative, the survey contains rich information about consumer payments, which is usually unobservable in the nationally representative data sources.⁶

First, our data set includes information on whether the consumer received credit card rewards and debit card rewards, respectively. This allows us to examine whether credit/debit reward receivers' payment choice is different from non-reward 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 leads 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 a payment method from five payment methods—cash, check, credit card, PIN-based debit card, and signature-based debit card.⁷ We will 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

⁶ 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.

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 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 in that retail type. This allows us to control the 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 reward receivers and non-reward receivers, not between cardholders and non-cardholders. This process leaves a total of 1,979 responses. Compared with the general U.S. population, income and educational levels are relatively higher in our sample (Table I). Finally, when estimating our multinomial logit models, we exclude responses with missing information about the most frequently used payment method in a given type of store. This leaves 1,915 responses 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 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 and higher educational levels are more likely to hold rewards cards. Rewards card holdings also vary by

⁷ See Hayashi, Sullivan and Weiner [2003] for the difference between PIN-based and signature-based debit.

consumer gender, ethnicity, residential region, and technology adoption behavior. For example, men are more likely to hold rewards cards than women are; Asians and Caucasians tend to hold rewards cards; people living in New England and mid-Atlantic regions are more likely to receive rewards on their payment cards; and consumers who use direct deposit and online banking are more likely to hold rewards cards. Age, however, seems to have no effects on reward credit card holdings.

Table II shows statistics on reward receivers in our sample.⁸ About 36 percent of consumers receive rewards via either credit card, debit card, or both. Approximately two-thirds of them (23 percent of consumers in our sample) receive rewards from credit card only; one-quarter of them (9 percent of consumers in our sample) receive rewards from both credit and debit cards; and the rest (4 percent of consumers in our sample) receive rewards from debit card only. Nearly 90 percent of debit reward receivers receive rewards when they make signature-debit transactions, while only 50 percent of them receive rewards when they make PIN-debit transactions.⁹

Table III provides summary statistics on consumer perceived payment method attributes. We observe 11 attributes of each payment method perceived by consumers: Comfortable and Fast are measured by a scale of 0-5;¹⁰ 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 are measured by dummy variables. Panel (A) shows the entire sample's average scores, while panel (B) shows the average scores by respondents' reward status. From panel (A), we find the following: cash receives the highest score for nine out of 11 attributes; credit card has

⁸ 1,979 responses are used to construct these statistics.

⁹ A typical U.S. debit card can carry out both signature- and PIN-debit transactions, but it is possible that consumers receive rewards only when they make signature-debit transactions.

the highest score for only one attribute, but has the second highest score for six attributes; consumers tend to give the lowest score to check, but they feel more comfortable with checks than with debit cards; and PIN-debit tend to receive higher scores than signature-debit for all attributes. Not surprisingly, credit and signature-debit cards are perceived more positively by consumers with credit card rewards and with signature-debit rewards, respectively, than consumers without those rewards. Compared with these two cards, the differences in scores for PIN-debit cards by consumers with and without PIN-debit rewards are less clear for variables other than Comfortable and Fast.

Table IV 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. Despite the fact that almost all stores that accept credit cards also accept signature-debit cards, some consumers do not recognize this—the differences ranges from 20 to 30 percentage points across retail types. As a result, while credit cards are perceived to be more widely accepted than PIN-debit cards, signature-debit cards are perceived to be less widely accepted than PIN-debit cards. The perceived acceptance rates of checks lie between those of cash and credit cards. More than 60 percent of consumers perceive checks to be accepted by all retail types, but only 11 percent of them perceive checks to be accepted at fast food restaurants.

Figure I presents the share of consumers who chose a particular payment instrument as their most frequently used payment method by retail type. Consumers are grouped into eight groups, according to their credit card balance, debit card rewards, and credit card rewards status. Four observations that are consistent across five retail types are: (1) Consumers who received

¹⁰ For Comfortable and Fast, 0 means “not use;” 1 means “not comfortable/very slow;” and 5 means “completely comfortable/very fast.”

credit card rewards are more likely to choose credit cards than those who did not receive credit card rewards; (2) conditioning on receiving credit cards rewards, consumers who did not carry credit card balances are much more likely to choose credit cards than those who carried balances (group 2 versus 6); (3) conditioning on receiving credit cards rewards, consumers who received debit card rewards are more likely to choose debit cards than those who did not receive debit card rewards (group 2 versus 4, and group 6 versus 8); and (4) conditioning on not carrying credit card balances and receiving credit cards rewards, consumers who received debit card rewards are much more likely to choose debit cards than credit cards (group 6 versus 8). The observations indicate that credit card rewards, debit card rewards, and credit card balance are correlated with consumer payment choice. It should be emphasized that these observations are merely statements regarding how the data look like from the perspective of an analyst—they are not statements about causality. In particular, one should not draw inference about the effects of rewards on payment choice from this figure because whether a consumer chooses to obtain a reward credit card or reward debit card may depend on his/her preference for credit cards or debit cards in the first place. The next section discusses how we address this endogeneity issue using the data on consumer perceived attributes of payment methods.

IV. ESTIMATION

This section discusses the econometric model specifications. For each retail type, we estimate a multinomial logit model that explains which payment method is most preferred by the consumers.

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 to 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 measures the mean utility from payment method j , regardless of consumer characteristics and card-related status. β and δ are vectors of utility weight for X_i and C_{ij} , respectively. 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 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} . Some consumers chose to get a reward credit/debit card because they had been using this payment method relatively more often due to higher ε_{ijh} . Those consumers may have spent search costs (or in some cases they may pay an annual fee) to join a rewards program that suits them well. Other consumers who currently have a reward credit/debit card may have had low ε_{ijh} 's when they first obtained a reward credit/debit card. Instead of deliberately search for a reward card, they may have received an offer of a reward credit/debit card from a card issuer for free. Although they did not have high ε_{ijh} 's initially, as they used their credit/debit cards more often because of rewards, they may have learned about the good features of credit/debit cards. As a result, reward programs may indirectly improve ε_{ijh} . Thus, both types of consumers who

have a reward credit/debit card may have higher ε_{ijh} than consumers who do not have a reward 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 data¹¹ to control for unobserved consumer heterogeneity is an alternative to the conventional econometric approach of using instrumental variables. But, unlike instrumental variables, this approach works in non-linear models, such as the multinomial logit model considered here. We use 11 consumer perceived attributes of each payment method discussed in section 3. 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:

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

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 perceived attributes data are a good proxy for individual level preferences. Instead, we will let the choice model tell us whether

¹¹ Note that we are using the term *attitudinal* data and *perception* data interchangeably in this paper.

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} in the long-run. As discussed above, this indirect effect could be due to consumer learning of the good features of credit/debit card. To identify this indirect effect, one would need panel data, which follows individual consumers, and see how they have changed their perceptions over time. Since our data is cross-sectional, we cannot explicitly estimate the indirect effect of rewards. In order to shed some light on the magnitude of the indirect effect, we will also estimate a specification that does not control for consumer perceptions. The coefficients for reward dummies in this specification will likely overestimate the sum of direct and indirect effects of rewards. We will interpret it as the upper bound of the magnitude of the indirect effects.

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 reward card are likely to be more sensitive to the 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. One way to address this selection problem is to make a distributional assumption on δ_{ijh} and model the consumer decision to get a reward card explicitly. For example, one could model whether to get a reward card and which payment method to use as a two-stage problem. In the first stage, consumers decide whether to get a reward card or not. In the second stage, based on their first stage decision, consumers decide which payment method to use at different retail stores. One could then estimate this two-stage model by using simulation-based estimation

methods. However, because the second stage consists of five retail types, estimating such a two-stage model requires us to estimate five choice models simultaneously. This is computationally very demanding, and beyond the scope of this paper.¹² We note that the estimates on the reward dummies obtained here should be interpreted as the upper bound of the mean effect of rewards on payment choice.

We estimate four model specifications. They depend on whether the specification includes consumer perceptions, 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. For example, suppose that a consumer's first choice is PIN-debit card and his/her second choice is signature-debit. It is possible that the grocery store he or she frequently visits does not accept PIN-debit cards but accepts signature-debit cards. Consequently, the consumer uses a signature-debit card most frequently at grocery store. If this is the case, the specification, which assumes that his or her choice set consists of all

¹² For each retail type, there are 63 parameters. This implies that a two-stage model will have more than 315 parameters to be estimated jointly.

payment methods, will result in biased estimates.¹³ 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 methods), 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.

V. RESULTS

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

The estimation results are reported in tables V, VI, and VII. Table V shows the log-likelihood of all four specifications for the five types of retail stores. The table confirms that including perceptions improves the fit of our model significantly. Under the homogeneous choice set, including perceptions 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 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 choice set variation improves log-likelihood significantly. When consumer perception variables are not included (specifications 1 and 3), the log-likelihood increases by 860 for discount stores and by 440 for fast food restaurants as we move from the homogeneous choice set to the heterogeneous choice set. Although the magnitude of increase diminishes, the log-likelihood also increases when perception variables are included. This implies that

¹³ In this case, it is likely that the intercept terms for signature-debit and PIN-debit will be biased upward and

controlling the variation of individual consumer's choice set is important, especially at discount stores and fast food restaurants. At these two types of stores, the improvement in log-likelihood due to allowing choice set variation is greater than that due to including perceptions. In contrast, at grocery, department, and drug stores, including perceptions improves log-likelihood more than allowing individual choice set to vary.

Table VI 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 what 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 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 becomes insignificant in specifications 2 and 4. This suggests that the endogeneity problem discussed earlier is not merely a theoretical concern. The point estimates of the dummies have also consistently reduced after incorporating the perception variables. However, due to the non-linear nature of the multinomial logit model, strictly speaking we cannot interpret this as evidence that the rewards dummies are overestimated if perception variables are missing. In the next section, we will demonstrate the magnitude of the bias by showing how the choice probabilities changes as we move from specifications without perceptions variables (i.e., 1 and 3) to ones with perception variables (i.e., 2 and 4).

Although the estimates have become less significant after controlling for the perception variables, the credit card rewards dummy remains statistically significant for all types of retail stores, and the signature-debit rewards dummy remains significant for all retail types but fast

downward respectively.

food restaurants in specifications 2 and 4.¹⁴ We interpret this as evidence that the existing rewards programs on credit cards and signature-debit cards increases consumers' likelihood of choosing these payment methods. After incorporating the perception variables, the zero balance on credit cards dummy remains significant for grocery stores, drug stores, and fast food restaurants. This suggests that although carrying a credit card balance discourages consumers to use credit cards in grocery stores, drug stores and fast food restaurants, it does not have any significant effects on department stores and discount stores. This may be because the transaction values of department stores and discount stores are usually larger than other retail types. Consumers may feel natural to use credit cards to borrow from their future incomes when purchasing items that are relatively more costly.

Finally, table VII reports coefficients for perception variables, which are included in specifications 2 and 4. Comfortable and Fast are measured by 0-5 scale, while other variables are dummies. For both specifications, most of the perception variables are highly statistically significant at 1 percent level for all but fast food restaurants. For fast food restaurants, only Comfortable, Fast, Convenient, Help me budget, and For small amount are significant at 1 percent level. Given the nature of the fast food restaurants, these are the variables that we expect to be the most important for consumers. Overall, Comfortable and Convenient turn out to be the most crucial perception variables that influence consumer payment choices. For small amount variable is not significant in department and discount Stores. This probably reflects that the transaction values at these two retail types are usually larger than other retail types. Safe is relatively less significant. This may be because consumers feel safe to use any payment methods at the point of sale nowadays. Only one variable, Money taken right away, is not significant at

¹⁴ It seems reasonable that rewards on debit cards are significant in fast food restaurants because (i) rewards on debit cards is typically less generous than rewards on credit cards, (ii) the dollar value of transactions at fast food

any retail types. Again, this confirms that the perception variables are able to control for a large extent of consumer heterogeneity in their preferences for payment methods. The results from the homogeneous choice set specification (i.e., specification 2) are remarkably similar to those from the heterogeneous choice set specification (i.e., specification 4), with only a few exceptions.¹⁵ This indicates that our results are robust regardless of how we model consumers' choice sets.

It should be noted that we treat 0 as “least comfortable/slowest,” and 5 as “completely comfortable/fastest,” for Comfortable/Fast variables in the estimation. In the survey, however, 0 refers to “not use this payment method.” Although our interpretation seems reasonable for Comfortable, it may be problematic for Fast. As a robustness check, we estimate specifications 2 and 4 for all retail types by excluding the Fast variable, and find that the estimation results have hardly changed. We next turn to discuss how to quantify the direct effects of rewards.

V.B. The Effects of Removing Rewards

To quantify the effect of payment card rewards on payment choice, we conduct three policy experiments that remove the reward features of 1) credit cards, 2) debit cards, and 3) both credit and debit cards using specification 4.¹⁶ Our goal is to address the following question: how would consumers change their payment choice if their payment cards no longer offer rewards? Our key identification assumption is that consumer perceptions toward payment methods would remain unchanged after the rewards were removed. We believe that this is a reasonable assumption. Although some consumers may change their perceptions towards payment cards via

restaurants is usually small.

¹⁵ Help me budget is significant under homogeneous choice set, but insignificant under heterogeneous choice set at department stores; Safe is significant at all but fast food restaurants under homogeneous choice set, but only significant at department and drug stores under heterogeneous choice set.

¹⁶ We use specification 4 instead of 2 because it has better goodness-of-fit. As a robustness check, we also conduct the experiments using specification 2 and find the results have hardly changed.

learning after joining rewards programs, their perceptions will likely remain unchanged even if rewards were removed. By using specifications that *do not* include perception variables, we can measure the upper-bound of indirect plus direct effect of payment card rewards. The results can be interpreted as how consumers would have chosen their payment method if the rewards had not been introduced.

The results of these policy experiments are related to the current policy debate about interchange fees. Recently, regulatory authorities in several countries have regulated or scrutinized interchange fees.¹⁷ 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.¹⁸ As a result, interchange fees have been lowered substantially and the value of reward points has also been reduced dramatically in Australia.¹⁹ Since a substantial portion of the interchange fees is used to cover the costs of rewards programs in the United States, the policy experiments we conduct here will shed light on the consequences of a policy of disallowing card issuers to use interchange fees to cover the costs of their rewards programs.

We now discuss the results from our first policy experiment: what would happen if we remove rewards on credit cards using specification 4? 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

¹⁷ Those countries include Australia, European Union, Mexico, Spain, and the United Kingdom.

¹⁸ The Bank of Mexico has also negotiated with card associations and their members not to include costs of providing rewards to interchange fees.

¹⁹ See Table 7 (p.12) of 2006 payments System Board Annual Report by the Reserve Bank of Australia.

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 who receive rewards on credit card only, and from 2.5 (F) to 10.1 (De) percentage points for consumers who receive rewards on both credit and debit cards. The percentage point reduction in the probability of choosing credit cards is the smallest at fast food restaurants. This is probably because the average transaction value at fast food restaurants is much smaller than that at the other types of stores. Consumers cannot earn much reward from a transaction at fast food restaurants, and therefore, whether they earn rewards on the credit card or not does not affect their payment choice very much. At department stores, the percentage point reduction in the probability of choosing credit cards is the largest (CC&DC rewards) or the second largest (CC rewards only). This can also be explained by the average transaction value: the average transaction value at department stores is generally larger than those at the other types of stores, which makes reward points earned by consumers per transaction higher. Among grocery, discount, and drug stores, the percentage point reduction in

probability of choosing credit cards is the largest at grocery stores. For consumers who receive rewards on credit card only, the reduction in probability of choosing credit cards at grocery stores is 3 to 5 percentage points higher than those at discount or drug stores, while among consumers who receive rewards on both credit and debit cards, the reduction at grocery stores is at most 2 percentage points higher. Although the reductions in probability of choosing credit cards vary across retail types, overall their magnitudes are moderate. Assuming that all of reward credit cardholders' credit card transactions were rewards credit card transactions before the policy is implemented and the number of transactions made by each consumer remains unchanged under this policy experiment, our results indicates 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 who receive rewards on both credit and debit cards, 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 who receive rewards on credit cards only, the likelihood of switching to debit cards is slightly lower than that to paper-based methods except at department stores. At fast food restaurants, the majority of reductions in probability of choosing credit cards are replaced by cash transactions for both groups of consumers. At department stores, about 60 percent of the reduction in credit card choice probability is replaced by debit card for the first group of consumers; while more than 80 percent of the reduction is replaced by debit card for the second group of consumers. This is quite intuitive because consumers who receive rewards on both credit and debit cards have more incentive to use a debit card than consumers who receive rewards on credit card only. In addition, the results are also consistent

with the common beliefs that consumers prefer cash for small amount of transactions, and payment cards for large amount of transactions.

We now turn to discuss what happens if we conduct the same policy experiment by using specification 3, which does not include perception variables. As we found in the previous subsection, coefficients for reward dummies in the specifications that *do not* include perception variables are greater in magnitude than those in the specifications that *do* include perception variables. By comparing the policy experiment results from specifications 3 and 4, we are able to quantify the importance of controlling for consumer heterogeneity in preference when examining the effect of removing rewards. Figure III shows the effect of policy when using specification 3. There are several differences between figures II and III: First, the probability of choosing credit card before the policy is implemented is estimated to be slightly lower (at most 1.5 percentage points) for consumers who receive rewards on credit card only, while that is estimated to be 0.4 to 3.6 percentage points higher for consumers who receive rewards on both credit and debit cards. Specification 3 also tends to overestimate the probability of choosing credit cards for the second group of consumers compared with specification 4. Second, the reductions in probability of choosing credit cards are much larger when using specification 3. At grocery stores, more than half of the reward credit card transactions are estimated to be replaced by debit cards and paper-based methods. At the other four types of stores, the majority of the reward credit card transactions are still replaced by non-reward credit cards; however, the share replaced by non-reward credit cards is much smaller. For example, in the case of department store transactions by consumers who receive rewards on credit card only, about 88 percent of reward credit card transactions are replaced by non-reward credit card transactions under specification 4, while under specification 3, about 71 percent of reward credit card transactions

are replaced by non-reward credit card transactions. Third, more reward credit card transactions are estimated to be replaced by paper-based transactions under specification 3. For consumers who receive rewards on credit cards only, the probability of choosing paper-based methods under specification 3 is higher by 1.7 (G) to 4.2 (De) percentage points than that under specification 4, and for consumers who receive rewards on both credit and debit cards, that under specification 3 is higher by 1.4 (G) to 1.8 (Di) percentage points than that under specification 4.

These findings show the importance of incorporating consumers' perceptions towards payment methods—the policy experiments based on a model without perceptions variables could generate seriously misleading policy implications. As mentioned before, we consider the policy that removes credit card rewards today rather than a counterfactual policy in which the credit card rewards would not have been introduced. The policy considered here does not eliminate the effect of credit card rewards in the past, i.e., the rewards improved consumer perceptions toward credit cards, which reduced paper-based transactions. However, if we use specification 3, the past effect of credit card rewards is likely to be eliminated because specification 3 does not control for consumer unobservable heterogeneity in preference. As a result, specification 3 overestimates the probability of choosing paper-based methods as substitutes for reward credit cards by 1.4 to 4.2 percentage points. This overestimation may potentially be large enough to alter the policy decision of removing credit card rewards. It is possible that specification 4, an appropriate specification, would suggest the policy removing credit card rewards today would result in cost-saving for the society as a whole, while specification 3 would suggest the same policy would be too costly for the society because the policy would increase too many paper-based transactions.

Critics of the credit card industry have argued that credit card rewards could increase consumers' credit card debts. In order to shed light on this public policy debate, we consider how consumer reaction to the policy of removing rewards from credit card varies depending on whether consumers carry a positive credit card balance or not. We divide consumers with rewards on credit cards only into two groups: (i) consumers with a positive credit card balance, and (ii) consumers without a balance. Figure IV presents the effects of removing credit card rewards on these two groups of consumers' average probability of choosing credit cards. In the figure, each type of stores has two bars: the left bar represents the consumers with a balance and the right bar represents the consumers without a balance. It should be highlight that consumers with a positive credit card balance are far less likely to choose a credit card at all types of stores before the policy is implemented. This suggests that consumers with credit card balance may be discouraged to use credit cards because of their high interest rates. After implementing the policy, both groups would reduce their probability of choosing credit cards. In particular, for consumers with credit card balance, the percentage point reduction ranges from 3 (F) to 12 (De) percentage points. This suggests that by removing the rewards, the policy could provide some non-trivial effects of reducing the credit card debts for some consumers, which could in turn potentially reduce card issuers' profits.

We now turn to discuss the results from the second policy experiment which removes rewards on debit cards. We divide consumers who would be affected by the policy into two groups: (i) consumers who receive rewards on debit card only (DC rewards only) and (ii) consumers who receive rewards on both credit and debit cards (CC&DC rewards). We calculate each group's average probabilities of choosing credit cards, debit cards, and paper-based methods before and after the policy is implemented. Similar to figure II, figure V shows the

effect of the policy on the two groups of consumers. In this figure, the height of the bar (measured from 0 percent) represents the probability of choosing debit cards before the policy is implemented. The left five bars show the effects on consumers who receive rewards on debit card only, and the right five bars show the effects on consumers with rewards on both credit and debit cards.

At all types of stores except fast food restaurants, both groups of consumers would reduce their probability of choosing debit cards if rewards on debit cards were removed.²⁰ In general, the reductions are much smaller than those of choosing credit cards under the first policy. They range from 2.1 (Di) to 6 (Dr) percentage points for consumers who receive rewards on debit card only, and from 3.4 (Di) to 7.5 (De) percentage points for consumers who receive rewards on both credit and debit cards. This may reflect the fact that rewards on debit cards are typically much less generous than those on credit cards. Consumers with rewards on both credit and debit cards would be more likely to substitute credit cards than paper-based methods for debit cards, while consumers with rewards only on debit cards would be more likely to do the opposite. The main message of this experiment is the same as the first experiment: the majority of reward debit card transactions would be replaced by non-reward debit card transactions if rewards on debit card were removed.

Finally, we consider the policy that removes rewards on both credit and debit cards. This policy affects three types 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 and on the second group of consumers are the same as those of the first policy and of the second policy,

²⁰ The reason why the probability of choosing debit cards would increase at fast food restaurants is that debit reward dummies are estimated to be negative, although they are statistically insignificant.

respectively, we will consider the effects on the third group of consumers here. In Figure VI, 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.

Consumers with rewards on both credit and debit cards would reduce their probability of choosing credit cards at all types of stores; however, the reductions in 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. The increases in probability of choosing paper-based methods range from 1.0 (F) to 6.3 (Dr) percentage points. Similar to the first and second policies, we find that most of the rewards credit (debit) cards users would keep using credit (debit) cards even if there were no rewards.

We have shown how the policies that remove rewards on payment cards affect consumers who currently receive rewards. Policymakers and industry participants would be also interested in overall effects of the policy. However, aggregating the effects of policy is very difficult. First of all, our analysis is limited to consumer payment choice for in-store transactions, but consumers also make payments for bills and online purchases. Even within in-store transactions, we only modeled consumer payment choice at five retail types, but there are many other retail types. Second, even among the five retail types, it is difficult to aggregate the effects of policy because the number of transactions each consumer makes at each type of stores is unobservable.

It may be implausible to assume all consumers distribute their transactions across the five retail types in one common way. For instance, for some consumers the share of grocery store transactions in their weekly in-store transactions is relatively higher than that for other consumers. Thus, we consider the effects of the policy at each of the five types of stores. 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 the policy is implemented. 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 store.²¹ This gives us an idea of how the policy impacts the payment transaction share at each type of stores. The effects of removing rewards are likely overestimated because our sample only includes consumers who hold a bank account as well as both credit and debit cards.²²

Table VIII 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 more than 3 percentage points at grocery and department stores, by more than 2 percentage points at drug and discount stores, 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, are replaced more by debit card transactions at department stores, and are replaced more 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

²¹ We also calculate the weighted average according to the number of in-store transactions of individual consumers. The results are similar to the unweighted average reported here.

on debit cards (policy 2) would reduce the debit card share by at most 1 percentage point.²³ The substitution patterns—whether the reduced card transactions are replaced more by the other type of card transactions or by paper-based transactions—are similar to those under policy 1. Under this policy, the share of paper-based transactions would increase by no more than 0.55 percentage points. Removing rewards on both credit and debit cards (policy 3) 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 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) if rewards were removed from credit cards and/or debit cards. The actual impact of removing rewards on payment choice would likely be even smaller than the results presented here for at least two reasons: First, as mentioned above, our sample do not include consumers who do not have a bank account, a credit card, or a debit card. Thus, the actual share of consumers who receive rewards among all consumers may be even smaller. Second, our coefficients for reward dummies in the specifications that include perception variables estimate the upper bound of the direct effect of rewards. As explained in the previous section, the coefficients for reward dummies are likely to be heterogeneous—consumers who have relatively high coefficients for rewards are more likely to obtain reward cards, however, we assumed they are homogeneous across consumers to simplify our estimation.

²² The effects could potentially be underestimated at certain types of stores if reward cardholders tend to make more transactions than non-reward cardholders at the stores. From the data, however, we do not observe any differences in the total number of in-store transactions between reward cardholders and non-reward cardholders.

²³ It is estimated that removing rewards on debit cards would increase debit card transactions by 0.12 percentage points at fast food restaurants. This is due to the negative coefficients for debit card reward dummies, which are statistically insignificant.

VI. CONCLUSION

This paper estimates the effects of payment card rewards programs on consumer payment choice for in-store transactions. By using a unique data set that contains rich information on consumer perceived attributes of payment methods and consumers' perceptions about which payment method is accepted by different types of retail stores, we are able to control for consumer heterogeneity in preferences and choice sets.

Our policy experiments suggest that removing rewards today would only cause a small percentage of consumers switching from electronic payment methods (credit/debit cards) to paper-based methods (cash/checks) at least 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 are no longer offered. Interestingly, our findings are consistent with the experiences in Australia. Although we cannot observe cash transaction volume or value, we observed that the usage pattern of credit cards has been essentially unchanged even though the value of the rewards points has been reduced dramatically after the Reserve Bank of Australia regulated the credit card interchange fees. Credit card transactions, in terms of volume as well as value, have continued to increase after the regulation took effect. Considering payment card market as a whole, combined market share of three credit card networks, Bankcard, MasterCard, and Visa, that were mandated to reduce their interchange fees in terms of volume has declined slightly (from 46.7 percent in 2003 to 43.5 percent in 2006), while the other credit card networks have increased their combined share (from 5 to 6 percent) and EFTPOS, the Australia's national debit card scheme, has increased its share (from 48.1 to 50.3 percent).^{24,25} Bankcard,

²⁴ Bankcard discontinued its operation starting January 1, 2007.

²⁵ These market shares are calculated by using statistics the Reserve Bank of Australia posted on the Web site. Our calculation does not include Visa Debit, another debit card network in Australia, because the statistics are not

MasterCard, and Visa's combined share in terms of transaction value has also declined slightly (by 1.9 percentage points), while American Express and Diners Club's combined share has increased by 1.2 percentage points and EFTPOS's share has increased 0.7 percentage points. These trends likely suggest that some of the consumers who received rewards on their Bankcard, MasterCard, or Visa credit cards may have switched to American Express or Diners Club credit cards, which now give more generous rewards than these three credit cards and some of them may have switched to EFTPOS, which does not provide rewards, but the majority of them have continued to use Bankcard, MasterCard, and Visa credit cards.

Although our results suggest that removing rewards today would not change consumers' use of payment cards very much, we do not claim that rewards have played a small role in the growth of credit and debit cards. Offering a reward credit/debit card to consumers who initially did not have favorable perceptions on the attributes of credit/debit card could have increased those consumers' usage of the card via the indirect effect: rewards might have induced them to try the card and consequently have changed their perceptions toward the card from unfavorable to favorable one. The difference in our estimates in specifications that *do* and *do not* include perception variables suggests that this indirect effect may not be small.

Another policy implication from our results is that removing rewards programs could potentially reduce consumers' credit card debts. As many critics pointed out, it is not clear if rewards received by consumers can compensate the increase in interest payment. It is also unclear if rewards will necessarily increase card issuers' revenues. On one hand, card issuers receive more interests from consumers who continue to keep up with their monthly minimum payment. On the other hand, the increase in credit card debt may also increase the default rate.

available. According to the information furnished by the Building Society to the Reserve Bank of Australia, EFTPOS share of the overall debit network is roughly 90 percent, while Visa Debit's is roughly 10 percent.

Our results also have implications to the businesses: credit card rewards programs would likely be beneficial to card issuers, while debit card rewards programs may not. We find that the effect of credit card rewards on the consumers' use of credit cards is greater than the effect of debit card rewards on the use of debit cards. We also find that consumers who currently receive rewards on debit cards would have replaced some of their credit card transactions with debit card transactions. Because a credit card transaction is typically more profitable than a debit card transaction due to higher interchange fees and potential revenues from interests, card issuers may want to be cautious when promoting rewards *debit* cards to their *credit* card customers.

This paper focuses on consumers' in-store transactions. We have not examined payment choice over Internet transactions or bill payments. As we find that the effects of payment card rewards vary significantly by retail type, its effects in these two areas are likely to be different from the in-store transactions. Moreover, we have not examined how payment card rewards affect the overall number of transactions or overall consumer spending. More comprehensive analysis is needed to understand how payment rewards affect overall consumer payment choice, card issuers, and the economy as a whole.

REFERENCES

- Amromin, Gene, Carrie Jankowski, and Richard Porter. 2005. "Transforming Payment Choices by Doubling Fees on the Illinois Tollway," Federal Reserve Bank of Chicago working paper.
- Ausbel, Lawrence. 1991. "The Failure of Competition in the Credit Card Market," *American Economic Review*, 81(1): 50-81.
- Bertaut, Carol and Michael Haliassos. 2002. "Debt Revolvers for Self-Control," University of Cyprus Working Papers in Economics 0209.
- Borzekowski, Ron, Elizabeth Kiser, and Shaista Ahmed. 2006. "Consumers' Use of Debit Cards: Patterns, Preferences, and Price Responses," *Federal Reserve Board Finance and Economics Discussion Series*, 2006-16.
- Bronnenberg, Bart and Wilfried Vanhonacker. 1996. "Limited Choice Sets, Local Price Response, and Implied Measures of Price Competition," *Journal of Marketing Research*, 33: 163-174.
- Chiang, Jeongwen, Siddhartha Chib, and Chakravarthi Narasimhan. 1999. "Markov Chain Monte Carlo and Models of Consideration Set and Parameter Heterogeneity," *Journal of Econometrics*, 89: 223-248.
- Dawson, Amy and Carl Hugener. 2006. "A New Business Model for Card Payments," Diamond Management & Technology Consultants, Inc.
- Dove Consulting and the American Bankers Association. 2005. *The 2005/2006 Study of Consumer Payment Preferences*.
- Hayashi, Fumiko and Elizabeth Klee. 2003. "Technology Adoption and Consumer Payments: Evidence from Survey Data," *Review of Network Economics*, 2(2): 175-190.
- Hayashi, Fumiko, Richard Sullivan, and Stuart Weiner. 2003. *A Guide to the ATM and Debit Card Industry*. Federal Reserve Bank of Kansas City.
- Harris, Katherine and Michael Keane. 1999. "A Model of Health Plan Choice: Inferring Preferences and Perceptions from a Combination of Revealed Preference and Attitudinal Data," *Journal of Econometrics*, 89: 131-157.
- Hirschman, Elizabeth. 1982. "Consumer Payment Systems: The Relationship of Attribute Structure to Preference and Usage," *Journal of Business*, 55(4): 531-545.
- Humphrey, David, Moshe Kim, and Bent Vale. 2001. "Realizing the Gains from Electronic Payments: Costs, Pricing, and Payment Choice," *Journal of Money, Credit and Banking*, 33(2): 216-234.

- Jonker, Nicole. 2005. "Payment Instruments as Perceived by Consumers - A Public Survey," De Nederlandsche Bank Working Paper No. 053/2005.
- Klee, Elizabeth. 2006a "Families' Use of Payment Instruments During a Decade of Change in the U.S. Payment System," *Federal Reserve Board Finance and Economics Discussion Series*, 2006-1.
- Klee, Elizabeth. 2006b "Paper or Plastic? The Effect of Time on the Use of Check and Debit Cards at Grocery Stores," *Federal Reserve Board Finance and Economics Discussion Series*, 2006-2.
- Kennickell, Arthur and Myron Kwast. 1997. "Who Use Electronic Banking? Results from the 1995 Survey of Consumer Finance," *Proceedings from the 33rd Annual Conference on Bank Structure and Competition*, Federal Reserve Bank of Chicago, 56-75.
- Mantel, Brian. 2000. "Why Do Consumers Pay Bills Electronically? An Empirical Analysis," *Federal Reserve Bank of Chicago Economic Perspectives*, 32-47.
- Mehta, Nitin, Surendra Rajiv, and Kannan Srinivasan. 2003. "Price Uncertainty and Consumer Search: A Structural Model of Consideration Set Formation," *Marketing Science*, 22(1): 58-84.
- Horsky, Dan, Sanjog Misra, and Paul Nelson. 2006. "Observed and Unobserved Preference Heterogeneity in Brand Choice Models," *Marketing Science*, 25: 4, July-August 2006, pp. 322-335.
- Prelac, Drazen and Duncan Simester. 2001. "Always Leave Home without It: A Further Investigation of the Credit Card Effect on Willingness to Pay," *Marketing Letters*, 12(1): 5-12.
- Reserve Bank of Australia. 2006. *Payment System Board Annual Report*.
- Stavins, Joanna. 2001. "Effect of Consumer Characteristics on the Use of Payment Instruments," *Federal Reserve Bank of Boston New England Economic Review*, (3): 19-31.
- Zinman, Jonathan. 2005. "Debit or Credit?" Working Paper, Dartmouth University.

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
		N=1979	N=721

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

TABLE II: Reward Card Holders

	Sample size	Percent of sample	Percent of reward card holders
Rewards card holders	721	36.43	100
Reward credit	634	32.03	87.93
Reward debit	269	13.59	37.31
Reward PIN debit	131	6.62	18.17
Reward signature debit	242	12.28	33.56
Reward credit & debit	182	9.20	25.24
Reward credit & PIN debit	82	4.14	11.37
Reward credit & signature debit	167	8.44	23.16

**TABLE III: Summary Statistics on Consumer Perceived Payment Method Attributes
(A) All Consumers**

Attribute	Scale	Cash	Check	Credit card	PIN-debit	Signature-debit
Comfortable	0: not use, 1 not, 5: completely	4.63	3.69	3.98	3.49	3.41
Fast		4.53	2.42	3.81	3.34	3.11
Convenient	0: no 1: yes	0.84	0.21	0.68	0.57	0.46
Easy to use		0.85	0.22	0.69	0.55	0.46
Preferred by stores		0.76	0.07	0.58	0.41	0.32
Safe		0.56	0.22	0.39	0.38	0.30
Taken right away		0.26	0.12	0.12	0.75	0.50
Helps me budget		0.60	0.30	0.18	0.44	0.33
For small amounts		0.89	0.11	0.11	0.28	0.19
Control		0.62	0.34	0.25	0.47	0.37
Easy-to-get refund		0.57	0.17	0.66	0.41	0.37

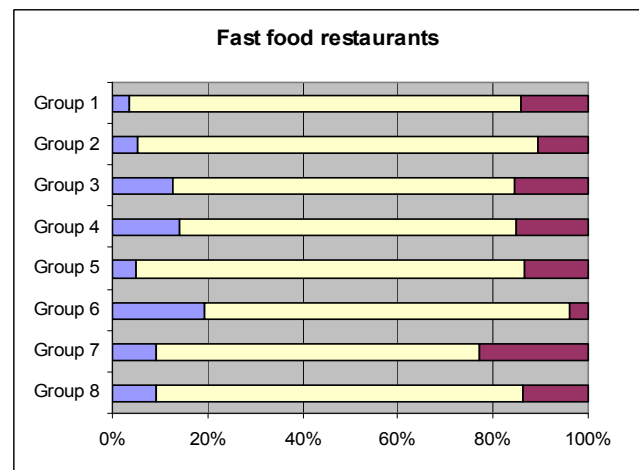
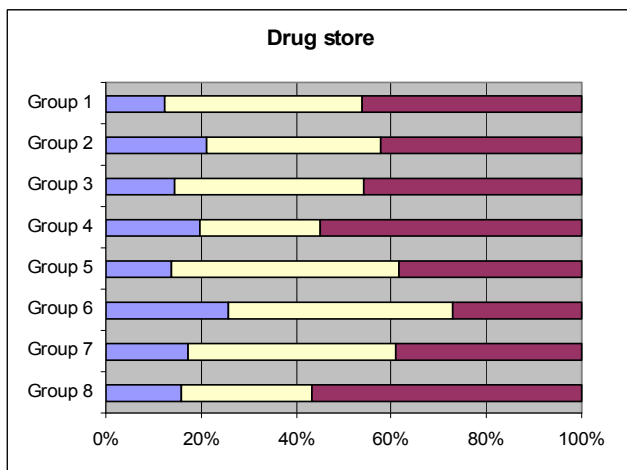
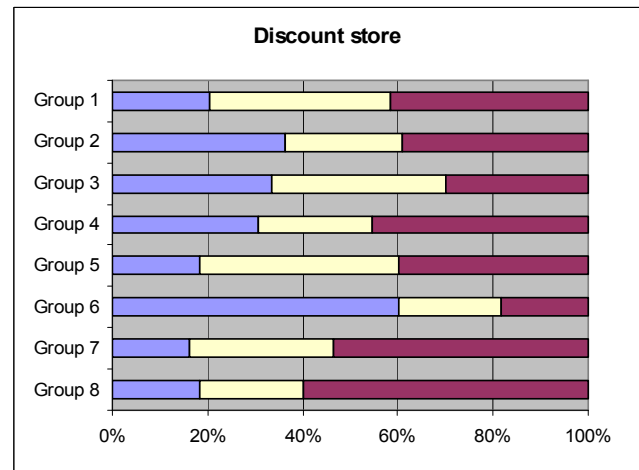
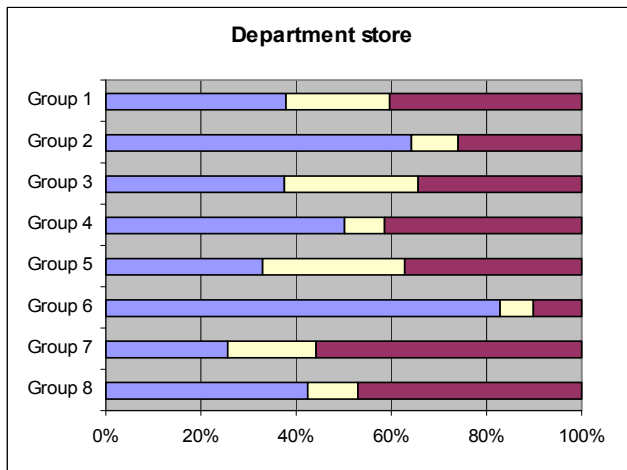
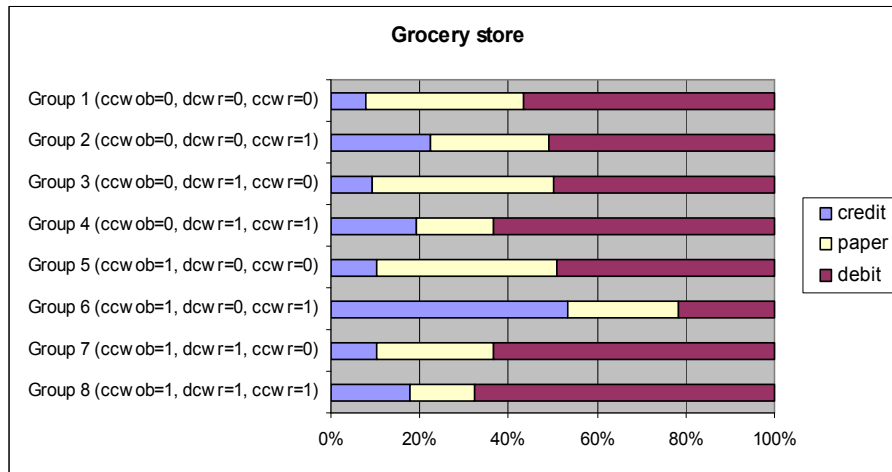
(B) By Reward Status

Attribute	Credit card		PIN-debit		Signature-debit	
	w/ rewards	w/o rewards	w/ rewards	w/o rewards	w/ rewards	w/o rewards
Comfortable (0-5)	4.49	3.74	4.18	3.45	4.43	3.27
Fast (0-5)	4.13	3.66	3.99	3.29	4.03	2.98
Convenient	0.82	0.61	0.54	0.57	0.61	0.44
Easy to use	0.84	0.61	0.55	0.55	0.62	0.44
Preferred by stores	0.65	0.54	0.38	0.41	0.43	0.30
Safe	0.54	0.33	0.39	0.38	0.46	0.28
Taken right away	0.12	0.13	0.72	0.75	0.58	0.48
Helps me budget	0.27	0.14	0.50	0.43	0.50	0.31
For small amounts	0.14	0.10	0.29	0.28	0.27	0.18
Control	0.39	0.18	0.51	0.47	0.53	0.35
Easy-to-get refund	0.80	0.59	0.33	0.41	0.53	0.34

TABLE IV: 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



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 V: 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 VI: 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)	0.720 ^{***} (0.156)
	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)	0.633 ^{***} (0.177)
	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)	0.531 ^{**} (0.274)
	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)

TABLE VII: 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)

FIGURE II: The Effects of Removing Credit Card Rewards

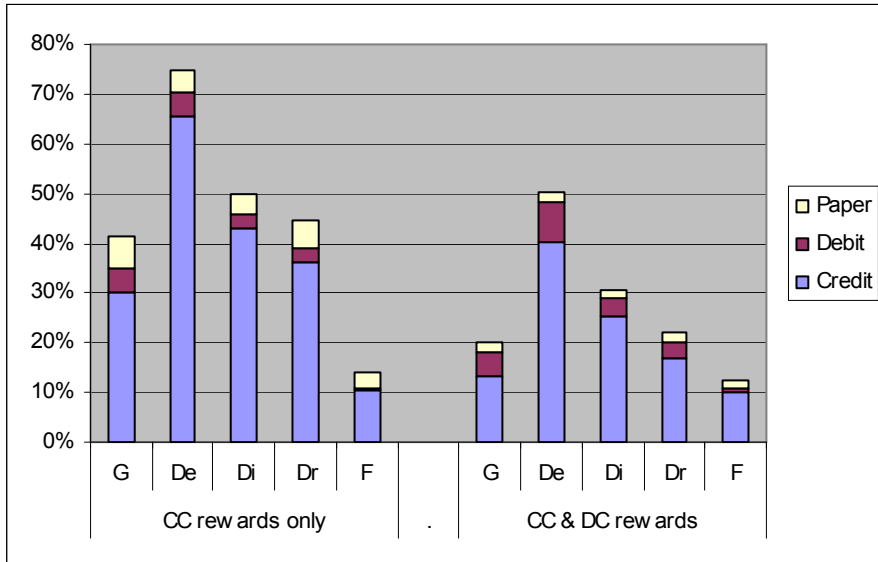


FIGURE III: The Effects of Removing Credit Card Rewards Using Specification without Perception Variables

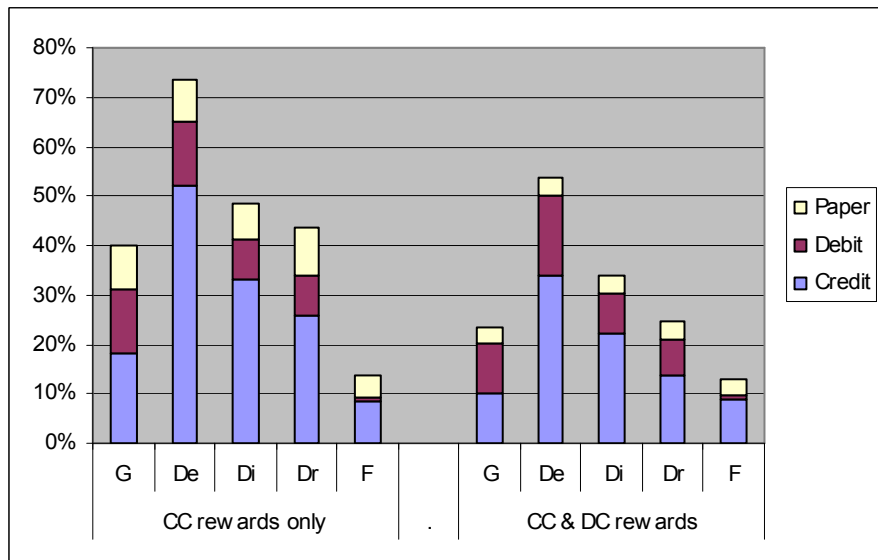
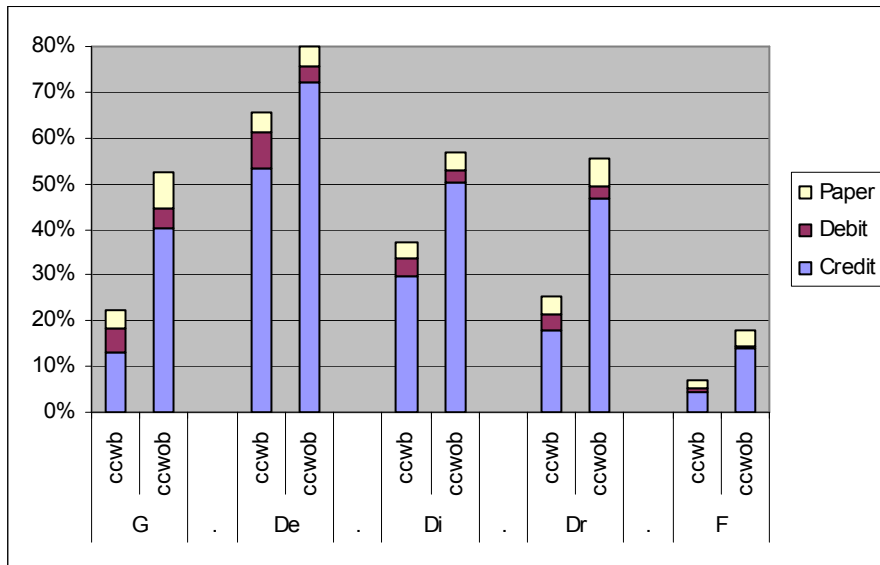


FIGURE IV: The Effects of Removing Credit Card Rewards on Consumers with and without Credit Card Balance



Note: ccwb: consumers with a balance on credit cards.
ccwob: consumers without a balance on credit cards.

FIGURE V: The Effects of Removing Debit Card Rewards

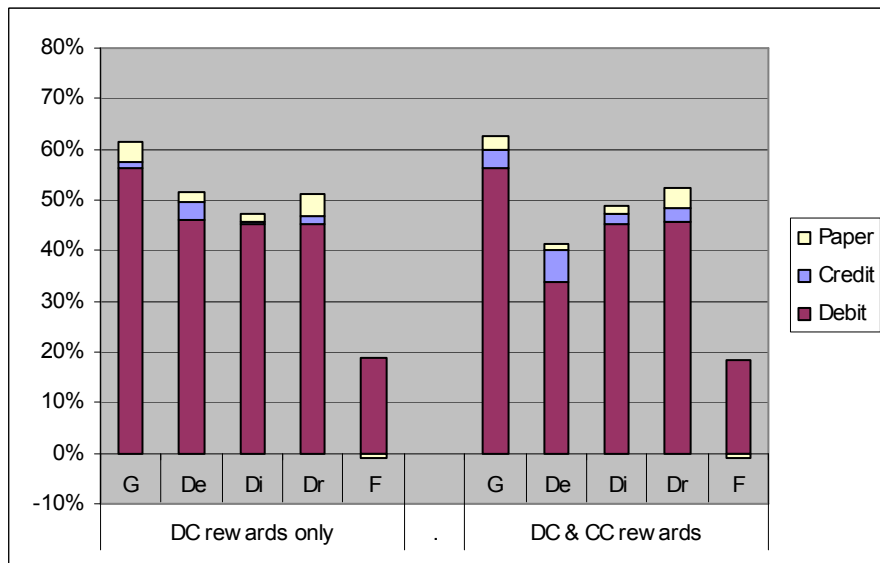


FIGURE VI: The Effects of Removing Credit and Debit Card Rewards

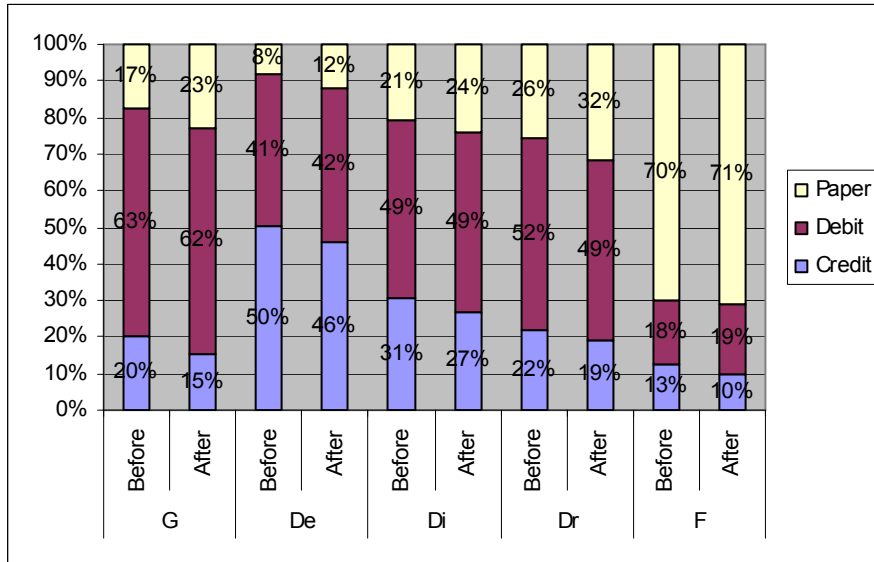


TABLE VII: Overall Effects of Removing Rewards

(Unit: percentage points)

	Policy 1 Removing credit card rewards			Policy 2 Removing debit card rewards			Policy 3 Removing both credit and debit card rewards		
	credit	debit	paper	Credit	debit	paper	credit	debit	paper
Grocery	-3.25	1.60	1.65	0.38	-0.82	0.44	-3.00	0.86	2.14
Department	-3.12	1.93	1.18	0.74	-0.95	0.20	-2.42	0.98	1.44
Discount	-2.02	1.00	1.02	0.22	-0.40	0.19	-1.83	0.60	1.23
Drug	-2.43	0.99	1.44	0.34	-0.89	0.55	-2.17	0.12	2.04
Fast food	-1.01	0.16	0.85	-0.02	0.12	-0.09	-1.03	0.27	0.75