The Role of Non-Banks as Payment Providers*

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Abstract

In the past few decades, non-banks have become increasingly important as providers of different retail payment services. In this paper we try to explain the key variables that explain the adoption and usage of credit cards provided by Canadian retailers; we focus on aspects such as the proximity of the nework, the credit limits, financial stress and other relevant demographic variables. To achieve our goal, we use a similar structural framework as in Koulayev et al. (2012) by using a simultaneous two equation model of the adoption and use of payment methods, where the adoption and use of retailer credit cards is one of the choices to be made by consumers (as well as cash, and bank-issued credit and debit cards). We distinguish between widely accepted retailer credit cards and retailer-specific credit cards. We find that network proximity is related positively to the use of cash and retailer-specific credit cards, and to the adoption of debit cards and bank-issued credit cards. The network effect is particularly relevant for retailer-specific credit cards. We also find that the effects of credit limits are unimportant to the use decision.

1 Introduction

Commercial banks have traditionally played a dominant role as providers of retail payment services. However, in the last decades non-banks have become increasingly important as providers of different retail payment services. Currently, about 25% of all credit cards in Canada are directly issued by retailers such as Canadian Tire, President's Choice or, they are marketed by a retailer and issued by a bank. These credit cards represent 15% of all credit cards purchases made in Canada. But

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what are the incentives of these retailers to provide these payment services? These cards typically offer rewards and better access to credit when used in the retailer's stores, increasing the demand for products sold by the retailer.

As opposed to retailers, commercial banks are regulated financial institutions that provide a large set of payment instruments and have a complex and rich interaction with consumers by the provision of many other financial products (loans, mortgages, etc). These marked differences between banks and non-banks allow us to treat their payments products differently because they are provided by firms with different strategies, different relationships with the final customer, and they may target different market segments.

In this paper we try to determine the key aspects that are driving the adoption and use of means of payments provided by retailers. To study this question, we use a similar structural framework as in Koulayev et al. (2012), Dubin and McFadden (1984) or Hendel (1999) by using a simultaneous two equation model of the adoption and use of payment methods, with emphasis on payment instruments provided by non-banks. In our model, consumers choose which payment methods to adopt from cash, bank-issued credit cards, widely accepted retailer credit cards, retailer-specific credit cards and debit cards. Once this adoption decision is complete, consumers decide how much to use each payment method. We estimate the effects of various factors on both the adoption and use equations, specific to each payment instrument. Of particular interest is the effect of network proximity. Since some of these cards offer significant rewards at the retailer's stores, proximity of these stores to the consumer could help explain usage or adoption of the credit card. Also, proximity of bank branches can help explain the adoption or usage of cash or debit cards. Demographic variables could also be relevant because these different firms may target different types of consumers in terms of age, income or education. We additionally include variables regarding the total credit limit and financial stress of consumers.

We hypothesize that high credit limits will increase spending on bank-issued credit cards, and have the opposite effect on the other credit card usage, as consumers substitute away from these alternative credit cards. In practice, we find that the effects of credit limits are unimportant to the use decision, which conflicts with the implications in Lee and Kwon (2002) that store credit cards are used as alternative financing. As expected, we find that network proximity is related positively to the use of cash and retailer-specific credit cards, and to the adoption of debit cards and bank-issued credit cards. Somewhat surprisingly, recent financial stress is found to have a positive effect on the adoption of bank credit cards. Additionally, we conduct one counterfactual experiment in which we study the effect of a credit contraction on payment use.

Our econometric model uses a large multi-year survey with information on usage/adoption of payment instruments and demographic variables of Canadian households. We also build a unique database of bank branches in Canada for all financial institutions, and the locations of various large retailers in Canada, including Canadian Tire and President's Choice. Using a geocoding tool and information on the 6-digit postal code of every location and every household, we can calculate the

number of bank branches and retail locations within a certain radius of each household, which gives a measure of the proximity of the bank and retailer network to the household.

Our paper models the adoption and use of payment methods in Canada, focusing on the distinction between credit card types. This model is based on that of Koulayev et al. (2012), in which simultaneous adoption and use of payment instruments is estimated. A predecessor to this is the simultaneous model of appliance choice and electricity demand specified in Dubin and McFadden (1984), in which a consumer must choose among a discrete number of appliances and determine how much electricity to allocate to each of these appliances. Another related model is the multiple-discrete choice model found in Hendel (1999).

As of late, much research has been done on payment choice in Canada. Arango, Hogg and Lee (2011) studies the persistent and important use of cash in the Canadian economy, particularly in volume. Arango, Huynh and Sabetti (2011) employ a discrete choice model to model the probability of choosing to pay with cash, debit or credit, and examines credit-rewards elasticity. Our paper has close ties with that of Arango and Perez-Saiz (2013) in that we incorporate network effects in the same way. Specifically, the number of bank branches within a given radius is used as a proxy for the inverse cost of making a cash withdrawal. We then construct a network effect indicator, which is set to one if there is at least one branch within five kilometers of the household, corresponding to the banks at which the consumer holds an account. We extend this method to approximate the likelihood of making a purchase with a retailer-only rewards card, by using the number of each retailer within a given radius as a proxy.

The literature on non-bank payment cards, particularly retailer credit cards, is quite limited. Hirschman (1979) studies the purchase behaviour of users of bank cards, retailer cards, and users of both. Lee and Kwon (2002) explores the functions of retailer credit cards, specifically as alternate methods of payment and financing media and finds that consumers tend to use store credit cards as a means of alternative financing when credit availability from other sources is reduced. Erasmus and Lebani (2008) looks at the reasons behind adoption of store cards, stating convenience as a primary factor in adoption decisions. The main contribution of our paper is to apply an adoption and use model to non-bank credit cards, and to incorporate network effects to our specification.

2 Some economics of the role of non-banks as retail payment providers

The retail payment industry is a complex industry that has evolved considerably in the last decades. A significant degree of innovation exists in the products and processes used, and there is also a significant level of entry of new players. The constant increase in the adoption and usage of payment cards has revolutionized how we purchase products and services.[1]

[1] See Evans (2005) for an excellent book about this industry, and Chakravorti (2003) for a survey of the literature.

One of the main players in this industry is commercial banks. Commercial banks are complex regulated financial institutions that provide retail payment instruments such as cheques, credit or debit cards. Banks also provide a great variety of other products, such as loans, mortgages, or lines of credit. Banks usually establish a complex relationship with their customers, with multiple interactions over time and across products. Large national banks, like the Big Six banks in Canada, have an extensive branch and ABM network that covers the most important metropolitan areas. This extensive network and product portfolio allows large banks to establish a complex and deep relationship with their customers, offering them bundles of financial products that include various payment technologies for a fixed monthly fee. Also, this relationship has important implications in this environment with an important degree of information asymmetry. Repeated exchanges of information between banks and consumers generate informational capital that can determine credit constraints that affect usage of credit cards. See Degryse et al. (2009) for a nice survey about the implications of this bank-borrower relationship.

In the recent years, non-banks have become more visible and prominent providers in the retail payment system. Bradford et al. (2003) thoroughly examine the distinct payment activities in which non-banks are involved, which include back-office processing activities and front-office activities more visible to the final customers. In the present article, we focus on non-banks that market credit cards to Canadian consumers. We define non-banks as firms whose primary business is not related to traditional banking activities (such as deposit taking or lending). In our article non-banks are typically retailers that either issue credit cards through their own bank subsidiary, or sponsor these credit cards using another bank as the issuer.[2] Although their importance has been growing in recent decades, retailers have been issuing credit cards directly to consumers since the onset of consumer credit cards. We do not consider either new payment technologies that are being developed, such as mobile payments and internet payments (such as PayPal), which are typically provided by non-banks. These technologies are still immature and do not account for a significant fraction of payments. However, they provide another indication that the role of non-banks is growing rapidly in this industry.

Credit cards sponsored by non-banks typically offer merchandise discounts, rewards points or special credit conditions when used with the sponsoring merchant. In some cases, these cards are part of a major card network such as Visa or MasterCard, and can be used in any other retailer that accepts cards from these card networks[3]. In other cases, these cards are "private credit cards" in the sense that they provide credit to the customers but can only be used in establishments of the merchant that provides these cards.

However, why would a retailer be interested in sponsoring or even issuing a credit card? We can cite a number of advantages for retailers. On the demand side, these cards increase the loyalty of the

[2] We do not consider other non-banks that have a prominent role in the payment industry in general, but are involved in other activities different than the marketing of these cards among consumers. This is the case of the two prominent card network providers, Visa and MasterCard.

[3] These cards are sometimes called "co-branded" cards.

customers, increasing the demand of cardholders for products sold by the merchant (see Ching and Hayashi (2010) and Carbó-Valverde and Liñares-Zegarra (2011)). For example, these cards provide a number of benefits, such as higher rewards compared to other cards, a special credit line for products sold by the merchant, special payment plans (such as deferred payment plans), and other benefits (priority check in airports, access to airport private lounge, etc.). Another demand-related advantage that can be cited is that these cards can help retailers gather important information on customers that can help better market their products. However, important legal constraints exist that prevent the use of private information.[4]

On the cost side, private cards enable the merchant to save the cost of the interchange fee, which can be about 1% or 2% of the value of the transaction (see Bourreau and Verdier (2010)). These cards allow retailers to save these payment costs by bypassing some key players present in the credit card value chain, and at the same time, provide similar benefits to other branded credit cards.

Finally, in a third category of cards, we have American Express, Diners Club or Discover. These are general purpose/travel and enterteinment cards that are not issued by banks nor by merchants and do not use the Visa or MasterCard network. These cards provide extensive benefits and rewards to the cardholders.

These marked differences between banks and non-banks allow us to treat them differently in terms of the adoption and usage of payment instruments by consumers. As we have seen, these two agents have different objective functions when considering payment technologies. They also have a very different type of interaction with consumers. As a consequence, they will presumably use different strategies when selling these products, and they may target different types of market segments. Local proximity to the customer should play an important role given the large network of bank branches and retail stores. For example, proximity of certain retailer to a customer could affect the adoption and usage of a credit card branded by this retailer.

3 Data

We use Ipsos Reid's Canadian Financial Monitor (CFM) database for the period 2009-2012 that includes a very complete overview of the financial services of about 12,000 Canadian households annually. The CFM database covers most financial products offered to Canadian households, such as credit cards, chequing and savings accounts, insurance products, mortgages, personal loans, lines of credit, bonds, stocks, mutual funds, etc. The database includes most relevant characteristics of these products, such as current balance, fees, interest rates, credit limits, provider name, type of card, etc. The database also includes some demographic characteristics such as income, location

[4] The use of private information on consumers for business purposes has significantly increased over the last decades. Hence, this is a very important issue that is subject to public scrutiny (see for example Steel (2012)).

(postal code), education, age, etc. There is also usage information, with total number of purchases in the last month for every debit and credit card used by every household. Although 5 percent of households never use cash, we assume that all consumers adopt cash as a payment instrument, and restrict our sample accordingly. Furthermore, households that made more than 120 payments within the last month (roughly 2 percent of the sample) are discarded as extreme cases.

The CFM database contains a wealth of information about the identity of the credit card provider and the type of card. We can observe if there is a major network used (Visa/MasterCard), or if it is a card that can be used in a department store or gas station. This allows us to further differentiate between widely accepted retail credit cards (sponsored and sometimes issued by non-banks that can be used in most establishments), and retailer-only credit cards (also called private credit cards).

We use a database on bank branches in Canada constructed with the information found in Financial Services Canada for the years 2009-2012. This includes the address and 6-digit postal code of every physical branch for every bank and credit union in Canada per year. We exploit a geocoding tool (geopy), which uses Google's geocoder to determine the latitude and longitude of each branch of every bank and credit union (using their postal codes). The same process was followed for each household in the CFM database. We then run a second program which uses these coordinates to calculate the number of branches of each bank within a certain radius of each household, provided that the branches existed at the time of the observation. This process was repeated for multiple radii. Given the geographic size of 6-digit Canadian postal codes (usually less than hundreds or even dozens of meters), this location process can be fairly accurate.

Additionally, we construct a database of the locations of various retailers in Canada, including Canadian Tire, President's Choice (Loblaws, Superstore, No Frills, etc.), HBC (The Bay, Home Outfitters, Zellers), Sears, Petro Canada and ESSO. The majority of the locations of each retailer were found on their respective websites, and the above process was repeated to discover the number of each retailer within a given radius of each household. However, the locations for each retailer were not available retroactively, so we assume that there were not many changes in the locations of these retailers since 2009.

This process gives us the total number of banks/credit union branches, and retail locations around a CFM household (see Figure 1). We can then link these numbers with the adoption or usage of different payment instruments related to these financial institutions or retailers that are used in our econometric model.

4 Payments Industry in Canada

4.1 Adoption and use of payment instruments

The retail payment industry in Canada is mainly dominated by the three payment instruments: cash, credit card and debit card. The use of personal cheque in terms of usage and value, is significantly smaller than these three payment instruments, and usage of stored-value cards is even smaller (see Arango and Welte (2011) who use data from a 2009 survey). Usage of personal cheque in Canada has been historically lower than in U.S., and its usage has been declining in the recent years in both countries (see Schuh and Stavins (2010)). Therefore, in our article we focus on these three main payment instruments.

In Table 2 we show some key demographic statistics for the sample. We observe significant variation in key demographic variables.

Table 3 and Table 4 present statistics for credit card and bank account use, respectively. Unsurprisingly, the mean number of bank accounts held is 2; averaging 1 chequing and 1 savings account. Similarly, households possess 2 credit cards on average, the majority of which are not premium or rewards cards. Consumers typically make 12 debit purchases per month, which is less than the average of 16 monthly credit card payments. The total value of monthly purchases is also significantly lower for debit cards, averaging $580 compared to the much higher $1,547 charged to credit cards. Of great interest to this study is the dispersion of credit limits; these range from $0 at the 1st percentile to $92,000 at the 99th percentile.

Multihoming, the adoption of multiple payment instruments, is of substantial importance. In Table 5, we report the percentage of the population that holds each combination of credit cards and debit cards.

4.2 Main payment providers

The retail banking system is marked by a few major players accounting for the majority of the industry. National Bank of Canada (NBC), Royal Bank of Canada (RBC), Bank of Montreal (BMO), Canadian Imperial Bank of Commerce (CIBC), Scotiabank (SB) and TD Canada Trust (known as the Big Six) comprise the majority of the retail banking market. Other large players also exist, such as Desjardins, HSBC and credit unions such as Meridian or ATB. Table 7 and Table 8 show the market shares of these banks in terms of credit and debit purchase value, number of purchases, and outstanding/account balance for consumers with varying number of cards and accounts. In the first column of either table, we see that these seven institutions dominate in terms of purchase value, for every group of consumers. The same can be said for the second and third columns, where number of purchases and balances are studied, respectively.

We distinguish between bank and retailer credit cards by identifying banks as firms whose primary business is related to taking public deposits and using these deposits to make loans. While other firms may offer similar services, they are considered non-banks if their *primary* business is not as above. While non-bank credit card issuers are not a major factor in the recent growth in non-banks, they remain an important player in the credit card market.

Perhaps not surprisingly, very large Canadian retailers are among the largest providers in this market. Canadian Tire (an automotive and home goods chain), and Loblows/President's Choice (a supermarket chain) are among the largest retail firms in Canada. More interestingly, there is a large variation in the type of firm that issues these credit cards, and in the range of financial products provided (see Table 1). For example, Canadian Tire offers both credit cards and savings accounts through its Canadian Tire Bank subsidiary. President's Choice (PC) is a unique case in that it offers a wide range of financial services. PC has small financial centers in many of its supermarkets in Canada that provide services fairly similar to bank branches. In practice, the PC Mastercard is issued by its own President's Choice Bank and the remainder of its financial services are provided by CIBC.

Also, Esso and PetroCanada offer Visa credit cards issued by RBC and CIBC, respectively. Slightly differently, Sears and Hudson's Bay depend on foreign banks with a small retail presence in Canada (JP Morgan and Capital One).

Table 10 reports the number of cards by different types of institutions in the first column and their share as a percentage of all credit cards on issue. Tables 11 and 12 report market shares of different credit card issuers in terms of total purchase value and number of purchases. It is evident from these tables that banks dominate in all categories. Despite the large number of credit union branches present in many markets, credit unions do not have a proportionate presence in the credit card market. Retailers make up a surprisingly high portion of the credit card market, particularly in terms of the number of cards on issue, at 26%. Of the largest specific retailers reported, Canadian Tire and President's Choice are by far the most important sellers of credit cards, accounting for a combined 10% of all credit cards. In addition, these retailers issue their own credit cards through financial subsidiaries. Other relevant retailers include Sears and HBC, though their impact is much smaller.

We then study with detail the structure of the network and its relationship with the adoption of credit cards. Table 13 shows the probability that CFM households have at least one branch of a financial institution within a close distance. All Big Six banks (except NBC) have, with about 70% probability, at least one branch in a circle of a 5 km radius around every household. This percentage decreases to about 30% for DesJardins, NBC and HSBC, which are very large financial institutions, but their geographical presence is more focused in a few markets. Finally, there are a number of credit unions that have a minor geographic presence. Table 14 shows in detail how this network presence affects the probability of holding credit cards from the Big Six banks (and DesJardins). As we expected, we observe a direct relationship between Table 13 and Table 14.

Perhaps surprisingly, we do not observe a large difference in Table 14 between the 10 km radius and the 5 km radius case.

We then proceed to show similar results for the retailers that we consider. Compared to Table 13, Table 15 shows a relatively similar level of proximity of these large retailers. Table 16 again shows a direct relationship between proximity and adoption, but the results observed in this table are consistent with the observed lower level of adoption of these retailer cards.

These results give interesting evidence about the effect of network proximity on the adoption (and possibly usage) of payment cards. In our econometric model, we assume that there are no relevant network effects for bank and widely accepted retail credit cards, since they are accepted almost everywhere. However, we suspect that proximity to the network of retailers would have an effect on the choice to pay with retailer only credit cards so we include this variable in our model.

5 Empirical strategy

Our model is based on that of Koulayev et al. (2012), though we focus on the adoption of retailer credit cards, distinguishing between those which can be used at a variety of stores and those which are only accepted at a particular retailer. Consistent with our previous explanation where we consider all these cards as products with essentially different characteristics, we treat them differently in our econometric model. Our model is a two stage process. In the adoption stage, consumer i selects bundle $b_i \in B$, where b_i is a combination of payment instruments chosen from the following: cash, bank issued credit card, widely accepted non-bank credit card, retailer-only credit card, and debit card. Then, in the usage stage, the consumer is confronted with a payment opportunity $l \in L$, and chooses payment method $j \in b_i$ in order to maximize utility. Alternatively, the consumer may choose not to make a payment at any given opportunity.

Usage Stage: The utility of consumer i of using payment method j is:

$$u_{ijl} = \delta_{ij} + \varepsilon^u_{ijl}$$

where δ_{ij} and ε^u_{ijl} are known to the consumer during the usage stage, and though the distribution of ε^u_{ijl} is known, its actual value is unknown when making adoption decisions. While δ_{ij} is known to the consumer, it is only partially observed by the researcher as follows:

$$\delta_{ij} = x_{ij}\beta_\delta + \nu_{ij} \tag{1}$$

where x_{ij} is a set of observable characteristics pertaining to consumer i and payment choice j, and ν_{ij} is unobservable. This unobservable information can be thought of as the consumer's idiosyncratic perception of the payment choice. The vector x_{ij} is comprised of demographic variables such as income, age, employment status, education level, marital status, whether or not the consumer owns

a home, and a constant term. These are distinct for each payment method. We include total credit limit in the regression equation for the usage of bank credit cards, widely accepted credit cards and retailer credit cards. Furthermore, we include bank network effects in the regression equation for cash usage as a proxy for the negative cost of withdrawing cash. Similarly, we regress the use of retailer-only credit cards on retail network effects.

For each opportunity l, consumer i -with bundle b_i- chooses the payment method j such that $u_{ijl} \geq u_{ij'l}$,so the consumer maximizes their indirect utility:

$$\upsilon_{il}(b) = \max_{j \in b_i} u_{ijl} \tag{2}$$

At the time of adoption, the consumer is concerned with the expected indirect utility averaged over ε^u_{ijl}. One can think of this as the average over payment opportunities:

$$\upsilon_i(b) = E[\upsilon_{il}(b)] \tag{3}$$

Adoption Stage: We select our sample such that every consumer adopts cash as a payment method, so we do not model the adoption of cash. The value to consumer i of adopting bundle b of payment methods is:

$$V_{ib} = \overline{V}_{ib} + \varepsilon^a_{ib} \tag{4}$$

where ε^a_{ib} is an stand normal term and

$$\overline{V}_{ib} = \sum_{j \in b} \lambda_{ij} + \upsilon_i(b) \tag{5}$$

Here, $\upsilon_i(b)$ is as in (3), and is known entirely to the consumer. This is because δ_{ij} is known and since the distribution of ε^u_{ijl} is known to be Type 1 Extreme Value, its expected value is known to be

$$\upsilon_i(b) = E[\upsilon_{il}(b)] = \ln\left(\sum_{j \in b} \exp(\delta_{ij}) + \gamma\right) \tag{6}$$

where γ is Euler's constant.

As is the case with δ_{ij}, the consumer observes λ_{ij}, but the researcher observes only the vector z_{ij}, where:

$$\lambda_{ij} = z_{ij}\beta_\lambda + \omega_{ij} \tag{7}$$

Here, z_{ij} includes demographic variables and a constant term as in x_{ij}, with distinct regressors for each payment method. Additionally, an indicator of financial stress is included in the regression

equation for the adoption of bank-issued credit cards, non-bank credit cards, and retailer-only credit cards. This variable is equal to one if the consumer, in the past year, has been behind on mortgage payments, behind on other debt, or has filed bankruptcy. Bank network effects are included in the adoption regression for bank-issued credit cards and debit cards. Additionally, retail network effects are included for the adoption of retailer-only credit cards.

The error term ε^a_{ijl} is independent and identically distributed as Type 1 Extreme Value. Thus, given ν^s_i, ω^s_i,and the set of parameters to be estimated, θ, the probability of adopting bundle b^*_i of payment methods is:

$$\Pr(b^*_i|\nu^s_i, \omega^s_i, \theta) = \frac{\exp(\overline{V}^s_{ib^*})}{\sum_{k\in B}\exp(\overline{V}^s_{ik})} \tag{8}$$

The vector y^*_i,comprised of y_{ij} for each payment method $j \in b_i$, represents the number of times each payment method j is used. Thus the probability of y^*_i payments is:

$$\Pr(y^*_i|b^*_i, \nu^s_i, \omega^s_i, \theta) = \prod_{j\in b^*_i}\left(\frac{\exp(\delta^s_{ij})}{\sum_{k\in b^*_i}\exp(\delta^s_{ik})}\right)^{y^*_{ij}} \tag{9}$$

Using these, we construct the following likelihood function to estimate the set of parameters $\theta = \{\beta_\delta, \beta_\lambda, \sigma_{ij}\ where\ j \in b_i\}$:

$$L_i(y^*_i, b^*_i|\theta) = \int_{\nu_i}\int_{\omega_i}\Pr(y^*_i, b^*_i|\nu_i, \omega_i, \theta)f(\nu_i, \omega_i)d\nu_i d\omega_i \tag{10}$$

And the total likelihood is

$$L(y^*, b^*|\theta) = \prod_{i=1}^{n} L_i(y^*_i, b^*_i|\theta) \tag{11}$$

The correlations of the error terms for the adoption and use equations for a given payment method j and consumer i are governed by the following parameters:

$$\begin{aligned}\nu_{ij} &= \sigma_1\varepsilon^1_{ij} + \sigma_{2,j}\varepsilon^2_{ij} \\ \omega_{ij} &= \sigma_{3,j}\varepsilon^3_{ij} + \sigma_{4,j}\varepsilon^2_{ij}\end{aligned} \tag{12}$$

where ε^k_{ij} are independent standard normal for any consumer i , payment method j, and $k \in \{1, 2, 3, 4\}$. Cash is an exception. Since we do not model its adoption, $\omega_{i,bank}$ does not exist, so $\nu_{i,bank}$ is simply a standard normal random variable.

The correlations between error terms are defined by the following relationships:

$$\begin{aligned} cov(\nu_{ij}, \omega_{ij}) &= \sigma_2 \sigma_4 \\ var(\nu_{ij}) &= (\sigma_1)^2 + (\sigma_2)^2 \\ var(\omega_{ij}) &= (\sigma_3)^2 + (\sigma_4)^2 \end{aligned} \tag{13}$$

And the error terms between different payment methods p and q are uncorrelated.

Estimates of the vector of parameters $\theta = \{\beta_\delta, \beta_\lambda, \sigma\}$ can be obtained by using simulated maximum likelihood (SML, see Lerman and Manski (1981) or Gourieroux and Monfort (1993)) to maximize the objective function (11), where we numerically estimate the integral in (10) using a large number S of random draws of the error terms. We analytically calculate the gradient of the objective function and use the KNITRO optimizer to maximize it.

6 Results

In the adoption equation, we neglect cash. For the other payment instruments, we observe the effects of demographic variables including income, age, employment, education level, marital status, and homeownership. Further, we observe network proximity effects for the adopting of bank-issued credit cards, retailer-only credit cards, and debit cards. Finally, we observe an indicator of financial stress for the adoption of each credit card type. Estimates for the effects of these variables on the use decision is displayed in Table 17.

In most demographic variables, we observe a significant degree of variation in the level and the sign of the estimates parameters across payment instruments. This shows that payment instruments are adopted by individuals with quite different characteristics. Income has a positive effect on widely accepted retail cards, and a negative effect on bank-issued credit cards, retailer-only credit cards and debit cards. Age had a positive and significant effect on all payment instruments. The effect on bank-issued credit cards is remarkably high. Employment has a positive effect on bank credit cards and debit cards, and a much smaller positive effect on retailer-only cards, while it has a slight influence widely-accepted retail cards negatively. Being married and being a homeowner both have the effect of increasing the utility of adoption for credit cards, but have the opposite effect on debit adoption.

The network proximity variable is defined as a indicator function equal to one if there exists at least one branch/retailer within 5 kilometers of the respondent for the corresponding bank/retailer that provides the credit card. Network proximity effects are observed for bank issued credit, retailer only credit and debit cards. Network proximity has a positive effect on adoption of bank-issued credit cards. This makes sense, since one is likely to obtain a credit card from a bank (as opposed to a retailer) if one lives close to the bank. Even higher is the network proximity effect for debit

card adoption. The same reasoning applies here, but it is more pronounced because bank branches are typically the only place to to obtain debit cards, whereas credit cards can often be obtained through offers via mail and other sources. The network proximity effect for retailer-only credit cards is insignificant. While unexpected, it's possible that in the adoption decision, attitudes towards retailers are more important than their proximity, resulting in a high positive effect of network proximity of use (since they already shop there) but not adoption.

The indicator of financial stress is included in the adoption equation for bank-issued credit cards, widely-accepted retailer-credit cards and retailer-only credit cards. We expect that financial stress would limit one's financial flexibilty, potentially leading one towards retailer credit cards, for which screening processes might not be as stringent as that of a formal bank; however, our findings indicate just the opposite. The effect of financial stress on adoption of bank credit cards is positive, and its effect on widely accepted retailer and retailer-only cards is negative, albeit very small. This large effect for bank-issued credit cards could just show that individuals that have experienced financial stress situations in the past are more likely to adopt credit cards for precautionary resons. Credit cards offer an easy and fast way (although expensive) of accessing to credit in the future.

In the usage equation, we use the same demographic variables as in the adoption equation. Additionally, we observe credit limits on each of the credit payments, and network proximity effects for cash and retailer-only cards. Table 18 shows estimates for the effects of each explanatory variable on the use equation, separated by payment instrument.

The effects of demographic variables are not very surprising. Income has a significant positive effect on the use of cash, bank cards and debit cards. This is unsurprising, as one expects an increase in spending to follow an increase in income. The negative effecto on widely accepted retailer credit cards is harder to interpret. Age has a negative effect on all payment instruments, but it is specially high for debit and cash. This negative effect might be related to the age of the sample. The sample tends to be older, so it might be that the older respondents have very fixed incomes or limited funds with which to make purchases. The effect of employment is also unsurprising; employment has a positive effect on the use of cash, bank credit cards and debit credit cards, while it has a large negative effect on the two retailer credit cards. This can likely be explained by the fact that unemployed people may be more strapped for credit, thus turning to alternative financing methods such as retailer credit. The effecto of education is positive in most cases, but it is specially high for bank issued credit cards and widely accepted retailer credit cards. This could be explained because these are sophisticated users that tend to use the most sophisticated payment instruments that provide also rewards.

The network proximity observed for cash use is defined as a indicator function if there exists at least one branch within 5 kilometers of the respondent for all the banks at which the respondent holds an account. The effect of network proximities on the use of cash and retailer-only credit cards are consistent with our hypotheses. Higher proximity to bank networks is positively linked with cash use. This is likely due to the fact that people who live closer to these bank networks must

spend less (in time, or travel) to attain cash. Similarly, the network proximity observed for retailer-only cards is defined as an indicator function equal to one if there exists at least one retailer within 5 kilometers of the respondent for which the respondent holds a credit card. Network proximity has an even higher positive effect on retailer-only credit card use, which is likely explained by the fact that people who live close to retailers would be more likely to make purchases there, thus making the discounts or rewards associated with retail cards even more valuable. This effect for retailer-only credit cards is much higher than the coefficient for cash, and it is consistent with our hypotheses. These are private cards that can only be used at the retailer, and therefore usage should increase significantly with proximity.

It is expected that a lower credit limit might necessitate the use of less traditional retailer cards as an alternative method of financing; thus higher credit limits should lead to high bank-credit card use, while the opposite is anticipated of widely-accepted retailer and retailer only credit cards. In reality, its effect is insignificant in the use of bank-issued credit cards, and positive but extremely unimportant for decisions regarding the use of the other credit cards.

7 Counterfactual experiment

We present one counterfactual experiment in which we observe the effect of lowering credit limits. We look at the conditional effect on use, given the observed bundles of payment instruments. In figure 2, we see that as credit limits are decreased (to the left), bank credit card use decreases, and there is a slight increase in both debit and cash use. The effect on non-bank credit use is rather small. This result may actually underestimate the effect of a decrease in credit card limits, since we do not account for the fact that credit limits set an upper bound on credit spending. We simply state the effect of changing credit limits on use, so if the model were adapted to allow for this bound on spending, use of credit cards may actually decrease more than observed, potentially resulting in a more pronounced substituion effect among payment methods.

We can think of the conditional experiment as the effect of a reduction in credit card limits in the short run, where payment bundles are fixed. Similarly, the unconditional case represents the long run effects of credit limit changes, where consumers change their bundle of payment instruments based on their newly changed expected utility of use.

8 Conclusion

In the last decades non-banks have become increasingly important as providers of different retail payment services. In this paper we try to determine the key aspects that are driving the adoption and usage of means of payments provided by retailers. We estimate a simultaneous two equation model of the adoption and usage of cash, bank-issued credit cards, widely accepted retailer credit cards, retailer-specific credit cards and debit cards. We are particularly interested in understanding the effect of the bank and retailer network proximity to the households in the adoption and usage of these instruments, as well as demographic variables and other relevant variables. Our results show that, as expected, network proximity is related positively to the use of cash and retailer-specific credit cards, and to the adoption of debit cards and bank-issued credit cards. Contrasting with views in the related literature, the effects of credit limits are unimportant to the use decision. We also find the unexpected result that recent financial stress has a positive effect on the adoption of bank credit cards. We also run a counterfactual experiment, and show that as credit limits are decreased, bank-issued credit use drops and there are slight increases in other payment use.

One of the assumptions of our model is that at the acceptance rate of credit and debit cards by merchants is one. In Canada, this may be a fair assumption, as the acceptance of both the Interac and credit networks are widespread. However, this may be inappropriate for other markets, and so discretion should be used when making inferences about our results.

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9 Figures and Tables

Table 1: What financial institutions back retail credit cards

Retailer	Backing Bank	Additional Info
Sears	JP Morgan Chase Bank	Originally Sears Canada Bank, purchased in 2005
Canadian Tire	Canadian Tire Bank	Also offers online-only savings accounts
Hudson's Bay Company/Zellers	Capital One	
President's Choice	President's Choice Bank	Other banking services offered by CIBC
Petro Canada	CIBC	
ESSO	RBC	

Figure 1: Measuring proximity of the network to the household.

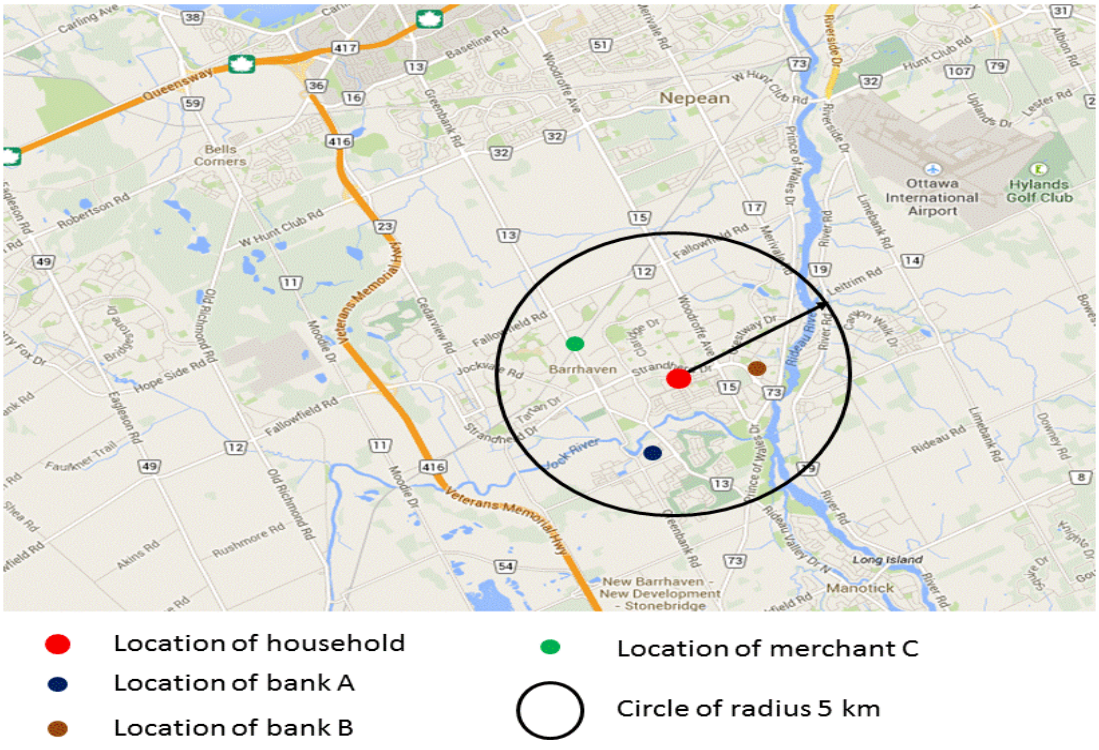

Table 2: Key Statistics - Demographics

	Mean	SD	1%	25%	Median	75%	99%	Min	Max
Household Size	2.2	1.1	1.0	1.0	2.0	3.0	6.0	1.0	8.0
Age of Head	54.0	15.7	22.0	42.0	56.0	65.0	86.0	18.0	99.0
Length of Time in Canada	46.7	21.4	6.5	32.0	51.0	63.0	85.0	1.5	99.0
Household Income (in $100,000)	0.6	0.4	0.1	0.3	0.5	0.9	2.0	0.1	2.0
Proportion of Anglophones (%)	71.9	44.9	0.0	0.0	100.0	100.0	100.0	0.0	100.0
Proportion of Francophones (%)	19.5	39.6	0.0	0.0	0.0	0.0	100.0	0.0	100.0
Proportion of Married (%)	47.4	49.9	0.0	0.0	0.0	100.0	100.0	0.0	100.0
Proportion Employed (%)	91.5	27.8	0.0	100.0	100.0	100.0	100.0	0.0	100.0
Proportion University	88.8	31.6	0.0	100.0	100.0	100.0	100.0	0.0	100.0
Degree (%)	74.5	43.6	0.0	0.0	100.0	100.0	100.0	0.0	100.0
Proportion of Homeowners (%)	7.8	26.9	0.0	0.0	0.0	0.0	100.0	0.0	100.0
Proportion Financially Stressed (%)	210,908	226,021	0	0	162,500	337,500	750,000	0	750,000
Total Value of Real Estate ($)	18,517	28,121	0	3,500	12,500	27,500	112,500	0	750,000
Total Value of Vehicles ($)	15,475	48,820	0	600	3,500	12,500	176,250	0	2,033,750
Total Balance Accounts ($)	8,981	59,361	0	0	0	0	237,500	0	3,887,500
Total Value of Bonds ($)	23,249	80,123	0	0	0	3,500	400,000	0	1,700,000
Total Value of GIC ($)	44,686	119,907	0	0	0	22,500	575,000	0	2,187,500
Total Value of Mutual Funds ($)	31,782	134,254	0	0	0	0	650,000	0	6,125,000
Total Value of Stock ($)	124,173	244,731	0	1,500	20,550	136,500	1,170,750	0	6,223,500
Total Liquid Assets ($)	235,513	245,703	0	12,500	193,750	355,000	930,000	0	1,750,000
Total Illiquid Assets ($)	2,253	6,502	0	0	0	1,500	32,000	0	158,000
Total Balance Credit Cards ($)	359,685	399,228	0	35,850	259,150	513,550	1,752,500	0	6,746,000
Total Balance LOC ($)	55,592	93,252	0	0	6,250	78,250	391,550	0	1,325,000
Total Balance Mortgage ($)	304,094	397,117	-136,250	17,500	171,800	445,600	1,726,250	-758,750	6,746,000
Total Balance Personal Loans ($)	643	1,184	0	104	363	890	3,622	0	71,440
N	46,945								

Source: CFM 2009-2011

Table 3: Key Statistics - Credit Cards

	Mean	SD	1%	25%	Median	75%	99%	Min	Max
Number of Credit Cards	2.1	1.6	0.0	1.0	2.0	3.0	7.0	0.0	10.0
Number of Premium Cards	0.5	0.8	0.0	0.0	0.0	1.0	3.0	0.0	8.0
Number of Regular Cards	1.6	1.5	0.0	0.0	1.0	2.0	6.0	0.0	10.0
Number Rewards Cards	0.5	0.9	0.0	0.0	0.0	1.0	4.0	0.0	10.0
Total Credit Limit ($)	17,181	31,863	0	2,000	11,000	24,900	92,500	0	5,029,000
Highest Credit Card Limit ($)	11,726	27,664	0	5,000	10,000	16,000	50,000	0	5,000,000
Lowest Credit Card Limit ($)	5,480	7,306	0	1,000	3,500	7,500	26,200	0	500,000
Number of Credit Purchases	16	34	0	1	8	23	95	0	2,065
Total Value of Credit Purchases ($)	1,551	2,890	0	89	668	2,000	12,018	0	100,000
Highest Credit Card Purchases ($)	1,459	2,487	0	200	732	1,842	10,000	0	80,000
Lowest Credit Card Purchases ($)	449	1,213	0	0	55	380	5,011	0	40,529
Current Outstanding Balance ($)	2,253	6,502	0	0	0	1,500	32,000	0	158,000
Highest Outstanding Balance ($)	1,994	4,343	0	0	0	1,500	22,500	0	35,000
Lowest Outstanding Balance ($)	699	2,226	0	0	0	300	12,500	0	35,000
Premium Card Annual Fees ($)	21	74	0	0	0	0	240	0	10,000
Regular Card Annual Fees ($)	10	41	0	0	0	0	149	0	5,060
Rewards Card Annual Fees ($)	16	74	0	0	0	0	220	0	10,000
N	46,945								

Source: CFM 2009-2011

Table 4: Key Statistics - Bank Accounts

	Mean	SD	1%	25%	Median	75%	99%	Min	Max
Number of Bank Accounts	2.2	1.6	0.0	1.0	2.0	3.0	8.0	0.0	10.0
Number of Chequing Accounts	1.3	0.8	0.0	1.0	1.0	2.0	4.0	0.0	10.0
Number of Savings Accounts	1.2	1.2	0.0	0.0	1.0	2.0	5.0	0.0	10.0
Number of Debit Cards	2.1	2.3	0.0	1.0	2.0	3.0	8.0	0.0	150.0
Number of Reward Cards	0.1	0.4	0.0	0.0	0.0	0.0	2.0	0.0	10.0
Total Number of Debit Purchases	11	23	0	0	5	15	75	0	1,395
Highest Number of Debit Card Purchases	11.1	20.2	0.0	1.0	6.0	15.0	60.0	0.0	895.0
Lowest Number of Debit Card Purchases	5.6	15.7	0.0	0.0	0.0	6.0	50.0	0.0	875.0
Number of Debit Purchases (Chequing)	10	21	0	0	4	15	70	0	1,395
Number of Debit Purchases (Savings)	4.8	15.4	0.0	0.0	0.0	3.0	52.0	0.0	800.0
Total Value of Debit Purchases ($)	569	2,125	0	0	180	605	5,000	0	200,000
Highest Value of Debit Card Purchases ($)	509	2,047	0	0	200	585	4,000	0	200,000
Lowest Value of Debit Card Purchases ($)	190	757	0	0	0	112	2,400	0	70,000
Value of Chequing Debit Purchases ($)	492	1,768	0	0	120	552	4,162	0	200,000
Value of Savings Debit Purchases ($)	249	1,752	0	0	0	100	3,000	0	200,000
Total Account Balance ($)	15,475	48,820	0	600	3,500	12,500	176,250	0	2,033,750
Highest Account Balance ($)	11,665	36,199	0	750	3,500	8,750	112,500	0	875,000
Lowest Account Balance ($)	3,832	19,905	0	300	750	3,500	45,000	0	875,000
Total Chequing Account Balance ($)	6,215	21,447	0	100	1,500	5,000	67,500	0	1,287,500
Total Savings Account Balance ($)	10,501	38,919	0	0	750	6,250	136,250	0	2,033,750
Total Monthly Service Charges ($)	6.7	11.9	0.0	0.0	0.0	10.5	52.5	0.0	250.0
Total Chequing Monthly Service Charges ($)	5.4	9.8	0.0	0.0	0.0	8.0	50.0	0.0	150.0
Total Savings Monthly Service Charges ($)	2.5	7.2	0.0	0.0	0.0	0.0	31.0	0.0	200.0
N	46,945								

Source: CFM 2009-2011

Table 5: Multihoming Distribution

	Proportion (%)
1 Credit Card	28.32
2 Credit Cards	25.30
3 Credit Cards	15.77
4 Credit Cards	8.70
More Than 4 Credit Cards	7.73
1 Debit Account	33.98
2 Debit Accounts	28.66
3 Debit Accounts	15.03
4 Debit Accounts	8.11
More Than 4 Debit Accounts	9.09
1 Credit Card and 1 Debit Account	13.92
1 Credit Card and No Debit Account	1.68
No Credit Card and 1 Debit Account	7.14
2 Credit Cards and 2 Debit Accounts	8.74
2 Credit Cards and 1 Debit Account	7.29
1 Credit Card and 2 Debit Accounts	7.47
1 Credit Card and it is Retail-Only	0.56
1 Credit Card and it is Widely Accepted Retail	1.38
1 Credit Card and it is Bank Issued	23.46
1 Credit Card and 1 Debit Account from Same Bank	7.63
All Cards from Same Bank	16.98
No Credit Card and No Debit Card	1.64
N	46945.00

Source: CFM 2009-2011

Table 6: Demographics by Strata

	All		Retail Card		One Credit Card		One Credit Card	
	Mean	Median	Mean	Median	Mean	Median	Mean	M
Size of Household	2.16	2.00	2.19	2.00	2.04	2.00	1.93	
Age	54.01	56.00	57.39	59.00	54.64	56.00	60.56	6
Household Income	0.64	0.50	0.68	0.57	0.56	0.50	0.37	
Net Wealth	304093.78	171800.00	370390.09	262500.00	249332.34	130000.00	160244.48	57
N	46945.00	.	8612.00	.	13293.00	.	263.00	

Source: CFM 2009-2011

Table 7: Big Six Market Shares (%) - Credit Cards

	Total Purchase Value	Number of Purchases	Outstanding Balance
Consumers with 1 Credit Card			
BMO	15.13	14.50	14.11
CIBC	22.47	22.86	16.98
Desjardins	6.47	6.80	6.25
National Bank	2.34	2.69	2.58
RBC	16.48	15.09	15.47
TD	9.76	8.33	9.16
Scotiabank	5.59	5.14	9.41
Consumers with 2 Credit Cards			
BMO	15.83	15.67	13.41
CIBC	22.75	23.14	15.36
Desjardins	4.80	4.72	4.87
National Bank	2.01	1.92	2.19
RBC	13.24	12.05	13.11
TD	8.29	7.74	9.16
Scotiabank	4.75	5.05	8.98
Consumers with 3 Credit Cards			
BMO	14.95	14.80	11.35
CIBC	21.99	22.87	16.58
Desjardins	3.50	3.45	3.08
National Bank	1.72	2.06	1.87
RBC	11.08	9.96	11.88
TD	7.82	6.97	8.77
Scotiabank	5.21	3.86	9.94
Consumers with 4 Credit Cards			
BMO	13.48	13.66	10.49
CIBC	20.91	22.13	17.81
Desjardins	3.42	1.69	2.18
National Bank	1.29	1.90	1.43
RBC	11.63	9.87	9.26
TD	7.81	7.35	7.76
Scotiabank	4.66	4.22	11.43
N	46945.00	.	.

Source: CFM 2009-2011

Table 8: Big Six Market Shares (%) - Debit Accounts

	Total Purchase Value	Number of Purchases	Account Balance
Consumers with 1 Account			
BMO	10.98	11.40	11.03
CIBC	13.10	13.72	13.12
Desjardins	11.40	11.03	9.01
National Bank	3.31	3.79	3.36
RBC	18.18	15.38	18.77
TD	16.39	17.18	16.45
Scotiabank	10.75	11.01	8.53
Consumers with 2 Accounts			
BMO	11.40	10.85	9.57
CIBC	14.94	16.91	13.94
Desjardins	7.62	9.08	5.81
National Bank	2.58	3.36	4.30
RBC	15.55	16.05	15.07
TD	19.28	18.38	17.04
Scotiabank	13.73	10.05	7.98
Consumers with 3 Accounts			
BMO	11.10	11.12	10.14
CIBC	17.09	17.98	12.89
Desjardins	7.76	9.42	5.13
National Bank	2.94	2.80	2.77
RBC	17.76	17.28	15.68
TD	18.29	16.56	16.16
Scotiabank	11.24	11.36	7.65
Consumers with 4 Accounts			
BMO	10.43	9.70	8.39
CIBC	15.55	20.13	16.92
Desjardins	10.73	7.51	3.86
National Bank	2.43	2.38	1.03
RBC	21.54	18.55	13.20
TD	17.08	17.81	17.26
Scotiabank	10.49	11.76	9.27
N	46945.00	.	.

Source: CFM 2009-2011

Table 9: Number of Credit Cards Held

	Mean	SD	1%	25%	Median	75%	99%	Min	Max
Number of Credit Cards	2.0652	1.6252	0	1	2	3	7	0	10
Number of Bank Issued Cards	1.2315	1.1317	0	0	1	2	5	0	10
Number of Credit Union Issued Cards	0.1269	0.3810	0	0	0	0	2	0	4
Number of Retailer Issued Cards	0.5142	0.8113	0	0	0	1	3	0	9
Number of Retailer Only Cards	0.2374	0.5610	0	0	0	0	2	0	6
Number of Canadian Tire Cards	0.1099	0.3400	0	0	0	0	1	0	6
Number of Sears Cards	0.0093	0.0991	0	0	0	0	0	0	2
Number of Walmart Cards	0.0001	0.0092	0	0	0	0	0	0	1
Number of The Bay Cards	0.0043	0.0674	0	0	0	0	0	0	2
Number of Zellers Cards	0.0009	0.0303	0	0	0	0	0	0	1
Number of PC Cards	0.0997	0.3163	0	0	0	0	1	0	4
Number of Eatons Cards	0.0000	0.0000	0	0	0	0	0	0	0
Number of ESSO Cards	0.0002	0.0131	0	0	0	0	0	0	1
Number of Shell Cards	0.0001	0.0080	0	0	0	0	0	0	1
Number of Petro Canada Cards	0.0004	0.0190	0	0	0	0	0	0	1
N	46,945								

Source: CFM 2009-2011

Table 10: Total Number of Credit Cards Held

	Total Number	Percent Share
Banks	58331	59.1580
Credit Unions	6030	6.1155
Retailers	24176	24.5188
Other	5634	5.7139
Canadian Tire	5158	5.2311
Sears	441	0.4473
Walmart	4	0.0041
The Bay	201	0.2038
Zellers	45	0.0456
Presidents Choice	4720	4.7869
Eatons	0	0.0000
ESSO	8	0.0081
Shell	3	0.0030
Petro Canada	17	0.0172
N	46945	.

Source: CFM 2009-2011

Table 11: Credit Card Market Shares (%)

	Total Purchase Value	Number of Purchases
Banks	71.4277	70.3386
Credit Unions	6.1794	5.8403
Retailers	15.2301	16.4511
Other	4.1270	4.5273
Canadian Tire	4.4631	5.5009
Sears	0.0962	0.0878
Walmart	0.0022	0.0035
The Bay	0.0247	0.0607
Zellers	0.0035	0.0130
Presidents Choice	6.6016	8.5904
Eatons	0.0000	0.0000
ESSO	0.0015	0.0021
Shell	0.0005	0.0010
Petro Canada	0.0012	0.0031
N	4.69e+04	.

Table 12: Credit Card Market Shares Given That One Has Retailer Card (%)

	Total Purchase Value	Number of Purchases
Banks	61.0712	59.8760
Credit Unions	3.7783	3.2711
Retailers	29.2552	31.4884
Other	3.3736	3.0760
Canadian Tire	8.5730	10.5291
Sears	0.1847	0.1680
Walmart	0.0042	0.0068
The Bay	0.0474	0.1162
Zellers	0.0067	0.0248
Presidents Choice	6.0923	7.8892
Eatons	0.0000	0.0000
ESSO	0.0029	0.0040
Shell	0.0010	0.0020
Petro Canada	0.0023	0.0060
N	4.69e+04	.

Source: CFM 2009-2011

Table 13: Probability of Having Each Branch Within Given Radius (%)

Bank	Within 5km	Within 10km
BMO	71.65	79.34
CIBC	71.75	81.20
Desjardins	31.42	40.29
National Bank	37.55	51.89
RBC	74.01	82.14
TD	69.43	76.89
Scotiabank	65.02	73.57
ATB	6.03	6.65
CWB	7.35	12.82
Laurentian	11.92	15.86
Vancity	5.09	5.92
HSBC	26.53	39.49
Alterna Savings	6.70	10.74
Coast Capital CU	5.26	6.68
Meridian CU	5.90	10.00
N	46945.00	.

Source: CFM 2009-2011

Postal codes were used to calculate geographic coordinates, then distances between branches and houses were calculated. Probabilities represent the proportion of households with at least one of the specified branches within given radius.

Table 14: Probability of Holding Credit Cards Given Proximity To Branch (%) - Credit Cards

Probability of Having:	Given a Branch Within 10km	Given a Branch Within 5km
1 BMO Card	13.9994	12.7341
2 BMO Cards	1.3782	1.2589
3 or More BMO Cards	0.1619	0.1555
1 RBC Card	14.1421	12.7149
2 RBC Cards	1.7467	1.5742
3 or More RBC Cards	0.1960	0.1725
1 Scotiabank Card	6.0092	5.3808
2 Scotiabank Cards	0.7008	0.5986
3 or More Scotiabank Cards	0.0895	0.0682
1 TD Card	11.3026	10.2439
2 TD Cards	1.3590	1.2312
3 or More TD Cards	0.1853	0.1598
1 CIBC Card	17.7697	15.9506
2 CIBC Cards	3.6149	3.2293
3 or More CIBC Cards	0.4580	0.4260
1 National Bank Card	2.8927	2.5200
2 National Bank Cards	0.3025	0.2577
3 or More National Bank Cards	0.0234	0.0149
1 Desjardins Card	5.9048	5.3914
2 Desjardins Cards	0.9564	0.8925
3 or More Desjardins Cards	0.0426	0.0383
N	4.69e+04	.

Source: CFM 2009-2011

Table 15: Probability of Having Each Retailer Within Given Radius (%)

Retailer	Within 5km	Within 10km
Sears	50.50	72.73
Canadian Tire	67.60	78.92
HBC	41.71	54.97
Presidents Choice	72.73	81.10
Zellers	51.96	69.91
Petro Canada	73.94	80.45
ESSO	76.10	83.94
N	46945.00	.

Source: CFM 2009-2011

Postal codes were used to calculate geographic coordinates, then distances between retailers and houses were calculated. Probabilities represent the proportion of households with at least one of the specified retailers within given radius.

Table 16: Probability of Holding Credit Cards Given Proximity To Retailer (%) - Credit Cards

Probability of Having:	Given a Retailer Within 10km	Given a Retailer Within 5km
1 Sears Card	0.6369	0.4729
2 Sears Cards	0.0234	0.0170
3 or More Sears Cards	0.0000	0.0000
1 Canadian Tire Card	7.0636	5.9112
2 Canadian Tire Cards	0.5006	0.4239
3 or More Canadian Tire Cards	0.0256	0.0213
1 HBC Card	0.2961	0.2535
2 HBC Cards	0.0064	0.0043
3 or More HBC Cards	0.0000	0.0000
1 President's Choice Card	7.8134	7.0764
2 President's Choice Cards	0.4047	0.3643
3 or More President's Choice Cards	0.0170	0.0170
1 Zellers Card	0.0596	0.0490
2 Zellers Cards	0.0000	0.0000
3 or More Zellers Cards	0.0000	0.0000
1 Petro Card	0.0298	0.0298
2 Petro Cards	0.0000	0.0000
3 or More Petro Cards	0.0000	0.0000
1 ESSO Card	0.0170	0.0170
2 ESSO Cards	0.0000	0.0000
3 or More ESSO Cards	0.0000	0.0000
N	4.69e+04	.

Source: CFM 2009-2011

Table 17: Estimates - Adoption Equation

Parameter	Estimate	Standard Deviation
Constant		
Bank Issued Credit Card	-0.069704	0.039731
Widely Accepted Retailer Credit Card	0.066565	0.029917
Retailer-Only Credit Card	0.064581	0.0063868
Debit Card	0.23705	0.074781
Income		
Bank Issued Credit Card	-0.096982	0.067504
Widely Accepted Retailer Credit Card	0.057077	0.0097321
Retailer-Only Credit Card	-0.0042879	0.00074554
Debit Card	-0.054242	0.019367
Age		
Bank Issued Credit Card	1.5571	0.56436
Widely Accepted Retailer Credit Card	0.83077	0.43058
Retailer-Only Credit Card	0.7733	0.14115
Debit Card	0.64784	0.23149
Employed		
Bank Issued Credit Card	0.13214	0.027169
Widely Accepted Retailer Credit Card	-0.046569	0.014248
Retailer-Only Credit Card	0.06488	0.020102
Debit Card	0.21214	0.0054752
Education		
Bank Issued Credit Card	-0.015998	0.0015194
Widely Accepted Retailer Credit Card	0.085173	0.016974
Retailer-Only Credit Card	-0.010166	0.0028307
Debit Card	-0.076046	0.0123
Married		
Bank Issued Credit Card	0.086576	0.03977
Widely Accepted Retailer Credit Card	0.12868	0.012414
Retailer-Only Credit Card	0.045055	0.031253
Debit Card	-0.034808	0.007595
Homeowner		
Bank Issued Credit Card	0.21862	0.024589
Widely Accepted Retailer Credit Card	0.078022	0.027369
Retailer-Only Credit Card	0.037049	0.0036381
Debit Card	-0.018505	0.0076594
Network		
Bank Issued Credit Card	0.081622	0.028119
Retailer-Only Credit Card	-0.0098925	0.0018747
Debit Card	0.12918	0.023341
Financial Stress		
Bank Issued Credit Card	0.14047	0.0099985
Widely Accepted Retailer Credit Card	-0.0092597	0.00016115
Retailer-Only Credit Card	-0.007075	0.001352

Source: CFM 2009-2012

Table 18: Estimates - Usage Equation

Parameter	Estimate	Standard Deviation
Constant		
Cash	-1.7023	0.068169
Bank Issued Credit Card	-3.5509	0.73858
Widely Accepted Retailer Credit Card	-1.946	0.90015
Retailer Only Credit Card	-4.0048	0.74353
Debit Card	-0.71337	0.31966
Income		
Cash	0.27694	0.014865
Bank Issued Credit Card	1.2989	0.53341
Widely Accepted Retailer Credit Card	-0.2439	0.16079
Retailer Only Credit Card	0.41091	0.27025
Debit Card	0.59471	0.05973
Age		
Cash	-0.1139086	0.0092493
Bank Issued Credit Card	-0.00905	0.0018914
Widely Accepted Retailer Credit Card	-0.012796	0.001757
Retailer Only Credit Card	-0.01068	0.0039399
Debit Card	-0.1573	0.03253
Employment		
Cash	0.12915	0.031131
Bank Issued Credit Card	0.44725	0.056193
Widely Accepted Retailer Credit Card	-1.2825	0.18004
Retailer Only Credit Card	-1.0574	0.39985
Debit Card	0.18205	0.010461
Education		
Cash	0.028543	7.5894e-17
Bank Issued Credit Card	0.2835	0.086815
Widely Accepted Retailer Credit Card	0.57066	0.19695
Retailer Only Credit Card	0.017509	0.0095648
Debit Card	-0.14547	0.014398
Married		
Cash	0.096425	0.054401
Bank Issued Credit Card	0.25472	0.067666
Widely Accepted Retailer Credit Card	0.65763	0.19693
Retailer Only Credit Card	-0.09374	0.025264
Debit Card	-0.25313	0.015015
Homeowner		
Cash	0.14083	0.012592
Bank Issued Credit Card	-0.081156	0.0080701
Widely Accepted Retailer Credit Card	-0.11087	0.02018
Retailer Only Credit Card	0.28456	0.079483
Debit Card	0.42697	0.0093785
Network		
Cash	0.019961	0.0069028
Retailer Only Credit Card	0.27214	0.041496
Credit Limit		
Bank Issued Credit Card	-0.00604	0.0006534
Widely Accepted Retailer Credit Card	-0.00323	0.0003238
Retailer Only Credit Card	0.00090705	3.8614e-05

Source: CFM 2009-2012

Table 19: Estimates - Covariances

Parameter	Estimate	Standard Deviation
$\sigma_{2,bank}$	1.3191	0.3794
$\sigma_{2,non-bank}$	1.3342	0.34646
$\sigma_{2,retail}$	0.74445	0.070149
$\sigma_{2,debit}$	1.9655	0.11333
$\sigma_{3,bank}$	7.0507	0.90386
$\sigma_{3,non-bank}$	0.0048543	0.00039142
$\sigma_{3,retail}$	-0.0087272	0.00056639
$\sigma_{3,debit}$	-0.19902	0.031378
$\sigma_{4,bank}$	7.4492	5.0156
$\sigma_{4,non-bank}$	6.2958	5.6871
$\sigma_{4,retail}$	4.7103	1.222
$\sigma_{4,debit}$	-0.27523	0.091515

Source: CFM 2009-2012

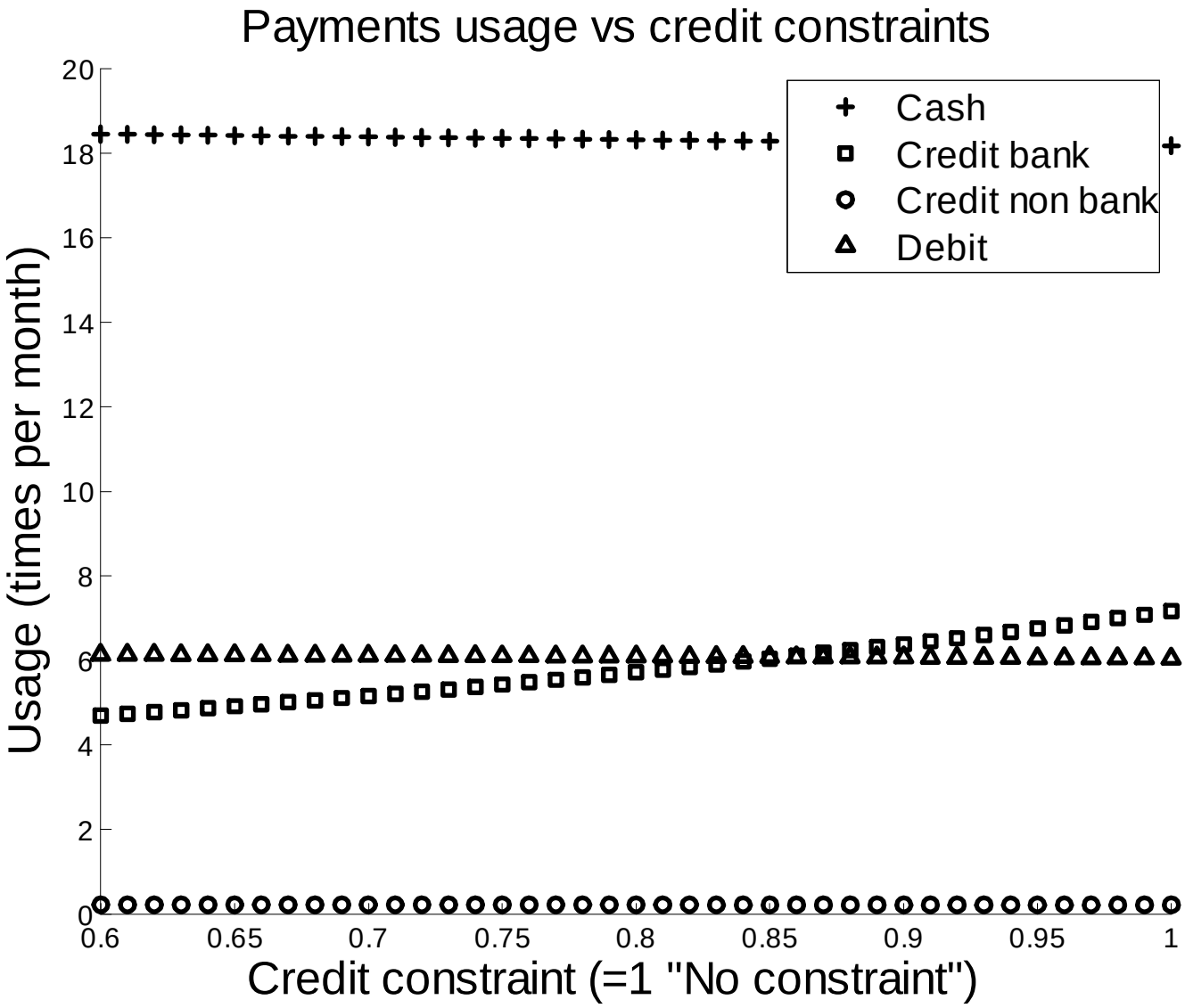

Figure 2: Figure 1: Counterfactual experiment on credit limits.