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## Abstract

This paper uses discrete-choice models to quantify the role of consumer socioeconomic characteristics, payment instrument attributes, and transaction features on the probability of using cash, debit card, or credit card at the point-of-sale. We use the Bank of Canada 2009 Method of Payment Survey, a two-part survey among adult Canadians containing a detailed questionnaire and a three-day shopping diary. We find that cash is *still* used intensively at low value transactions due to speed, merchant acceptance, and low costs. Debit and credit cards are used more frequently for higher transaction values where safety, record keeping, the ability to delay payment and credit card rewards gain prominence. We present estimates of the elasticity of using a credit card with respect to credit card rewards. Reward elasticities are a key element in understanding the impact of retail payment pricing regulation on consumer payment instrument usage and welfare.

*JEL classification: E41, C35, C83*

*Bank classification: Bank notes; Econometric and statistical methods; Financial services*

## Résumé

Les auteurs font appel à des modèles de choix discrets pour quantifier le rôle des traits socioéconomiques des consommateurs, des attributs des instruments de paiement et des caractéristiques des opérations dans la probabilité d'usage de l'argent comptant, des cartes de débit et des cartes de crédit au point de vente. À cette fin, ils se servent des données de l'enquête sur les modes de paiement menée par la Banque en 2009 auprès des Canadiens d'âge adulte – sondage à deux volets comprenant un questionnaire détaillé et un journal d'achats tenu pendant trois jours. Ils constatent que l'argent comptant est *encore* beaucoup utilisé pour les petits achats parce que ce mode de paiement est rapide et peu onéreux et qu'il est bien accepté par les marchands. Les cartes de débit et de crédit sont plus souvent choisies pour les transactions de plus grande valeur où la sécurité, l'enregistrement de l'opération et la possibilité, dans le cas des cartes de crédit, de différer le paiement et d'obtenir des récompenses ont plus d'importance. Les auteurs donnent des estimations de l'élasticité de l'utilisation de la carte de crédit par rapport aux récompenses offertes. Les élasticités-récompenses constituent un élément clé pour examiner les effets de la réglementation relative à la tarification des paiements de détail sur l'usage des différents instruments de paiement par les consommateurs et sur le bien-être de ces derniers.

*Classification JEL : E41, C35, C83*

*Classification de la Banque : Billets de banque; Méthodes économétriques et statistiques; Services financiers*

# 1 Introduction

Debit and credit cards have changed how consumers pay for every day retail transactions. As a result, there has been a significant shift from cash into debit and credit cards. To better understand the current tradeoffs between payment instruments, this paper investigates consumers' use of cash, debit and credit cards for everyday transactions using the 2009 Bank of Canada Method of Payment (MOP) survey. The dataset is a rich micro survey of adult Canadians who completed a household survey questionnaire and a three-day shopping diary of personal transactions.

One of the key stylized facts in retail payments is the strong relationship between transaction value and payment instrument choice. Table 1, illustrates the dominance of cash as a payment choice, in terms of volume and value, for transaction values below 25 dollars. However, above 25 dollar debit and credit cards dominate in terms of volume and value.

The contribution of our paper is to understand the underlying factors governing the transaction value and payment choice relationship. Previous work such as Bounie and Francois (2006) and Klee(2008) have found that transaction value is a good predictor of payment choice. Our study is similar in spirit to Klee (2008) as she focuses on point-of-sale data from scanners in grocery stores. She finds that payment patterns vary significantly by consumer demographics such as income and age. However, this relationship could be driven by unobservable factors such as: the consumers' weighting of convenience and cost of alternative payment methods. Another drawback of her study is that the demographic data is at the census-tract level, therefore, the results cannot be directly translated into consumer characteristics.

The novelty of our study is that we can estimate a discrete-choice model that accounts for the effects of consumer demographic characteristics, payment attributes, perceptions and transaction features on the probability of using cash, debit and credit cards at the point-of-sale (POS). Our results show that payment choices are a function of incentives derived from payment instrument attributes such as fees, rewards, interest rates, speed and security. Demographics and transaction values play a limited role once these factors, which are correlated with transaction value, are taken into consideration. We briefly summarize our findings as follows:

1. Cash dominates at the lower transactions below 25 dollars. We find that this result is

driven by: one, the perception that there is a limited acceptance for alternative payment methods; two, the high premium consumers place on ease of use/speed; and three, how much cash is on hand. However, debit cards compete closely with cash due to security, record keeping, and costs.

2. Above a transaction value threshold of 25 dollars, there is a strong substitution effect from debit cards to credit cards due to credit card rewards. For example, at transactions between 25 and 100 dollars, those with credit card rewards are 3.6 to 12.8 percent more likely to pay with credit cards relative to those without rewards. However, most of the rewards effect is due to the change in monetary rewards as they are proportional to the transaction value (e.g. rebates, miles, etc.). We compute the elasticity of the credit card probability with respect to rewards and find that consumers are relatively inelastic to credit card monetary incentives. Our elasticity calculation reveals that a 10 percent increase in dollar incentives raises the likelihood of paying with credit card by about 1.2 to 3.7 percent depending on the transaction value and the rewards plan. Our results are consistent with those found by Simon, Smith, and West (2010) and Ching and Hayashi (2010) who also investigated the effect of monetary incentives on payment choice.
3. Other monetary incentives are significantly associated with different payment behaviour. Debit cards are the predominant payment method among consumers who have a debit card plan that does not charge per-transaction fees. Furthermore, credit card convenience users (those who pay credit card charges due in full) are more likely to use their credit card than revolvers (those who do not pay their balance in full), indicating that revolvers are sensitive to the higher marginal costs of credit card liquidity.

Overall, consumers prefer to use cash because it is easy to use and widely accepted. The effects of credit card reward plans induce substitution away from debit into credit while the effect on cash is small. However, innovations in debit and credit card that make them *easy to use* along with *increased acceptance* may diminish the use of cash. Our elasticity estimates can be used to provide empirical insights to the theoretical literature on ad-valorem fees and how rewards can be used to exercise price discrimination in payment networks as in Shy and Wang (2011). Also, these insights may also help us to understand the interplay between market structure and

regulation as discussed in a cross-country comparison by Hayashi and Wiener (2006) and more recently in the US by Prager, Manuszak, Kiser, and Borzekowski (2009), inter alia.

The rest of the paper is organized as follows: Section 2 provides a brief description of the 2009 Bank of Canada MOP survey while section 3 briefly discusses the discrete-choice methodology utilized in this paper. The empirical results are presented in section 4 while Section 5 concludes.

## **2 2009 Method of Payments Survey**

The Bank of Canada commissioned the survey to a market research firm which constructed the sample from access panels. Access panels are databases of people that sign up to participate in surveys on a regular basis. The sample was drawn from two access panels; an online panel of about 200,000 households, from which 2,000 diaries were targeted, and an offline *mail out* panel with close to 50,000 households, from which 1,000 diaries were targeted. The inclusion of an offline panel improved coverage of segments of the population without internet access and who may have significant differences in payment instruments use.

The 2009 MOP survey focuses on payment choice for day-to-day purchases of goods and services, abstracting from bill payments and purchases associated with work or self-employment activities. Stratified random samples of adults 18 to 75 years old were drawn from both panels in order to meet quota targets towards a national representative sample. The surveys were sent out in waves spread out across different days of November 2009, so that the diaries could be representative of a month's worth of transactional data.

Respondents were asked to complete two survey instruments: a survey questionnaire (SQ) and a three-day diary survey instrument (DSI). The SQ contained 52 questions similar to the 2004 Bank of Canada survey and the 2008 Survey of Consumer Payment Choices of the Federal Reserve Bank of Boston and Dove Consulting, further details are available in Foster, Meijer, Schuh, and Zabek (2010) and Arango and Welte (2011). The SQ was divided into four major sections:

1. Banking information on debit and credit cards, their respective types and features.
2. Consumer perceptions on payment instrument attributes such as: ease of use, record

keeping, risks, costs, and acceptance.

3. Cash holdings and cash management choices such as frequency of cash withdrawals.
4. A comprehensive set of socioeconomic questions including knowledge of personal finance and behavioral attitudes on shopping behavior.

The DSI collected retail information about payment behavior and transaction characteristics as follows:

1. The front section collected information about cash and card holdings, to be completed by respondents prior to starting the diary.
2. Participants were then asked to record the following information about each purchase of goods or services:
  - Core transaction attributes such as payment amount, type of good or service purchased, type of merchant, day of week, and payment instrument used.
  - The two top stated reasons for a particular payment instrument choice.
  - Which payment instrument, if any, was not accepted by the merchant to settle the transaction.

The respondents from the online panel were allowed to opt-out of participating in the diary resulting in roughly 40 percent of online SQ respondents completing the DSI. The combination of the online and the offline subsamples provided a total of 6,800 questionnaires, 3,190 diaries and about 15,000 transactions. Appropriate weights were designed to combine the online and offline subsamples, using the demographic profile of the Statistics Canada 2009 Canadian Internet Use Survey (CIUS) and a random digital dialing telephone survey that included five questions on payment instrument ownership, usage and attitudes towards payment instrument attributes as benchmarks. The CIUS is a national representative sample of 23,178 residents of Canada 18 years of age or older.

Table 2 shows the final distribution of the survey before and after weighting both the SQ

sample and the DSI sample. The last column represents the distribution of the Canadian population based on CIUS. The weighed samples better match the CIUS sociodemographic profile compared to the unweighted samples.

## 2.1 Payment Instrument Perceptions

Perceptions about payment attributes, such as convenience, costs and risks, have been used extensively in payments survey design to understand what could explain differences in payment use. They are convenient measures of underlying costs and benefits that vary by consumers but are hard to observe by researchers. For instance, how difficult is it to remember pin numbers; or do online banking to keep track of expenditures, or sign up for a credit card; or, how risky it is for people to hold or withdraw cash or be exposed to identity theft? Including perceptions in the econometric analysis of payment behaviour has proven very useful in terms of model fitness and also in terms of an explicit account of the unobservable components of consumer preferences and a better understanding of substitution among choices (e.g. Ching and Hayashi (2010) and Schuh and Stavins (2010)).

The survey provides a rich set of questions on perceptions about different means of payment attributes. Respondents were asked to rank their perceptions of cash, debit cards, credit cards, stored-value cards and personal cheques in terms of ease of use, record keeping, risk of financial loss, acceptance by merchants, and costs, with five possible categorical levels. The rankings were done on a *Likert* scale from one to five, where five was associated with the strongest view. The survey respondents also answered attitudinal questions, ranking the importance of several key payment attributes, such as: ease of use, security, anonymity, fear of overspending and speed of transaction. The ranking of importance was based on a scale from one to ten.

Table 3 presents summary statistics of perceived payment method attributes based on our estimation sample. On average, cash is perceived as the least costly, most accepted and safest. Credit cards on the other hand are perceived as the easiest to use but most costly, and risky; although they rank better than debit cards in terms of record keeping and acceptance. Ease of use was deemed the most important attribute on average followed by security, speed, anonymity and potential to control overspending.

In the models below we work with relative measures of perceived attributes. Following Arango and Taylor (2009), relative measures of participant  $i$  perceived payment attributes are calculated as:

$$RCHAR_{kji} \equiv \frac{CHAR_{kji}}{\sum_{j=1}^m CHAR_{kji}}, \quad (1)$$

where  $k$  indexes the five characteristics and  $j$  indexes over the  $m$  payment instruments. In this way, perceptions of a particular attribute are normalized by the individual's overall absolute perceived levels of satisfaction across payments. This index allows for standardized levels of satisfaction across payment attributes and individuals. We normalize the rating of importance of attributes by the ranking of importance for ease of use.

## 2.2 Debit and Credit Card Account Plans

The survey provides detailed information on the types of bank and credit card accounts held by survey respondents. In terms of debit card fees, consumers are mostly divided into two schemes. One which resembles a pay-as-you-go plan with limited free debit transactions and likely a monthly fee. The other with a large or unlimited number of free debit transactions and either a monthly fee or no fee in the case it is waived by holding minimum bank account balances. In particular, 60 percent pay monthly fees, 72 percent have more than 20 free debit transactions and 66 percent of those paying monthly fees have more than 20 free transactions.

In terms of credit card plans, the data shows that consumers are divided into those with no annual fees but high interest rates, many whom use their credit cards for convenience as they pay their credit card balances in full at the end of the month. In particular, 62 percent of the survey respondents do not pay annual fees, 63 percent face 15-20 percent interest rates or higher and 59 percent have paid their balance in full at the time of the survey. Finally, among those that have access to a credit card, 71 percent have some type of reward program.

These differences in debit and credit card plans clearly bring different sets of incentives that would impact significantly the likelihood of choosing a particular payment instrument at the POS. As an illustration, the information in the diaries show that the proportion of credit card payments for those that do not have reward programs associated with their credit cards are three times lower than the proportion of credit card payments of those with reward programs. In the next section we describe credit card reward plans in detail.

## 2.3 Credit Card Rewards Plans

The survey identifies whether respondents earn rewards on their credit cards but does not explicitly identify the respective reward plan. However, using the name of the credit card which the respondent provides, we are able to match the rewards program associated with their credit card using publicly available information directly from the financial institution or from the Financial Consumer Agency of Canada (FCAC).<sup>1</sup> Although Canada is noted for a highly concentrated banking sector with a relatively small number of financial institutions, amongst the respondents there were 178 different credit card types. Of these, roughly 50 percent are associated with some sort of *ad valorem* reward program which either falls in the broad category of: cash-back, reward points redeemable for a selection of merchandise, travel or gift cards, and air miles principally for travel, but which may also be converted to merchandise. In the event that the credit card name is not provided or cannot be identified, we use the stated features as the most precise measure.

In order to have various rewards on the same scale, we convert points and miles to an equivalent percentage cash-back. However, the reward structure is often non-linear when converting points to a monetary value. For example, an American Express AIR MILES credit card user receives one air mile per 20 dollars spent. However, the value obtained in merchandise or travel certificates as a share of miles depends on the number of miles redeemed. Air tickets are hard to value given the volatility of pricing. To provide a direct measure, we focus on branded gift certificates which translate into an exact monetary value. For example, in the Summer of 2011, a Toys R Us<sup>®</sup> 20 dollar gift certificate required 175 air miles which translates into roughly 0.67 percent rewards. Due to the ambiguity of the reward schedule we impute 0.5 percent. Placing a lower bound on the equivalent measure of percentage cash back is to prevent an overestimate of the rewards effect. This ambiguity is especially acute when the reward incentive is tiered depending on aggregate annual credit card expenditures. In this case, we estimate the respondent's total credit card expenditures since the start of 2009 up to the beginning of the diary based on their last month's new credit card purchases, provided in their SQ. We also vary the rewards appropriately when reward plans vary by transaction type, for example, increased

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<sup>1</sup>The FCAC website is [www.fcac-acfc.gc.ca/eng/index-eng.asp](http://www.fcac-acfc.gc.ca/eng/index-eng.asp).

reward incentives for gasoline purchases.<sup>2</sup>

Table 4 highlights the average value and volume shares of cash, debit and credit purchases by level of rewards. Higher levels of rewards are associated with higher shares of credit card purchases in both value and volume terms relative to the case of no-rewards. The decrease in average value and volume shares for debit cards are more pronounced than for cash.

## **2.4 DSI Payment Choices**

On average, participants in the diaries made five transactions during the three day period; with 60 percent of the diaries containing between one and five transactions, 30 percent between six and 10 transactions, and 10 percent over 10 transactions. In terms of type of good or service, 36 percent of the transactions were grocery stores, 24 percent entertainment services, 12 percent on durable goods/retail (e.g. appliances, furniture, personal attire), eight percent at gas stations and the remaining on services, hobby/sports, and other.

Several elements reduced the sample size used in the econometric analysis. We use the following criteria to exclude observations: One, observations where payment choice or transaction amount are unanswered. Two, individuals without access to either credit or debit cards. Three, transactions that are not exclusively undertaken at some type of store, in particular, those conducted online, by phone or to a person. Fourth, transaction values above \$400 were eliminated to remove any outliers that may bias the results. As a result, our sample size comprises 2,351 diaries and 10,228 transactions. The final dataset used in the econometric analysis combines the information collected in the SQ with the transactional data collected at the DSI level. This dataset allowed us to control for consumer characteristics, payment instrument attributes and transaction characteristics on payment instrument choices at the POS. A full list of variables used in the estimations is included in the Appendix together with their description.

Table 5 presents estimates of the probability of choosing cash, debit and credit cards obtained from the DSI by key demographic variables. Additionally, the average and median transaction values of purchases are displayed by demographic strata. The results confirm the findings by other surveys both in Canada and elsewhere with respect to the correlation between demographics and payment instrument use. As expected, young, urban, high-income individu-

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<sup>2</sup>More details about the rewards imputation are available upon request.

als are more card intensive than their older, rural, lower income counterparts. These results are usually quoted to claim that the shift towards electronic payments may take long as it depends on demographic and income dynamics.

However, Table 5 also shows that there is a strong association between the average transaction values purchased by strata and the share of cash payments in total volumes. The fact that younger and poorer individuals (living in low income households) conduct purchases of lower transaction values on average may well explain why they tend to use cash more frequently. In addition, the correlation between demographics and payment usage could reflect different underlying incentives associated with card fees and rewards.

These results show the importance of controlling for transaction characteristics at the POS as well as payment instrument attributes to isolate pure demographic effects as suggested in Arango and Taylor (2009). For example, as pointed out by Arango, Hogg, and Lee (2011), households with older adults and higher incomes are more likely to sign up for both credit card ownership and credit card reward. Furthermore, choices may be limited by what is accepted at the POS. Table 6 presents perceived card acceptance in the diaries. It shows the percentage of transactions where respondents perceived credit and debit cards to be accepted by retail type and transaction values. Acceptance rates climb rapidly for transactions over 25 dollars.

Table 6 presents a table on perceived acceptance at the POS. These perceptions percentage of respondents who perceive both credit and debit to be accepted by retail type across the transaction space. Acceptance rates climb rapidly for transactions over 25 dollars.

### **3 Empirical Methodology**

We utilize discrete-choice models to understand a consumer's choice of payment methods at the POS. The next section discusses the discrete-choice methodology.

#### **3.1 Discrete-Choice Models**

A household has  $m$ -choices with regards to the payment instrument used in a transaction and the utility of payment instrument  $j$  is denoted as:

$$U_j = V_j + \epsilon_j, \quad j = \text{Cash, Debit Card (DC), or Credit Card (CC)}. \quad (2)$$

Let  $V_j$  be the observed utility of choice  $j$  and  $\epsilon_j$  be the random choice variation. By definition, for payment instrument  $j$  to be chosen, it must yield the highest utility relative to other choices:

$$\begin{aligned} \text{Prob}[\text{Payment} = j] &= \text{Prob}(U_j > U_k), \forall j \neq k \\ &= \text{Prob}(V_j + \epsilon_j > V_k + \epsilon_k), \\ &= \text{Prob}(V_j - V_k > \epsilon_k - \epsilon_j). \end{aligned}$$

If the density of  $F(\epsilon_j) = e^{\epsilon_j} \exp(-e^{\epsilon_j})$  and  $V_j = \mathbf{x}'_j \beta_j$  then we have Multinomial Logit (MNL):

$$\text{Prob}[\text{Payment} = j] = \frac{\exp(\mathbf{x}'_j \beta_j)}{\sum_{l=1}^m \exp(\mathbf{x}'_l \beta_l)}. \quad (3)$$

The MNL is considered the standard workhorse model in the discrete-choice literature, see Train (2003). It is tractable and can be implemented in standard software packages. One of the major disadvantages of MNL models is the assumption of independence of irrelevant alternatives (IIA). The IIA assumption allows for the choice probabilities to have a closed-form solution and therefore the log-likelihood is easy to compute. However, if the IIA assumption is violated the MNL leads to unrealistic predictions i.e. the famous Red-Bus Blue-Bus problem mentioned in Train (2003). In technical terms the MNL error structure assumes an extreme value distribution that is independently distributed from each other, i.e. the covariance matrix is restricted to a diagonal form.

To avoid the IIA assumption, the covariance matrix must allow for the errors to be correlated with each other. One possible alternative model is the Multinomial Probit (MNP) which assumes that the error terms are multivariate normally distributed or  $\epsilon \sim MVN(0, \Omega)$ . The variance-covariance matrix  $\Omega$  allows for correlation across choices.

### 3.2 Model Specification

We model the decision of the consumer at the POS using the merged SQ-DSI data. The choice set of the consumer is Cash, Debit Card (DC), or Credit Card (CC). We relate the latent utility,  $U_j$ , of choosing payment instrument  $j$  to four sets of factors: consumer demographics, payment attributes, perceptions, and transactions characteristics.

The set of demographic variables includes: income, education, age, gender, employment status, choice of housing, region of Canada, and family size. Payment attributes includes the

features associated with consumer bank and credit card plans such as: whether the respondent pays a monthly debit card fee, receives unlimited free debit card transactions, earns credit card rewards, pays an annual credit card fee, and pays credit card balances in full at the end of the month or revolves on their credit card debt. As for cash, we include the starting cash balance at the beginning of the diary.

Perceptions include: relative measures of perceived costs, acceptance, record keeping, ease of use, risk of financial loss and fear of fraud as defined in section 2.1. We also include relative measures of the respondent's stated preference for avoiding overspending and security. Transaction characteristics are features of the transaction environment at the POS. The latter includes the transaction value, the type of good, day of the week, perceived card acceptance and top reasons for choosing the payment method used to finalize the transaction.

To understand what matters at the POS for payment instrument choices, we abstract from the adoption decision of debit and credit card features as part of their personal financial portfolio. Therefore, the estimates in this paper are based on consumers that held both debit and credit cards during the completion of the diary. We also do not explicitly model the amount of cash they had in their wallet before undertaking the three-day diary transactions. We leave these issues for future work.

### 3.3 Marginal/Partial Effects

Coefficients are difficult to interpret in a nonlinear model, therefore, we compute marginal effects, see Train (2003) for further details. For example, the marginal effect on the probability of choice  $j$  ( $p_{ij}$ ) of a small change in the observed factor ( $\mathbf{x}_i$ ) is:

$$\frac{\partial p_{ij}}{\partial \mathbf{x}_i} = p_{ij}[\beta_j - p_{ij} \sum_{l=1}^m p_{il} \beta_l]. \quad (4)$$

The first part of the marginal effect is the direct effect of choice  $j$  and the second part consists of  $p_{il}$  and  $\beta_l$  are the probabilities and coefficient of the alternative choices. The marginal effects are estimated by calculating the effect in the choice probabilities of a change in a regressor for a given individual and then averaged over individuals to produce what is commonly referred to as average marginal effects. The marginal effects also decompose the effects of a change in a regressor on the probabilities across choices and allows for a more informed analysis of

substitution patterns.

Note that this definition is only valid for continuous variables. Our study contains many discrete and categorical variables therefore we make use of average partial effects which is defined as:

$$\frac{\Delta p_{ij}}{\Delta \mathbf{x}_i} = p_{ij}(\mathbf{x}'_i = x_A) - p_{ij}(\mathbf{x}'_i = x_B), \quad (5)$$

where  $x_A, x_B$  denote the values for category A and B, respectively. Due to the number of variables, the marginal effects are split into blocks. The first block contains the demographic effects followed by perceptions, portfolio and POS characteristics. Finally, the presentation of the results that follows is based on the MNL model estimations as there are no quantitative differences with the MNP specifications in terms of marginal effects and elasticities. A technical appendix containing details on the comparison between MNL and MNP is available upon request.

### 3.4 Predicted Probabilities

To evaluate the effects of different observed factors in the model we compute the predicted probabilities or the probability of choice  $j$  conditional on a set of covariates ( $\mathbf{x}_g$ ) evaluated at profile  $g$ :

$$\hat{P}_{gj} = \frac{\exp(\mathbf{x}'_g \hat{\beta}_j)}{\sum_{l=1}^m \exp(\mathbf{x}'_g \hat{\beta}_l)}. \quad (6)$$

The predicted probabilities,  $\hat{P}_{gj}$ , could be computed over a range of possibilities. In this paper, we consider the following demographic profile  $g$  described as: an urban, married, Canadian, male, employed, homeowner in Ontario, earning 30-50K/year, with average perceptions.

## 4 Results

The results of the MNL are contained in Table 7. This table lists the coefficients of debit and credit card choices with cash as the base outcome. Figure 1 plots the payment frequencies observed in the data for those who pay with cash, debit and credit cards across transaction values. The picture portrays an average payment profile where cash dominates for payments below 25

dollars. Above this range, credit and debit cards are the preferred payment instruments but neither dominates.

#### **4.1 Credit and Debit Card Plan Effects**

Table 8 displays the average partial effects for various portfolio features. We find strong commitment effects for subscribers of debit card monthly fees and credit card annual fees, respectively. In particular, the probability of paying with debit cards for those who both pay a monthly debit card fee and receive unlimited free transactions increases by roughly 12 percent (adding the two effects). Paying a credit card annual fee increases the probability of paying with credit by roughly five percent. Although both debit and credit fees are fixed costs, they are also highly correlated with accrued marginal advantages such as free debit transactions, and credit card rewards.<sup>3</sup>

We also include dummy variables for different ranges of credit-card-debt to credit-card-limit ratio conditional on being a revolver to distinguish between credit card convenience users and credit card revolvers. The credit card debt-to-limit ratios measure the individual's credit availability and their preference for avoiding further debt. Table 8 shows that the probability of using credit cards decreases by roughly seven percent if the consumer is revolving up to 50 percent of their limit. The effect is increasing in debt ratio but in a non-linear fashion as individuals become closer to their limit. Consumers are either paying in full their credit card balances at the end of the month (known as convenience credit card users) or those who carry a balance on their credit card debt (credit card revolvers). Although, this feature is not a choice of the credit card plan, it becomes a given at the POS and would imply different marginal costs. In fact, someone with revolving debt will pay a financial fee on each credit card transaction whereas the one paying in full at the end of the month would actually receive a free loan. These results are in line with those found in Zinman (2009).

Cash holdings also play an important role. Our proxy for the cost of using cash is cash holdings at the beginning of the diary. The higher the amount of cash held by diary participants the less likely the need to obtain cash but also entails the costs of holding cash. On the

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<sup>3</sup>Scholnick, Massoud, Saunders, Carbo-Valverde, and Rodríguez-Fernández (2008) offers a thorough review of the industrial organization literature on card pricing and market structure.

other hand, with a low cash balance an individual must rely on the availability of card payments or otherwise forego or postpone a purchase. As seen in Figure 2, higher initial cash holdings leads to higher probability of paying with cash. The result is especially pronounced for transactions below 25 dollars. The probability of paying with cash for an individual carrying 150 dollars could be twice as large compared with that of someone with only 5 dollars. However, as transaction value increases the marginal cost of paying with cash goes up reducing the difference in probabilities between high and low cash holders.<sup>4</sup>

Figure 3 depicts the predicted probabilities of payment choices across transaction values for a typical demographic profile who is an *uncommitted individual*. This type of individual does not pay any debit or credit fees, nor gains from obtaining free debit transactions or credit card rewards and is not revolving. Debit dominates for larger transaction values while cash dominates for lower transactions. The figure offers a different perspective than the raw payment frequencies in Figure 1. In contrast, Figure 4 is the same type of individual but with the added benefit of credit card rewards. As can be seen, credit cards now compete more heavily with debit for larger value transactions.

Figure 5 portrays the case of a typical demographic profile who is a *debit card intensive user*. The individual has free debit card transactions, pays a debit monthly fee, but does not earn credit card rewards, nor pays an annual credit card fee, and is not a credit card revolver. The predicted probability of using a debit card rises sharply to about 50 percent when the transaction value is above 10 dollars. The debit card individual trades off cash with respect to debit while the usage for credit card is relatively flat. These results are similar to the findings of Borzekowski, Elizabeth, and Shaista (2008) for the US which finds the likelihood of paying with debit cards decreases due to debit card transaction fees.

Figure 6 shows the case where the individual is a *credit card intensive user* who pays credit card annual fees, earns rewards but does not pay a debit monthly fee and does not receive free debit transactions. Relative to debit, credit card usage is higher than that of the debit-intensive user. Credit card usage starts to increase at transaction values as low as 25 dollars.

Finally, Figure 7 illustrates the case of a *credit card intensive user* who has rewards but is

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<sup>4</sup>Arango, Hogg, and Lee (2011) contains a detailed discussion of what drives cash payment choices based on the 2009 MOP survey.

also a revolver. In this case, the consumer still uses credit cards but not as intensively as before. Again the revolvers do not have a strong preference for either debit or credit. Interestingly, this result highlights the dual role of credit cards. With rewards, credit cards become a viable means of payment and competes with debit. However, in the case of revolvers, credit cards are perhaps relied upon as a financing vehicle for consumption-smoothing purposes, these results are similar to Telyukova and Wright (2008).

## **4.2 Factors at the Point-Of-Sale**

Table 9 highlights some of the supply side effects arising from the transaction type, and limited acceptance of cards.<sup>5</sup> Furthermore, we include the individual's stated top reasons for payment choice. Availability constraints from the point of view of the merchant will tilt the balance between paying with cash versus paying with debit or credit cards. The probability of using cash is 32 percent lower at a POS where all payment methods are accepted. These results highlight some of the features of the two-sided market nature of payments. Consumers most likely would like to pay with cash at low transaction values because of its convenience, which coincides with lower levels of merchant acceptance of alternatives to cash. This finding is similar to the feedback effect previously studied by Rysman (2007). These types of transaction purchases also pick up supply side constraints. For example, relative to grocery purchases, gasoline and goods/retail purchases are heavily transacted with credit cards while cash is less frequently used for services. Entertainment purchases tend to be in cash relative to grocery purchases. Finally, the top reasons for payment choice yield additional information from the individual about the motivations for payment choice. Ease of use is principally a factor in paying with cash while avoiding fees favors cash and debit. Delay payment, as expected, is heavily associated with paying with credit cards.

Finally, the top reasons for payment choice yield additional information from the individual about the motivations for payment choice. Ease of use is principally a factor for paying with cash, while avoiding fees favours cash and debit. Delay payment as expected is heavily associ-

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<sup>5</sup>Time effects such as day of the week, or whether the transaction was made in the first second or third day of the diary were not statistically significant. This result highlights the importance of diary design, as it shows that a three-day diary may be a good compromise between the tendency to over-report in a one-day diary and the fatigue effect observed in a seven-day diary. This result is in line with a seven survey pilot study completed by Jonker and Kosse (2009).

ated with paying with credit cards. The fact that ease of use/speed increases the likelihood of paying with cash supports the results in Borzekowski and Kiser (2008). Their analysis shows that the faster contactless features on cards could significantly displace cash in the US. This result is particularly relevant in the Canadian case now that the card networks are introducing this feature nationwide for debit, credit and mobile payments.

### 4.3 Rewards and Transaction Values

One key fact about credit cards is that most reward programs are associated with the value of the transaction (e.g. rebates, air miles, point rewards). This feature allows us to estimate quite accurately the dollar value of the rewards obtained by each survey respondent in each credit card transaction. In particular, in the model we specify that the per-transaction rewards are of the following functional form:

$$\beta_1 RW_i + \beta_2 RW_i \times TV_i, \quad (7)$$

where  $RW_i = RP_i \times \mathbf{1}\{(RP_i > 0)\} \times TV_i$ , and  $RP_i$  denotes the reward points that consumer receives from their credit card plan,  $\mathbf{1}\{(RP_i > 0)\}$  is a binary variable that is one if the consumer has a rewards plan and zero otherwise while  $TV_i$  denotes transaction value. The interaction with transaction value in the last term is added to test for differentiated reward effects at different transaction values.

Other empirical studies by Carbó and Linares-Zegarra (2009) and Agarwal, Chakravorti, and Lunn (2010) have calibrated  $RP$  to one percent. Recall from Table 4 that provides the descriptive statistics on the matched reward plans. There is substantial heterogeneity in rewards with an average  $RP$  of about 0.78 percent. We exploit this heterogeneity to estimate a rewards elasticity.

There is one complication in calculating the elasticity of rewards. Some households do not earn rewards so the discrete and continuous nature make it difficult to interpret the effect of rewards on credit card usage. Therefore, to understand the pattern of substitution due to rewards we propose two measures: one, based on predicted probabilities and second based on marginal effects or an elasticity. The predicted probability measure provides the difference in probabilities by whether you have rewards or not (the extensive margin). The second measure

provides an elasticity measure due to a marginal increase in the monetary value of credit card rewards (the intensive margin).

### 4.3.1 Extensive Margin of Rewards

The extensive margin of rewards is equivalent to the average partial effect of adopting a rewards feature on the probability of using a credit card. For simplicity the subscript  $i$  will be suppressed in the rest of the discussion. Specifically, we define the extensive margin of rewards as the difference in the predicted probability due to having a rewards credit card, holding all other characteristics similar such as the consumer profile and the transaction value:

$$EXT[RW, \bar{x}_g] = \widehat{P}_{gj}(RW = 0.78 \times TV, \bar{x}_g) - \widehat{P}_{gj}(RW = 0, \bar{x}_g), \quad (8)$$

the  $RP$  is set to the average value of rewards points, transaction value is set at  $Q$ -dollars and  $\bar{x}_g$  is the typical profile of the consumer. The extensive margins are computed to illustrate the substitution patterns due to having a credit card with rewards across transaction values. The results are summarized in Table 12. The decompositions show that the extensive margin of rewards is small at transaction values less than 25 dollars increasing the probability of using credit cards between 0.58 to 3.61 percent; mostly at the expense of cash usage. However, as transaction value increases (above 50 dollars) the extensive margin is large, as having a reward plan increases the probability of paying with credit cards by 12.81 percent at 100 dollar transaction value; at the expense of debit card market shares.

### 4.3.2 Rewards Elasticity

The second measure of the response in the credit card probability with respect to rewards is a marginal effect calculation evaluated at the means or a credit card reward elasticity. It is based on the following formulation:

$$E_{P_{CC}, RW} = \frac{\partial P_{CC}}{\partial RW} \frac{\widehat{RW}}{\widehat{P}_{CC}}. \quad (9)$$

The results of the calculation is available in Table 13. There are four corresponding levels of  $RP$  : 0.5, 0.78, 1.0 and 1.5 percent. As expected, the elasticity is the smallest for low reward plan of 0.5 percent. At low transaction values (five dollars) the elasticity is quite small 0.03

to 0.08 but it increases with the transaction values. At a transaction value of 100 dollars the elasticity is in the range of 0.19 to 0.37 implying that a ten percent increase in monetary rewards leads to an increase in the probability of using a credit card by 1.9 to 3.7 percent depending on the  $RP$  that consumer receives. These elasticities highlight that the effect of rewards on credit card usage is inelastic.

#### **4.4 Demographics**

Table 10 contains the average partial/marginal effects of demographic variables. Overall, demographic characteristics play a muted role in influencing the probability of payment choice. The most salient result is that income and age effects are not significant. This result is in contrast with previous empirical findings which stress strong differences in payment behavior across age and income groups. Second, being a male induces a preference for credit cards over debit card relative to being a female. Third, levels of education have the similar expected signs as established in the literature and demonstrate that highly educated people have a preference for credit cards. There is also a tendency for part-time or unemployed workers to rely more on credit cards, perhaps due to a consumption-smoothing effect.

#### **4.5 Perceptions**

Table 11 presents average marginal effects for perceptions and individuals' attitudes towards payment methods. These perceptions are answered prior to the diary and so we can assume these attitudes are predetermined. Therefore, they remain constant across the POS. First, individuals tend to prefer debit cards and avoid cash when security in terms of fraud, theft or counterfeiting is an important factor, a similar finding as in Schuh and Stavins (2010). Paradoxically, anonymity seems to favour credit cards, as it is possible the use of credit cards leads one to become more concerned about identity theft.

Second, the importance of speed of payment favours cash over debit cards with no effect on credit cards. However, consumers seem to differ in other dimensions of convenience with those finding credit cards easy to use having a substantial shift towards credit cards (0.76 marginal effect on the probability of paying with credit cards), other things equal. In terms of relative costs, debit cards seem to play a central role. They are a closer substitute to cash for those who

find debit cards not so costly but a closer substitute to credit cards for those finding credit cards particularly costly.

Finally, budgeting issues also seem to divide consumers in their preferences for cash, debit and credit. Those who use their debit cards as a tracking device substitute significantly more from cash. This substitution may reflect the fact that some consumers are more comfortable with “a glance into their pocket” (and their ATM withdrawal receipts) to monitor their liquidity; similar to the results found in von Kalckreuth, Schmidt, and Stix (2011). As per those comfortable with credit cards as a tracking device (controlling for credit card debt) they tend to substitute relatively more from debit payments. However, those individuals concerned about overspending tend to stay away from credit cards and rely more on cash, but not so on debit cards, which contrast with the results found by Fusaro (2008).

The results for relative perceptions are all in line with expectations. The more favourable a perception is for a means of payment then the more likely that payment method is used. Record keeping plays an important role and portends to individuals relying on a particular type of method of payment relative to other payment methods for the reasons of simplifying their records. Overall, these perceptions are mostly significant even after controlling for all the variables in the model, alluding to the presence of idiosyncratic factors that provide additional benefits and costs of using a payment instrument. The results confirm the importance of including perceptions and attitudes to help take into account heterogeneous preferences.

## **5 Conclusion**

Using discrete-choice methods with rich microdata drawn from the 2009 Bank of Canada Method of Payments survey yield an informative picture of why consumers choose alternative payment instruments. We estimate the probability of using cash, debit, and credit cards at the POS and find that:

1. Bank and credit card account plans as well as perceptions of payment instrument attributes play a major role on how consumers pay at the POS. The richness of the data allows us to model payment decisions at the POS to
2. The models significantly explain the relationship between transaction value and payment

shares in terms of key payment instrument attributes. We find that cash dominates at low transaction values due to limited acceptance of alternatives to cash and ease of use/speed. In addition, there is strong relationship between credit card rewards and credit card payment choices for transaction values beyond 25 dollars.

3. Consumers are relatively inelastic to credit card rewards. However, the probability of using a credit card increases with transaction value due to the proportionality of credit card reward plans.

An interesting extension would consider the negotiation of consumers of bank and credit card account plans with the issuers. Shedding light on this issue would help policymakers to understand, for example, the effect of interchange fees on these plans and their impact on payment instrument demand.<sup>6</sup> Future work will also investigate the factors that drive consumer choices of different bank and credit card account plans as well as the optimal cash holding strategies used by consumers holding different card instruments.

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<sup>6</sup>Theoretical work on this issue has been investigated by Schmalensee (2002), Rochet and Tirole (2002) and Julian and Wright (2003).

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Table 1: Payment Frequencies, Volume and Value

TV	Frequency				Total Value			
	< 15	15-25	25-50	50+	< 15	15-25	25-50	50+
Cash	72.8	42.0	24.9	16.7	59.6	37.7	21.6	10.9
Debit	18.1	31.9	40.0	36.3	25.4	33.1	37.7	37.0
Credit	9.5	26.4	35.7	48.0	15.0	29.2	40.7	52.1

Note: Sample statistics are computed from the SQ-DSI dataset using 10,228 transactions. Maximum transaction value is \$ 400. Numbers displayed are in percentage terms. Frequency represent share of number of transactions conducted using a certain method, conditional on transaction belonging to specific range. Value represents share in dollar amount of transactions conducted using a certain method, conditional on transaction belonging to specific range. Sample weights used.

Table 2: Effect of Sample Weights on SQ and DSI

	SQ-U	SQ-W	DSI-U	DSI-W	CIUS
<b>Age</b>					
18-34	26.5	30.2	27.5	30.2	30.6
35-54	41.8	40.9	42.1	40.9	40.8
55-75	31.7	29.0	30.5	29.0	28.7
<b>Income</b>					
Less than 30K	26.3	17.1	26.8	16.9	16.8
30K-60K	33.3	28.0	32.7	27.9	27.5
60K-100K	24.9	28.5	24.8	28.6	28.4
more than 100K	15.5	26.4	15.8	26.6	27.3
<b>Gender</b>					
male	46.9	48.8	48.5	48.8	48.9
female	53.1	51.2	51.5	51.2	51.1

Note: Survey Questionnaire Unweighted (SQ-U), Survey Questionnaire Weighted (SQ-W), Survey Design Unweighted DSI-U, Survey Design Weighted (DSI-W), and Canadian Internet Usage Survey (CIUS).

Table 3: Perceptions

	Cash	DC	CC
Ease of Use	4.64	4.65	4.75
Cost	1.48	2.23	2.57
Record keeping	2.81	4.08	4.29
Acceptance	4.82	4.34	4.47
Fraud	2.04	2.53	2.72
Financial loss	3.11	3.58	3.70

Note: Numbers displayed are average perceptions are computed from SQ dataset based on sample of 2,351 individuals who completed diaries included in our estimation sample using SQ-DSI dataset. Each perception is ranked on a scale from 1 to 5. Sample weights used.

Table 4: Credit Card Reward Plans

RP	None	(0,0.5)	[0.5, 1.0)	[1.0, 5.0)
<b>Cash</b>				
Value	38.5	35.1	29.5	30.3
Volume	51.2	48.4	43.3	44.8
<b>Debit</b>				
Value	42.2	31.2	27.0	20.9
Volume	35.3	27.4	24.8	19.4
<b>Credit</b>				
Value	19.3	33.7	43.4	48.8
Volume	13.5	24.2	31.8	35.8
<b>Households</b>	949	249	683	470

Note: Based on 2,351 individuals with access to a credit card in DSI. Value represents share of purchases by payment method in dollars. Volume represents share of purchases by payment method in frequencies. Shares do not add up to one due to other payment categories such as cheques and stored-value cards.

Table 5: Descriptive Statistics

	Probability of Usage			Transaction Value		
	Cash	Debit	Credit	Mean	Median	S.E
Less than 30K	0.562	0.303	0.141	26.227	15.055	1.626
30K-50K	0.516	0.289	0.198	28.906	16.870	1.329
50K-80K	0.463	0.323	0.221	33.345	18.505	1.308
More than 80K	0.461	0.251	0.293	34.810	19.820	1.232
18-25 years	0.502	0.301	0.217	24.069	15.000	1.605
26-35 years	0.425	0.337	0.246	32.410	15.000	1.891
36-45 years	0.482	0.253	0.267	31.995	18.305	1.268
46-55 years	0.490	0.270	0.244	36.466	19.945	1.601
56-65 years	0.505	0.254	0.246	31.857	17.590	1.857
65-75 years	0.516	0.271	0.217	33.366	21.180	2.161
Male	0.479	0.268	0.257	31.778	17.490	1.054
Female	0.482	0.294	0.232	33.601	17.490	1.018
Homeowner	0.541	0.288	0.175	34.108	19.875	0.874
Renter	0.469	0.274	0.263	27.916	14.665	1.272

Note: Sample statistics are computed from the SQ-DSI dataset and the number of observations is 10,288 which corresponds to participants holding both debit and credit cards as they start the diary. The first three columns compute the probability of using cash, debit card, and credit card for each transaction. The mean, median, and standard error of the transaction value is computed. Sample weights used.

Table 6: Point-Of-Sale Acceptance

TV	< 15	15-25	25-50	50+
Groceries	68.9	81.1	84.2	87.7
Gasoline	77.4	79.8	84.8	86.7
Goods/retail	70.6	85.5	94.4	88.3
Services	56.4	68.7	83.7	95.1
Hobby/sports	49.0	72.0	89.3	88.7
Entertainment	51.5	69.1	86.2	78.7
Other	43.9	78.0	81.0	86.6

Note: Sample statistics are computed from the SQ-DSI dataset based on 10,288 transactions. Numbers displayed represent percentage of transactions where both credit and debit card were perceived to be accepted, conditional on transaction belonging to certain range and displayed across types of purchases.

Table 7: Multinomial Logit Estimates

	Debit Card	Credit Card
Transaction Value (TV)	0.009	0.037*
	0.02	0.02
Transaction Value <sup>2</sup>	-0.000***	-0.000***
	0	0
Fraud	0.645***	0.136
	0.170	0.21
Ease	-1.25	8.779***
	1.51	1.87
Ease × TV	0.089**	-0.06
	0.03	0.03
Recordkeeping	2.695***	3.164***
	0.79	0.62
Recordkeeping × TV	-0.027	0.024*
	0.02	0.01
Cost	-1.426***	-0.939*
	0.41	0.450
Fear of Overspending	-0.540**	-0.981***
	0.2	0.25
Overspending × TV	0.00	0.005
	0.01	0.01
Speed	-0.562**	-0.26
	0.19	0.23
Debit Fee	0.301**	
	0.1	
Debit Free Trans	0.590***	
	0.12	
CC Annual Fee		0.527***
		0.11
Rewards		1.471***
		0.31
Rewards <sup>2</sup>		-0.006***
		0
CC and DC accepted	2.313***	3.226***
	0.14	0.26
Cash beginning of diary (bod)	-0.006***	-0.005***
	0	0
Cash bod × TV	-0.043*	-0.024**
	0.02	0.01
Reason for MOP: Ease	-0.515*	-2.531***
	0.2	0.2
Reason for MOP: Avoid fees	-0.256*	-1.591***
	0.12	0.18
Reason for Mop: Delay payment	0.49	3.271***
	0.43	0.35
0 < CC Debt < 0.5	0.239	-0.625***
	0.13	0.17
0.5 < CC Debt < 0.8	0.349*	-0.925**
	0.18	0.28
CC Debt > 0.8	0.188	-0.528**
	0.14	0.19
Constant	-0.978	-5.505***
	0.95	1.17

Note: The MNL model are estimated using survey weights. Cash is the base outcome and the sample size is 10,288 transactions. For brevity, results from demographics, type of transaction, online/offline dummy, and day of week dummies are omitted. The 1, 5, and 10 percent level of significance are denoted via \*\*\*, \*\*, \*, respectively.

Table 8: Average Partial Effects of Portfolio Features

	Cash	DC	CC
DC monthly fee	-0.026**	0.041**	-0.015**
	0.01	0.01	0.00
DC free transactions	-0.051***	0.081***	-0.030***
	0.01	0.02	0.01
CC annual fee	-0.019***	-0.027***	0.046***
	0.00	0.01	0.01
0 < CC Debt < 0.5	0.002	0.065***	-0.067***
	0.01	0.02	0.01
0.5 ≥ CC Debt < 0.8	0.004	0.096***	-0.100***
	0.02	0.02	0.02
CC Debt ≥ 0.8	0.003	0.053**	-0.056***
	0.02	0.02	0.01

Note: This table calculates the average partial effect of various portfolio features (either yes or no). The 1, 5, and 10 percent level of significance are denoted via \*\*\*, \*\*, \*, respectively.

Table 9: Average Partial Effects of POS characteristics

	Cash	DC	CC
Both CC and DC accepted	-0.320***	0.154***	0.166***
	0.01	0.02	0.02
Gasoline	-0.061**	-0.031	0.093***
	0.02	0.02	0.02
Goods/retail	-0.037	-0.031	0.067***
	0.02	0.02	0.02
Services	-0.092*	0.034	0.059
	0.04	0.03	0.03
Hobby/sports	-0.053	0.010	0.044*
	0.03	0.03	0.02
Entertainment	0.062***	-0.072***	0.010
	0.01	0.02	0.01
Other purchases	0.005	-0.029	0.025
	0.02	0.02	0.02
Weekend	0.005	0.011	-0.016
	0.01	0.01	0.01
Top reason: ease of use	0.138***	0.059**	-0.197***
	0.02	0.02	0.01
Top reason: avoid fees	0.081***	0.046**	-0.127***
	0.01	0.02	0.01
Top reason: delay payment	-0.164***	-0.100*	0.263***
	0.05	0.05	0.02

Note: This table calculates the average partial effect of various POS characteristics (either yes or no). The 1, 5, and 10 percent level of significance are denoted via \*\*\*, \*\*, \*, respectively.

Table 10: Average Partial Effects of Demographics

	Cash	DC	CC
30K-50K	0.025	-0.003	-0.021
	0.02	0.02	0.02
50K- 80K	0.005	0.016	-0.022
	0.02	0.02	0.02
More than 80K	0.044*	-0.057*	0.013
	0.02	0.02	0.02
Technical/some college	-0.022	-0.017	0.039**
	0.01	0.02	0.01
Post secondary	-0.037*	-0.035*	0.072***
	0.02	0.02	0.01
West	-0.009	-0.001	0.010
	0.01	0.01	0.01
Quebec	-0.003	-0.015	0.018
	0.02	0.02	0.01
Atlantic	-0.013	0.011	0.002
	0.01	0.02	0.01
Age	0.001	0.000	-0.001**
	0.00	0.00	0.00
Family Size	-0.007	0.003	0.004
	0.01	0.01	0.00
Male	0.001	-0.027*	0.026**
	0.01	0.01	0.01
Rural	-0.002	-0.003	0.005
	0.01	0.02	0.01
Ethnicity	0.015	0.009	-0.024*
	0.01	0.01	0.01
Manages finances	0.008	-0.030*	0.022*
	0.01	0.01	0.01
Not Married	-0.015	0.006	0.009
	0.01	0.01	0.01
Employed full-time	0.016	0.032*	-0.049***
	0.01	0.01	0.01
Renter	0.032*	-0.028	-0.004
	0.01	0.01	0.01
Access online	-0.054*	0.061**	-0.007
	0.02	0.02	0.02
Online access panel	0.062***	-0.062***	0.001
	0.01	0.01	0.01

Note: This table calculates the average partial effect of various demographic features (either yes or no). The only exceptions are Age and Family size which are continuous variables and in this case it is the marginal effect. The 1, 5, and 10 percent level of significance are denoted via \*\*\*, \*\*, \*, respectively.

Table 11: Marginal Effects of Perceptions

	Cash	DC	CC
Security	-0.061**	0.082***	-0.021
	0.02	0.02	0.02
Speed	0.058**	-0.064**	0.006
	0.02	0.02	0.02
Ease CC	-0.271***	-0.290**	0.561***
	0.06	0.09	0.14
Ease DC	-0.071	0.253	-0.182*
	0.11	0.17	0.07
Record CC	-0.139***	-0.229***	0.368***
	0.02	0.03	0.04
Record DC	-0.178**	0.240**	-0.062
	0.06	0.09	0.04
Cost DC	0.123***	-0.197***	0.073***
	0.04	0.06	0.02
Cost CC	0.035*	0.048*	-0.083*
	0.02	0.02	0.04
Overspending	0.072***	-0.022	-0.050***
	0.02	0.02	0.01
Anonymity	-0.021	-0.022	0.043**
	0.02	0.02	0.02

Note: This table calculates the marginal effect of various perceptions. The 1, 5, and 10 percent level of significance are denoted via \*\*\*, \*\*, \*, respectively.

Table 12: Substitution Patterns Due to the Rewards Extensive Margin

TV	Cash	DC	CC
5	-0.37	-0.21	0.58
25	-1.82	-1.78	3.61
50	-2.76	-5.12	7.87
100	-2.10	-10.71	12.81

Note: The *extensive margin* of rewards as the difference in the predicted probability due to rewards holding all other characteristics similar such as the profile and transaction value:

$$EXT[RW, \bar{x}_g] = \hat{P}_{gj}(RW = 0.78 \times TV, \bar{x}_g) - \hat{P}_{gj}(RW = 0, \bar{x}_g), \quad (10)$$

where  $RW = RP \times \mathbf{1}\{RP > 0\} \times TV$ . Let  $RP$  denote the reward points that consumer receives from their credit card plan and  $\mathbf{1}\{RP > 0\}$  denote a binary variable that is one if the consumer has a rewards plan and zero otherwise.  $TV$  denotes the transaction value and  $\bar{x}_g$  is the typical profile of the consumer.

Table 13: Rewards Elasticity

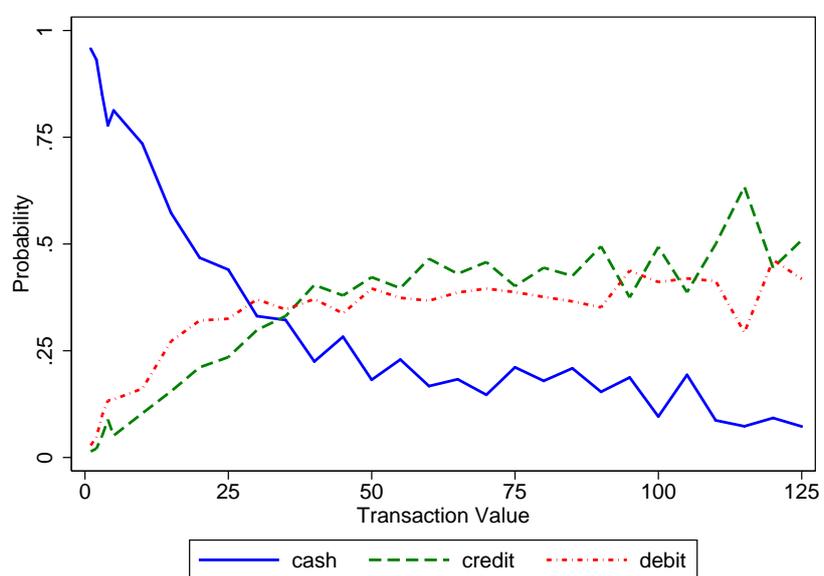
TV	RP = 0.5%	RP = 0.78%	RP = 1.0%	RP = 1.5%
5	0.03 (0.006)	0.04 (0.010)	0.06 (0.012)	0.08 (0.018)
25	0.12 (0.026)	0.18 (0.039)	0.22 (0.049)	0.32 (0.068)
50	0.17 (0.041)	0.26 (0.058)	0.32 (0.069)	0.43 (0.085)
100	0.19 (0.053)	0.27 (0.070)	0.32 (0.077)	0.37 (0.081)

Note: The elasticity of the probability of using credit cards with respect to rewards or:

$$E_{P_{CC}, RW} = \frac{\partial P_{CC}}{\partial RW} \frac{\widehat{RW}}{\widehat{P}_{CC}}. \quad (11)$$

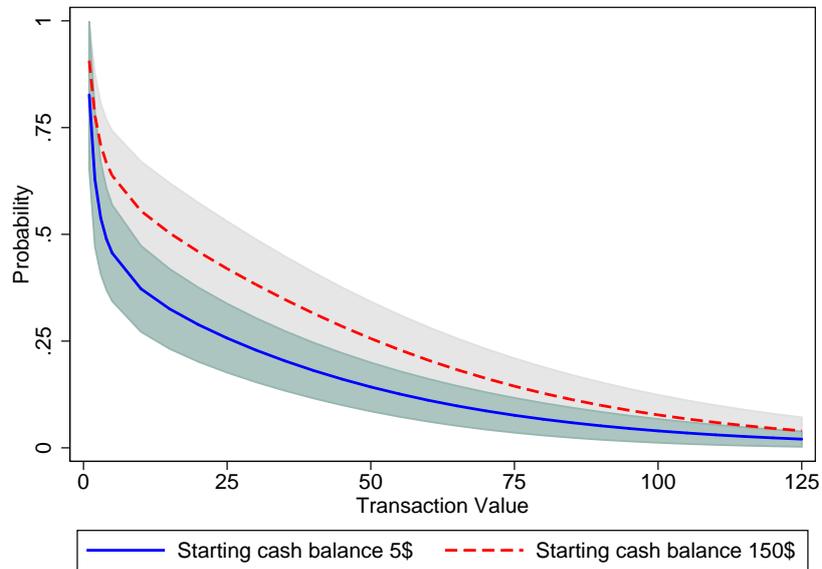
Standard errors are in parentheses.

Figure 1: Payment Frequencies



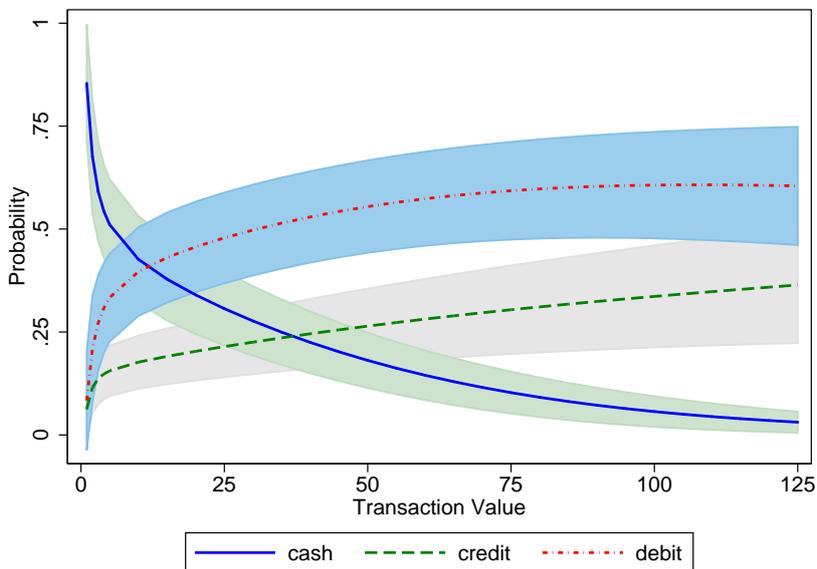
Note: This graph illustrates the choice frequency of cash, debit and credit over the transaction range of 1 to 125 dollars. These frequencies are calculated based on a sample of 10,288 transactions in diary using sample weights.

Figure 2: Initial cash holdings



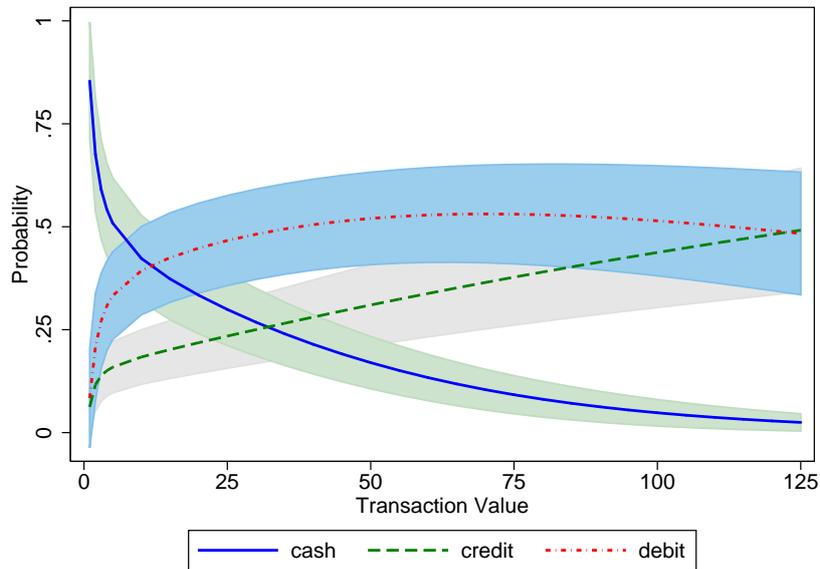
Note: Calculated for a typical demographic profile. Earns rewards, no DC free transactions, no DC monthly fee, no CC annual fee, and not CC revolver. Shaded areas represent 95 percent confidence intervals.

Figure 3: Baseline Consumer



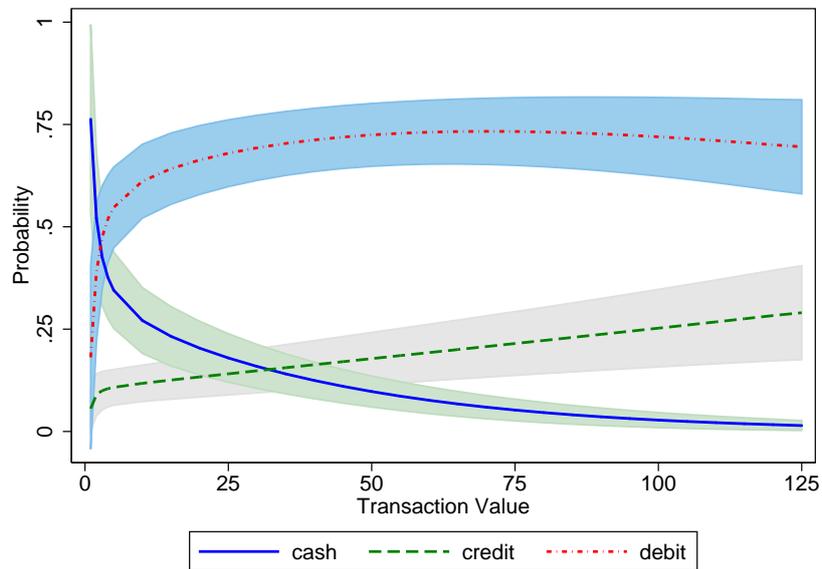
Note: Calculated for a typical demographic profile but with no rewards, no DC free transactions, no DC monthly fee, no CC annual fee, and not CC revolver. Shaded areas represent 95 percent confidence intervals.

Figure 4: Baseline Consumer with Rewards



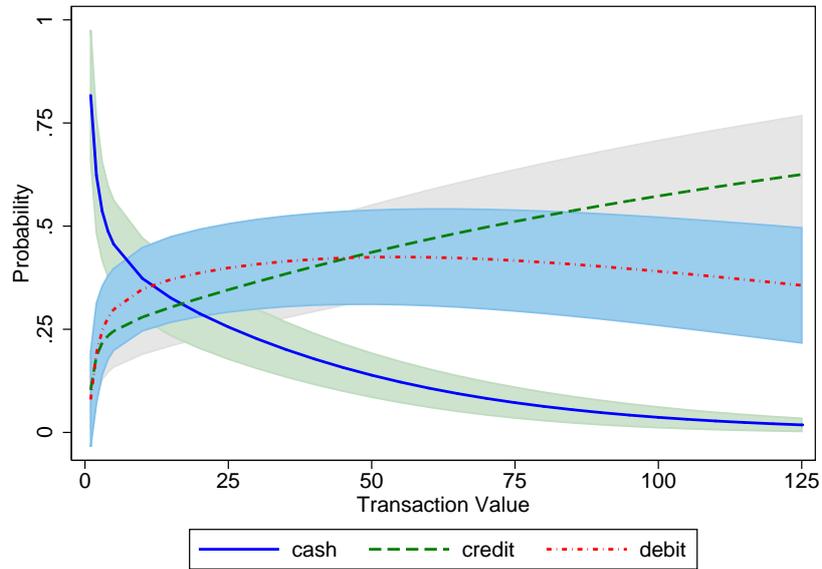
Note: Calculated for a typical demographic profile but earns rewards, no DC free transactions, no DC monthly fee, no CC annual fee, and not CC revolver. Shaded areas represent 95 percent confidence intervals.

Figure 5: Debit Card Intensive User



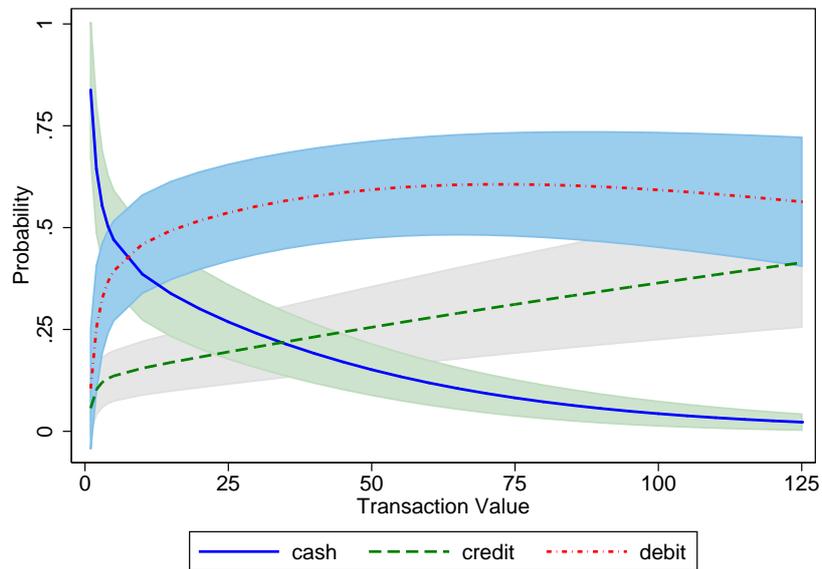
Note: Debit Card User with free DC transactions, pays debit monthly fee, no CC annual fee, not CC revolving. Calculated for average demographic profile. Shaded areas represent 95 percent confidence intervals.

Figure 6: Credit Card Intensive User



Note: Credit card intensive user with rewards, no free DC transactions, no debit monthly fee, pays CC annual fee, not CC revolving. Calculated for average demographic profile. Shaded areas represent 95 percent confidence intervals.

Figure 7: Credit Card Intensive User & Revolving



Note: Credit card intensive user with rewards, no free DC transactions, no debit monthly fee, pays CC annual fee, and CC revolving. Calculated for average demographic profile. Shaded areas represent 95 percent confidence intervals.

# A Appendix

## A.1 Variable List

- *Transaction Amount*: The questionnaire asks the respondent “What was the total amount of the transaction?” The value is deflated by 100.
- *Ease of Use*: The questionnaire asks the respondent “When making a payment, in your opinion how easy is it for you to use each of the following methods of payment? Please use a scale from ‘1’ to ‘5’, where ‘1’ means it is “not at all easy to use” and ‘5’ means it is ‘very easy to use.’
- *Record Keeping*: The questionnaire asks the respondent “In your opinion how useful are (or would be) the following methods of payment in terms of helping you to keep a record of your spending. Please use a scale from ‘1’ to ‘5’, where ‘1’ means it is “not at all useful” and ‘5’ means it is ‘very useful.’
- *Cost*: The questionnaire asks the respondent “Taking into consideration costs such as withdrawal fees, account fees, and interest paid, in your opinion how costly is it (or would it be) to make a payment using the following methods of payment. Please use a scale from ‘1’ to ‘5’, where ‘1’ means it is “not at all costly” and ‘5’ means it is ‘very costly.’
- *Security, Speed, Fear of Overspending, Anonymity*: The questionnaire asks the respondent, “Thinking about the different methods of payment you could use for a variety of expenditures, please rate each of the following attributes in terms of their importance to you when considering what type of payment method to use. Please use a scale from ‘1’ to ‘10’, where ‘1’ means it is “not at all important” and ‘10’ means it is ‘very important.’ The attributes include ‘Ease of Use’, ‘Speed’, ‘Security’, ‘Potential to control overspending’ and ‘Anonymity in terms of not having to provide your name or other personal information.’ We then weight the attributes by importance of ease of use.
- *Cash beginning of diary*: This variable is constructed based on respondents’ answers to a series of questions on the number of bills and coins in their wallet.
- *Debit Monthly Fee*: The questionnaire asks the respondent, “Do you pay a fixed monthly fee such as service charge or account fee on your main bank account?” The possible answers are, “Yes, every month”, “Yes, but only some months”, “No”, “Not sure.” We define a variable for Debit monthly fee that takes a value equal to one based on the answer “Yes, every month.” We impute answers for “Not sure.”
- *Debit Free Transactions*: The questionnaire asks the respondent, “How many free debit transactions are permitted from your main bank account?” The possible answers are: “0,” “1 -4”, “5-9”, “10-19”, “20+ or unlimited”, “Not sure.” We define a variable for debit monthly fee that takes a value equal to one if they answer “20+ or unlimited.” We impute answers for “Not sure.”

- *Rewards*: The questionnaire asks the respondent “Does your main credit card offer any rewards?” If they do not state what type of rewards they receive we impute it by matching the credit card name to information from FCAC and/or the retail bank information at their website.
- *Credit card annual fee*: The questionnaire asks the respondent, “What is the annual fee you pay for that card?” The answers are again categories but we construct a dummy variable equal to one to indicate whether the respondent pays a fee and zero otherwise.
- *Credit Card debt limit*: We construct dummy variables indicating whether the respondent’s ratio of revolving credit card debt to credit card limit is above zero percent but less than twenty five percent, between twenty five percent and fifty percent, and over fifty percent. The base category holds that the respondent is not revolving. We construct this variable using the former question on the unpaid credit card balance and the following question, “What is the credit limit on your main card?”
- *Top reason for payment choice*: For every transaction, the questionnaire asks the respondent to provide the top two reasons for which they chose a certain method of payment from the following list: ease of use, avoid fees, delay payment, avoid fraud, gain rewards/points, or get cashback. We construct indicator variables for whether the first reason was either ease of use and avoid fees.
- *Perceived card acceptance*: For every transaction, the questionnaire asks the respondent, “What method of payment would not have been accepted?”. From this information we construct indicators of perceived payment acceptance for both credit and debit cards.
- *Type of Transaction*: For every transaction, the questionnaire asks the respondent, “What was the main type of goods or service purchased during this transaction?” We construct dummy variables for the following categories: gasoline, goods/retail, services, hobby/sports, entertainment, other. The base category is groceries.
- *Weekend*: We include a dummy variable for whether the transaction occurred between Friday and Sunday, based on the reported day on which the transaction occurred.
- *Demographics*: We include dummy variables for a set of demographics. For income, the base category is under 30K. For education, the base category is Post-Secondary which includes either completing a college degree or graduate studies. Ontario is the base category for region. Family size is a continuous variable representing number of individuals living in the respondent’s household. We include a dummy for whether the respondent claims to manage the household finances. We include dummies for Male, Rural, Not Married, Full-Time, Renter and Offline.