Distributional Effects of Payment Card Pricing and Merchant Cost Pass-through in the United States and Canada

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September 25, 2020

Abstract

Using data from the United States and Canada, we quantify consumers' net pecuniary cost of using cash, credit cards, and debit cards for purchases across income cohorts. The net cost includes fees paid to financial institutions, rewards received from credit or debit card issuers, and the merchant cost of accepting payments that is passed on to consumers as higher retail prices. Even though credit cards are more expensive for merchants to accept compared with other payment methods, merchants typically do not differentiate prices at checkout, but instead pass through their costs to all consumers. As a result, credit card transactions are cross-subsidized by cheaper debit and cash payments. Card rewards and consumer fees paid to financial institutions are additional sources of cross-subsidies. We find that consumers in the lowest-income cohort pay the highest net pecuniary cost as a percentage of transaction value, while consumers in the highest-income cohort pay the lowest. This result is robust under various scenarios and assumptions, suggesting payment card pricing and merchant cost pass-through have regressive distributional effects in the United States and Canada.

JEL codes: D12, D31, G21, L81

Keywords: Regressive effects, rewards, credit cards, interchange fees, pass-through

[1] Bank of Canada, Federal Reserve Bank of Kansas City, Federal Reserve Bank of Boston, Bank of Canada. We thank Nathan Blascak, Kim Huynh, Anneke Kosse, Oleksandr Shcherbakov, members of the Business Analysis and Policy Development team at the Bank of Canada, and seminar participants at the Federal Reserve Bank of Kansas City for helpful comments, and Ruth Cohen, Rebecca Ruiz, and Liang Zhang for research assistance. The views expressed here do not necessarily represent the views of the Federal Reserve Bank of Boston or Kansas City, the Federal Reserve System, or the Bank of Canada.

1. Introduction

When consumers purchase goods and services at retail locations in the United States or Canada, they choose payment methods based on their own benefits and costs. Credit card transactions frequently yield rewards paid by issuers to cardholders. In the United States, some debit cards also pay rewards. Consumers bear the direct cost of using payment methods, including annual credit card fees, monthly bank account fees, and per-transaction fees, such as ATM fees for cash withdrawals. Consumers also incur an additional cost—often without being aware of it—as merchants pass through their own cost of accepting payment methods to consumers as higher retail prices. These benefits and costs may be sources of cross-subsidies from cash and debit card transactions to credit card transactions. Cash and debit card transactions never or rarely yield rewards, unlike credit card transactions. Through merchant cost pass-through, the cost of accepting credit card transactions, which is much higher than the costs of accepting cash and debit card transactions, may be spread out to all transactions. Because higher-income consumers tend to use credit cards more often than lower-income consumers, these cross-subsidies may lead to regressive distributional effects.

In the United States and Canada, the vast majority of point-of-sale (POS) transactions are paid with cash, credit cards, or debit cards. In the United States, most merchants accept all three methods. In Canada, while cash is nearly universally accepted, debit and credit card acceptance differs across merchant size and industry: Almost all large merchants accept those cards, but only about 70 percent of small and medium-sized merchants do the same (Fung et al. 2017; Huynh et al. 2019). Of the three methods, credit card payments are generally the most expensive, due to high interchange fees that merchants have to pay to the card issuers for each transaction. For U.S. merchants, debit card transactions are generally more expensive than cash transactions, while for Canadian merchants, debit card transactions are less expensive than cash transactions if the size of the payment is moderate or large (Garcia-Swartz et al. 2006; Fung et al. 2017). Despite the differences in cost across payment methods, U.S. and Canadian merchants typically do not differentiate prices at checkout based on the payment method. For many years, credit card surcharges were prohibited by card networks in the United States (Hayashi 2012), and cash discounts—although less restricted—are also very rare (Stavins 2018). In Canada, merchants are allowed to offer discounts for different payment methods, but only eligible merchants are

permitted to charge a convenience fee for credit card transactions.[2] Anecdotally, however, few Canadian merchants offer discounts or charge a convenience fee. Briglevics and Shy (2014) and Welte (2016) show that it is not profitable for merchants to offer discounts to consumers for using debit cards or cash. Compared with differentiated prices, uniform pricing is also more straightforward for both merchants and consumers. Uniform pricing implies that merchants pass through those costs to all consumers as higher retail prices. As a result, the higher cost of accepting credit cards is spread over all transactions, and credit card transactions may be cross-subsidized by cheaper debit and cash payments.

Card rewards and consumer fees paid to financial institutions may be other sources of cross-subsidies. Credit card rewards are proportional to the amount charged on a card, benefiting higher-income consumers, who are more likely to hold rewards cards, tend to hold cards with higher reward levels, and tend to spend more on those cards.[3] In the United States, debit card rewards are also proportional to the amount charged on a card, but those rewards are less common and much lower in value compared with credit card rewards. In Canada, debit cards rarely pay rewards.[4] Consumer fees paid to financial institutions, such as annual credit card fees and monthly bank account fees, partially offset the card rewards that consumers receive.

Previous literature shows that consumer adoption and/or use of payment methods is correlated with income. Many low-income consumers do not own a credit card, possibly because they have no credit history or their credit score is very low: According to the 2018 Survey of Consumer Payment Choice (United States) and the 2017 Methods of Payment Survey (Canada), the credit card ownership rate among consumers with annual household income below $25,000 is less than 50 percent in the United States and about 60 percent in Canada, which is much lower than it is among higher-income consumers in both countries. Higher-income consumers also use credit cards more frequently, while low-income or middle-income consumers use cash or debit cards more often (Stavins 2016). As a result, the cross-subsidies across payment methods likely become transfers from lower-income consumers to higher-income consumers.

[2] Merchants must disclose convenience fees to the consumer before finalizing the transaction. See https://www.canada.ca/en/financial-consumer-agency/services/merchants/credit-fees-merchant.html.
[3] See Hayashi (2009) and her references for a comprehensive overview of card rewards programs.
[4] According to the bank accounts comparison tool of the Financial Consumer Agency of Canada (FCAC), accessible at https://itools-ioutils.fcac-acfc.gc.ca/ACT-OCC/SearchFilter-eng.aspx.

Previous literature finds that merchants' pass-through of the cost of accepting payments to all consumers results in cash and debit card users subsidizing credit card users. This result is first discussed in Carlton and Frankel (1995), and later in Katz (2001), Gans and King (2003), and Schwartz and Vincent (2006). Schuh et al. (2010) quantify transfers from low-income cash users to high-income credit card users resulting from merchant fees on credit cards in the United States, but the authors do not quantify other costs associated with payment use, such as bank account or ATM fees, and they assume there is a uniform cost of accepting payment cards across merchants, regardless of whether they are rewards or non-rewards cards. In contrast to these studies, Gans (2018) argues that cross-subsidies are unlikely in practice, because merchants have heterogeneous mixes of cash and card transactions and can selectively increase prices for goods and services depending on the preferences of their customer base.

Our study is closely related to Schuh et al. (2010), as we focus on quantitative analysis of distributional effects across income groups. However, unlike that study, we do not quantify transfers across income groups, because doing so poses several challenges. First, one should consider not just merchants' pass-through to consumers but also financial institutions' (or card issuers') pass-through. Even if merchants perfectly price-discriminate based on payment methods, cross-subsidies may occur through financial institutions' pass-through to consumers. Second, determining who transfers to whom is difficult. For example, higher retail prices paid by cash and debit card users due to higher credit card interchange fees may be used to finance rewards given to credit card users or be retained by financial institutions as profit. Third, while cross-subsidies often imply that one group pays more than it is supposed to pay and another group pays less, determining the amount each is supposed to pay is difficult. The resource cost incurred by all parties to process a cash, debit card, or credit card payment is a natural candidate to represent the amount each consumer is supposed to pay for making a POS payment. However, the resource cost is not a perfect measure, because it may not be attributable solely to consumers; POS payments are two-sided markets, and the two end users—the consumer and the merchant—jointly benefit from a POS payment.

In this study, we examine whether payment card pricing and merchant cost pass-through have regressive distributional effects. To this end, we divide consumers into different income cohorts and quantify each cohort's net pecuniary cost associated with payments by accounting for rewards, consumer fees paid to financial institutions, and merchant cost pass-through as

higher retail prices. We examine whether low-income consumers incur a disproportionally greater net pecuniary cost relative to their transaction amount. Our analysis uses multiple data sources: detailed data on the use of each payment instrument at the POS from consumer payment surveys and diary studies, data on the costs borne by merchants from a merchant cost study and other sources, and data from various sources on the fees consumers pay to financial institutions.

Our main findings are the following: The net pecuniary cost is lower for low-income consumers than for high-income consumers in absolute terms, as the formers' transactions are smaller in both number and value; however, compared with high-income consumers, low-income consumers incur disproportionally high net pecuniary cost relative to their transaction amount. In both the United States and Canada, consumers in the highest-income cohort pay the least as a percentage of their transaction amount, while consumers in the lowest-income cohort pay the most, suggesting payment card pricing and merchant cost pass-through have regressive distributional effects on consumers in both countries. Although the quantitative results vary with the specific assumptions, such as merchants' pass-through rate or whether a merchant serves all income cohorts or just a subset, the basic finding that low-income consumers bear a disproportionally high net pecuniary cost remains robust.

The rest of the paper is organized as follows. Section 2 describes the methodology and data used in this study. Section 3 provides the results of the base case scenario and carries out robustness checks by relaxing some of the assumptions. Section 4 discusses potential ways to address distributional effects and caveats of our analysis. Section 5 concludes.

2. Methodology and Data

2.1. Methodology

To examine whether payment card pricing and merchant cost pass-through have regressive distributional effects, we divide consumers into several cohorts based on their annual household income and calculate the net pecuniary cost associated with payment transactions for each income cohort.[5] When considering distributional effects, we compare not only the absolute net pecuniary costs for the cohorts but also the ratios of net pecuniary cost to the overall transaction amount. It is feasible that low-income consumers may incur a net pecuniary cost that

[5] While distributional effects likely exist across age groups, education groups, and other socioeconomic groups, our analysis focuses on distributional effects across income groups to examine regressive effects.

is smaller than the cost incurred by high-income consumers, and yet, compared with high-income consumers, they may incur a net pecuniary cost relative to their overall transaction amount that is disproportionally greater.

Net pecuniary cost includes three components: merchant cost pass-through, card rewards, and fees that consumers pay directly to financial institutions.[6] The first component occurs when merchants pass through their cost of accepting payments to consumers. They generally do so in a way that does not differentiate prices by payment method, but instead raises retail prices paid by all customers. The second component, card rewards, involves mainly credit cards, but some debit card issuers also offer rewards to their cardholders. The third component, fees paid to financial institutions, includes annual credit card fees, monthly checking account fees, and per-transaction fees, such as ATM fees. We exclude credit card interest charges or overdraft fees from this study for two reasons: first, this study focuses on the payment function (not credit function) of cards; and second, we do not have data on consumers' use of alternative sources of short-term credit, such as payday loans and installment loans, and cash and debit card users may use these alternative sources of credit to make their payments.[7]

Figure 1 shows the flow of a credit card payment and the three components of net pecuniary cost associated with credit cards in the four-party credit card payment market. A four-party credit card payment market comprises cardholders, merchants, card issuers, and merchant acquirers, in addition to card networks.[8] When the card issuer obtains funds from the cardholder

[6] We exclude from our analysis consumers' non-pecuniary costs associated with payment transactions, such as time costs and forgone interest costs for cash they have on hand and for a non-interest-bearing prepaid or checking account.

[7] Limited data prevent us from examining whether lower-income consumers incur higher costs of credit compared with higher-income consumers. For example, according to the 2018 Survey of Consumer Payment Choice and the 2018 Diary of Consumer Payment Choice, lower-income U.S. consumers are less likely than higher-income U.S. consumers to borrow on credit cards, because many lower-income consumers do not own credit cards. However, according to the 2017 FDIC National Survey of Unbanked and Underbanked Households, lower-income U.S. households are more likely than higher-income U.S. households to borrow using alternative financial services, such as payday loans, refund anticipation loans, pawn shop loans, and auto title loans, which are typically more costly to use than credit cards. Similar findings are based on the 2018 Survey of Household Economics and Decisionmaking. While these surveys provide data on whether consumers use certain credit products, they do not provide data on the degree to which consumers use such products. The Consumer Financial Protection Bureau (2017) provides characteristics of frequent overdrafters, who have accounts with both 11 or more overdrafts and insufficient funds in a 12-month period. Relative to other consumers, frequent overdrafters are less likely to own a credit card, more likely to have low credit scores, and use debit cards significantly more often. In 2018, frequently overdrafted accounts made up about 8 percent of all consumer accounts but accounted for almost 75 percent of all overdraft fees.

[8] Merchant acquirers are entities that perform a variety of merchant-related functions within the payment card industry, including linking merchants to card networks, crediting merchant accounts for sales on card transactions,

account—$100 in this example—it provides rewards to the cardholder, say 1 percent of the purchase value, or $1. The card issuer retains a portion of the funds as an interchange fee. In this example, the interchange fee rate is 2 percent of the purchase value, or $2. The card issuer then sends $98 to the merchant acquirer, which charges the merchant a merchant service charge. That charge includes the interchange fee, the network fee ($0.15), and the merchant acquirer fee ($0.15). The merchant acquirer then deposits $97.70 into the merchant account. Merchant cost pass-through is included in the consumer's $100 payment. While the cardholder doesn't pay a credit card fee to the card issuer on a per-transaction basis, they do pay an annual credit card fee.

We focus on distributional effects based on income to examine whether the effects are regressive. Income is also strongly positively correlated with the adoption and use of credit cards, which are a key source of cross-subsidies. In the United States, income is also correlated with bank account adoption. We divide all consumers into six cohorts based on their annual household income. In the United States, the six income cohorts are less than $25,000, $25,000 to $49,999, $50,000 to $74,999, $75,000 to $99,999, $100,000 to $149,999, and $150,000 or more (in US$); and in Canada they are less than $25,000, $25,000 to $44,999, $45,000 to $64,999, $65,000 to $84,999, $85,000 to $134,999, and $135,000 or more (in CA$).[9]

For each income cohort, we consider a representative consumer who makes the average number and value of transactions for each payment method, receives the average amount of credit and/or debit rewards, and pays the average fee amount to financial institutions.[10] When calculating the average rewards amount and the average fee amount, we account for ownership rates of credit cards and bank accounts in each income cohort. For example, the average credit card fee amount is derived not just from the fee amount paid by credit card owners, but also from the absence of (that is, "zero") fees paid by credit card non-holders.

collecting the fees charged to merchants for each transaction, and channeling different parts of each fee to distinct parties in the credit and debit card industry.

[9] Income categories in the United States differ somewhat from those in Canada due to different response categories in the consumer payment surveys in each country.

[10] Limited data, especially from diary studies, prevent us from dividing consumers into finer cohorts. Consumers' numbers and values of transactions, rewards amounts, and fee amounts likely vary within an income cohort. For example, credit card owners and non-owners within the same income cohort have different numbers and values of transactions and different rewards amounts and annual credit card fees. However, differences across income cohorts for consumers with a credit card (or for consumers without a credit card) are similar to the differences across income cohorts when we assume a representative consumer in each income cohort.

We calculate the net pecuniary cost by income cohort, which is equal to the average merchant cost pass-through attributed to that cohort minus the average rewards amount received plus the average consumer fee amount paid to financial institutions:

$$C_i = \sum_j M_{ij} - \sum_j R_{ij} + \sum_k F_{ik} \ , \qquad \text{(Eq. 1)}$$

where C_i is the net pecuniary cost of making payments by a representative consumer in income cohort *i*, M_{ij} is the merchant cost pass-through for payments made by a representative consumer in income cohort *i* using payment method *j* (*j* = cash, credit card, debit card), R_{ij} is the rewards amount received by a representative consumer in income cohort *i* for payments made with payment method *j* (credit and debit cards), and F_{ik} is the fee of type *k* (*k* = annual credit card fees, monthly bank account fees, ATM fees, or other per-transaction fees) apportioned to payments paid by a representative consumer in income cohort *i* to financial institutions.

We focus on POS purchases using one of three payment methods—cash, debit card, or credit card—as the vast majority of POS purchases (more than 90 percent in the United States and more than 95 percent in Canada) are made with these three methods. We exclude purchases made online and bill payments, because merchants' cost structure and pass-through for these payments are likely to be different from those of POS merchants, and because cash is usually not an option for online payments.[11] From consumer survey and diary data on consumer purchases in the United States and Canada, we obtain the average number and value of POS purchases conducted with each payment method in a month for a given income cohort.

To obtain the merchant cost pass-through, we first derive the merchant cost per transaction for each payment method using the merchant cost study conducted by the Bank of Canada and transaction data for the United States and Canada. While the merchant cost of accepting a debit card does not vary based on whether it is a rewards or non-rewards debit card, the merchant cost of accepting a credit card does vary based on whether it is a non-rewards, basic rewards, or premium rewards card. In the base case scenario, we assume that all POS merchants in the same country incur an identical cost per transaction as long as the transactions are identical—that is, the transactions use the same payment method (cash, debit card, non-rewards

[11] Some billers assess a convenience fee, a type of surcharge, to consumers (Hayashi 2012).

credit card, basic-rewards credit card, or premium-rewards credit card) and the amount of transaction is identical. For example, all U.S. merchants incur the same cost for a $30 POS purchase using a basic rewards credit card, and all Canadian merchants incur the same cost for a $10 POS purchase using a debit card. We relax this assumption as a robustness test. Next, we assume that merchants pass through their cost of accepting payments to consumers by raising retail prices by a fixed percentage, regardless of payment methods used by consumers. In the base case scenario, we assume that merchants pass through 90 percent of their cost to consumers through all goods and services they sell, but as our robustness test we vary the pass-through rate.[12] Finally, we assume that low-income and high-income consumers shop at the same stores in the base case scenario, but we relax that assumption as our robustness test.

Consumers who use rewards cards receive credit and/or debit card rewards as a percentage of the value of their transactions. For credit cards, the percentage varies depending on whether consumers use a basic rewards card or a premium rewards card. For debit cards, the rewards are assumed to be the same for all rewards cards.

Three types of consumer fees paid to financial institutions are included in our analysis: annual credit card fees, monthly bank account fees, and per-transaction fees. These fees are typically fixed regardless of how many transactions consumers make; however, our analysis of distributional effects is based on individual POS transactions. For example, a cardholder pays the same annual credit card fee regardless of how many credit card purchases they make. Therefore, we have to allocate the fees to individual transactions. For a credit card fee, we divide the monthly portion (annual fee divided by 12) between POS purchases and other transactions based on their respective value shares. Similarly we divide bank account fees between cash and debit card transactions and transactions with the other payment methods (such as checks and direct debits) based on the number of transactions. Finally, for the United States, we allocate ATM fees to cash payments at POS based on the value shares of cash POS purchases in the total cash

[12] Theoretical and empirical literature suggests that various factors affect the merchant pass-through rate. We select 90 percent, as it is about the midpoint of long-run pass-through rates on retail prices due to industry-wide cost changes estimated by previous empirical studies on U.S. industries: 90 percent or 92 percent in the U.S. coffee industry (Leibtag et al. 2007; Nakamura and Zerom 2010), 81 percent or 100 percent in the U.S. gasoline industry (Borenstein et al. 1998; Marion and Muehlegger 2011), and 73 percent to 103 percent in the U.S. processed cheese industry (Kim and Cotterill 2008).

transactions (for example, POS purchases, bill payments, and person-to-person transfers). Details are provided in Appendix B (for the United States) and Appendix C (for Canada).

2.2. Data

In this section, we summarize data sources and how we use data for the United States and for Canada.

a. Number and value of POS purchases by payment instrument

For the United States, transaction data are from the 2018 Survey of Consumer Payment Choice (SCPC) and the 2018 Diary of Consumer Payment Choice (DCPC).[13] For each income cohort and each payment method, the average number of POS purchases conducted per consumer per month are from the SCPC, and the average POS purchase values are calculated from both the SCPC and DCPC. Payment methods are cash, rewards credit cards, non-rewards credit cards, rewards debit cards, and non-rewards debit cards. In total, 3,153 respondents filled in the SCPC. The number of transactions is weighted using the SCPC weights, which are designed to provide accurate estimates of payment statistics for the entire population of U.S. consumers over the age of 18.[14] Table 1, Panel A shows the share of consumers in each income cohort and the average value and number of POS purchases per consumer per month by payment method and by income cohort.

For Canada, transaction data are from the Bank of Canada's 2017 Methods-of-Payment (MOP) Survey, which consists of a survey questionnaire (SQ) and a diary survey instrument (DSI). In total, 3,123 respondents filled in the SQ, and of those respondents, 2,187 also filled in the DSI.[15] For each income cohort and each payment method, the average monthly number and value of POS purchases conducted per consumer per month are calculated by extrapolating, from the 2017 MOP DSI, the behavior of respondents observed over a three-day period up to the monthly level (Table 1, Panel B).

[13] For details on the 2018 SCPC, see Foster et al. (2019), and for details on the 2018 DCPC, see Greene and Stavins (2019).
[14] For details on the SCPC sample weights, see Angrisani et al. (2018). The weighting process was exactly the same in 2018 and 2017.
[15] Detailed information about the 2017 MOP Survey is provided by Henry et al. (2018). Chen et al. (2018) present the statistical methodology employed to ensure that the survey data are statistically representative of the adult population living in each Canadian province.

b. Merchant costs per transaction and interchange fees

In the United States, credit card interchange fees increase with the rewards level. Based on the Nilson Report 2018 data, the weighted average merchant discount rate is 2.32 percent. Based on the U.S. credit card networks' interchange fee schedules for 2018, we assume that the non-rewards credit card interchange rate is 0.15 percentage point below the basic rewards credit card interchange rate, which in turn is 0.45 percentage point below the premium rewards credit card interchange rate, regardless of card brands.[16] We use the actual distribution of credit card transactions by credit score from the SCPC and DCPC and derive the merchant discount rates of 1.89 percent for non-rewards credit cards, 2.04 percent for basic rewards cards, and 2.49 percent for premium rewards cards. We use a debit card interchange rate of 0.78 percent, which is the 2018 average debit card interchange rate reported by the Board of Governors of the Federal Reserve System.

Due to the lack of recent information on U.S. merchant costs, we estimate the other component of costs for U.S. merchants by using data from the Bank of Canada 2015 Retailer Survey on the Cost of Payment Methods.[17] Where possible, we apply the U.S. data instead of using Canadian data to estimate the average merchant cost per transaction for each payment instrument.[18] We assume cash, credit cards, and debit cards are universally accepted because most U.S. merchants accept all three. The merchant cost by payment method varies with both the number and value of transactions, because each transaction carries a fixed cost (per transaction) and a proportional cost (percentage of dollar value). Among payment instruments included in our analysis, cash is the least costly to accept, while premium rewards credit cards are the most expensive (Figure 2, Panel A). Even non-rewards credit cards, which carry the lowest interchange fees for credit card transactions, are more costly than debit cards.

For Canada, the merchant costs per transaction for cash and debit cards are based on data from the Bank of Canada 2015 Retailer Survey on the Cost of Payment Methods, as reported in Kosse et al. (2017). Because Kosse et al. (2017) exclude overhead costs, which do not vary by

[16] Visa, Mastercard, and Wells Fargo Merchant Services.
[17] The component of costs include point-of-sale terminal costs, tender time, fees paid to financial institutions or armored car companies, back-end processing costs, and fraud losses and premiums for insurance against fraud losses or data breaches.
[18] We use the number of U.S. merchants by size from the 2012 Economic Census (www.census.gov) to account for the fixed cost per merchant. Other U.S. data include average wages for cashiers and back-office staff, credit and debit card interchange fees, chargebacks, and terminal rental cost. For more details, see Appendix B.

the number or value of transactions, we add those costs divided by the number of transactions to the fixed per-transaction cost. As opposed to what we do for the United States, we take into account Canadian merchants' varying acceptance of payment methods when estimating the average merchant cost per transaction for each payment method. We modify the proportional cost of credit cards by using the 2018 interchange fees (Figure 2, Panel B). While Kosse et al. (2017) report the average proportional costs, we incorporate differences in interchange fees between non-rewards, basic rewards, and premium rewards credit cards, as in the U.S. analysis discussed above. Canadian merchants face a somewhat different price structure for accepting debit card payments compared with U.S. merchants: Except for contactless debit card transactions, for which a proportional fee may be charged, a fixed fee per transaction is generally charged for debit cards. Thus for Canadian merchants, debit cards are less costly than cash or credit cards for all but very small transaction amounts.

c. Rewards

For the United States, rewards card use is obtained from the DCPC. The rewards level is assumed to vary by credit score: Lower-credit-score (deep subprime, subprime, and near-prime) consumers have basic rewards credit cards, while higher-credit-score (prime and super-prime) consumers have premium rewards credit cards.[19] Using the 2018 SCPC's self-reported credit scores, we map each credit score tier—from deep subprime to super-prime—to the household income cohorts to obtain a distribution of basic and premium rewards cards for each income cohort (Figure 3, Panel A).[20] Based on the available information, we assume the following levels of rewards: 1 percent of the transaction value for a basic rewards credit card, 1.5 percent for a premium rewards credit card, and 0.4 percent for a debit card. According to information available on websites that compare credit and debit card offerings in the United States, basic rewards credit cards generally offer 1 percent cash back or one point/airline flight mile for every

[19] We follow the borrower risk profile classification adopted by the Consumer Financial Protection Bureau (CFPB; see https://www.consumerfinance.gov/data-research/consumer-credit-trends/student-loans/borrower-risk-profiles/). The CFPB classifies borrowers into the following five risk categories: deep subprime (credit scores below 580), subprime (580 to 619), near-prime (620 to 659), prime (660 to 719), and super-prime (720 and above).

[20] The CFPB credit tier classification differs from the one used in the 2018 SCPC. However, we map the credit scores by assuming that consumers' credit scores are uniformly distributed within each cohort. Details on the mapping are available from the authors. For SCPC respondents who did not know their credit score, we assumed that their scores are distributed the same way as are those for respondents with the same household income who did know their score.

$1 spent, while premium rewards credit cards generally offer 2 percent or 3 percent cash back for eligible transactions (such as those made at grocery stores, gas stations, or other types of stores), 1 percent cash back for other transactions, or two points/airline flight miles for every $1 spent.[21] Debit cards that offer rewards are less generous than basic rewards credit cards, offering one point for every $2 spent when cardholders use those cards without providing their PINs.

For Canada, information on rewards and non-rewards credit card ownership is available in the 2017 MOP SQ. We combine that information with information on basic and premium rewards credit card ownership from the 2015 Personal Cardholder Study (PCS) to derive a distribution of non-rewards, basic rewards, and premium rewards cards for each income cohort (Figure 3, Panel B).[22] We then derive the average rewards rate for each income cohort by assuming a basic rewards rate of 0.75 percent and a premium rewards rate of 1.5 percent.[23] From the lowest-income cohort to the highest-income cohort, the average rewards rates are 0.78 percent, 0.86 percent, 0.86 percent, 0.90 percent, 1.01 percent, and 1.02 percent, respectively. We assume that debit cards have no rewards, as many Canadian issuers charge a transaction fee for debit card transactions instead of offering rewards.

d. Consumer fees to financial institutions

For the United States, annual credit card fees per card and the prevalence of those fees by credit score tier are from the Consumer Financial Protection Bureau (2019). The average number of general-purpose credit cards held by consumers in each credit tier is from the Equifax credit bureau data. The average credit card annual fee *per person* in a given credit score tier equals the average fee per card in that tier multiplied by the number of cards per person in that tier. We use SCPC data to map each credit score tier to income cohorts and calculate the average annual

[21] According to Discover's Form 8-K filing to the Securities and Exchange Commission in April 2019, Discover's overall rewards rates were between 1.27 percent and 1.31 percent in 2018. According to American Express's 2019 Annual Report, the network's overall rewards rate, including both in and outside the United States, was about 0.95 percent in 2018, suggesting its rewards rate in the United States likely exceeds 1 percent, as many countries regulate interchange fees.

[22] The PCS is an online, syndicated survey of Canadian cardholders conducted by Ipsos. In 2015 its sample size was 10,551 cardholders. In 2020, the PCS was renamed Digital Wallet & Payment Trends.

[23] Basic rewards rates are usually between 0.5 percent and 1 percent, while premium rewards start at 1 percent and may go up to 4 percent or higher. For both types of rewards cards, the rate varies with the type of merchants. Some cards also offer other types of rewards, such as store or travel points. See the FCAC credit card comparison tool accessible at https://itools-ioutils.fcac-acfc.gc.ca/CCCT-OCCC/SearchFilter-eng.aspx.

credit card fee payment for each income cohort. We assume no annual fees for debit cards, because banks rarely charge periodic fees specifically for debit cards in the United States.

The average monthly bank account fee and the average account balance threshold needed to waive the bank account fee are based on the 2019 checking account and ATM fees study from Bankrate.com.[24] Checking account ownership and balances from the 2018 SCPC and DCPC are used to calculate the share of consumers in each income cohort who have balances below the minimum threshold and are assumed to pay monthly bank account fees.

To obtain the average ATM fee per month for each income cohort, we multiply the following three factors: the average surcharge and foreign fee for an ATM cash withdrawal (made by all consumers) obtained from the Bankrate.com study mentioned above, the average number of ATM cash withdrawals per month for each income cohort calculated from the DCPC, and the fraction of out-of-network ATM cash withdrawals, which are assessed surcharges and foreign fees, based on GAO (2013).

For Canada, we use annual credit card fees from respondents' main credit card that are reported in the 2017 MOP SQ and convert them to monthly fees. Monthly bank account fees are obtained by combining survey information on respondents' main bank account with data from the Financial Consumer Agency of Canada (FCAC) on banking fees in 2017.[25] In Canada, accounts that charge monthly fees typically come with a package that allows a specified (sometimes unlimited) number of debit transactions, including cash withdrawals at various locations and debit card purchases. In such a case, per-transaction fees apply when the number of monthly debit transactions exceeds the account's allowed number. Other accounts, such as no-package checking accounts and most savings accounts, charge a per-transaction fee for every transaction. In addition to fees charged by their own institution, consumers can also incur network fees and surcharges for withdrawing cash at other financial institutions or at private banking machines. We estimate average per-transaction fees by income cohort based on self-reported values collected in the 2017 MOP SQ. Appendix C provides details on how we allocate consumer fees to POS purchases involving cash, credit cards, and debit cards in Canada.

[24] Accessed at https://www.bankrate.com/banking/checking/checking-account-survey/.
[25] The FCAC collects information on banking and credit card fees for a wide range of products offered by Canadian financial institutions. This information is made available on the FCAC website and provided to the Bank of Canada on a quarterly basis.

3. Results

We report detailed results under the base case scenario. This scenario assumes that a given merchant serves consumers from all income cohorts and passes through 90 percent of its cost of accepting payments to consumers as higher retail prices. In other words, each merchant has the same distribution of customers, and therefore each merchant distributes its cost of accepting payments uniformly across all of its customers. We later relax these assumptions and show that the results we obtain under the base case scenario are robust even with alternative assumptions.

3.1. The base case scenario

a. Merchant cost pass-through

In both countries, merchants' cost of accepting the three payment methods of cash, credit cards, and debit cards increases monotonically with the income of consumers, both because higher-income consumers spend more overall and because they tend to use payment methods that are more costly for merchants to accept. In the United States, merchants on average incur payment acceptance costs of $10.97 per month for a consumer in the lowest-income cohort and $52.32 for a consumer in the highest-income cohort (Figure 4). In Canada, merchants incur average monthly costs of $13.33 (CA$17.28) for a consumer in the lowest-income cohort and $40.14 (CA$52.01) for a consumer in the highest-income cohort.[26] In both countries, the vast majority of merchant cost is attributed to credit cards, due to high interchange fees. In the United States, merchants incur a greater cost per consumer for processing debit card payments than for accepting cash, but this is not the case in Canada. The merchant cost of processing debit card payments is higher in the United States than in Canada, because the United States has interchange fees associated with debit cards, and because U.S. consumers use debit cards more frequently than Canadian consumers do.

The ratio of the merchant cost to the POS purchase amount varies across income cohorts in both countries, but the pattern differs between the United States and Canada (Figure 5). In the United States, the ratio is highest for the highest-income cohort, at 1.90 percent, and lowest for the lowest-income cohort, at 1.37 percent. For the highest-income cohort, more than 80 percent

[26] For currency conversion, we apply the 2018 average exchange rate.

of the merchant cost stems from accepting high-interchange-fee credit cards. In contrast, for consumers in lower-income cohorts, 30 to 40 percent of the merchant cost is generated from transactions involving debit cards, a payment method that lower-income consumers use more frequently compared with higher-income consumers.

In Canada, on the other hand, the ratio of merchant cost to the POS purchase amount is inverse-U-shaped: It increases from the lowest-income cohort (1.70 percent) to the middle cohort (2.07 percent) and decreases from the middle to the highest cohort (1.71 percent). Relative to consumers in the lowest-income cohort, those in the middle cohort substitute away from cash to credit cards. Debit card use is very similar between the lowest- and middle-income cohorts. Because credit card processing is more costly than accepting cash, a larger share of credit card use by the middle cohort implies a higher ratio of merchant cost imposed by the middle cohort compared with the lowest cohort. Relative to the middle-income cohort, consumers in the highest cohort substitute away from cash to debit cards.

Because debit cards are the least costly payment method for merchants for transactions involving more than CA$20 (Kosse et al. 2017), a larger share of debit card payments by the highest cohort implies that the highest-income cohort imposes a lower ratio of merchant cost than the middle-income cohort does. Indeed, cash accounts for 36 percent of merchants' cost of accepting payments from the lowest-income consumers, and this share falls to 15 percent for the middle cohort, and to 7 percent for the highest cohort. Credit cards account for 50 percent of the cost of payments from the lowest-income cohort, and this share increases to 72 percent for the second-lowest, and to 85 percent for the highest cohort. Debit cards account for 15 percent of the cost for the lowest cohort, and it decreases to 7 percent for the highest cohort. Relative to the debit card transaction value, the merchants' cost of accepting debit cards decreases significantly with the income cohort. This cost pattern is explained by the low proportional cost of debit cards, hence allowing merchants to exploit economies of scale when high-income consumers make larger-value payments.[27]

Because we assume that merchants pass through 90 percent of their costs to all consumers by raising their retail prices by a fixed percentage, the merchant cost is distributed proportionally to consumers' POS purchase amount across consumers of all income cohorts. The

[27] Contactless debit card transactions, which are becoming more common, have higher proportional fees. The current scenario assumes that all debit card transactions are processed with chip-and-PIN technology.

merchant cost pass-through results in a retail price increase of 1.42 percent for U.S. consumers and 1.71 percent for Canadian consumers, implying that relative to the POS purchase amount, the merchant cost pass-through is more costly for Canadian consumers than for U.S. consumers (Figure 5). The absolute amount consumers pay via merchant pass-through is, however, similar across the two countries (Figure 6). Since the POS purchase amount increases with income, the amount of merchant cost pass-through in absolute value is greater for higher-income consumers than for lower-income consumers. In the United States, a consumer in the highest-income cohort pays $39.19 per month, while a consumer in the lowest-income cohort pays $11.39. In Canada, a consumer in the highest-income cohort pays $40.10 (CA$51.96), and a consumer in the lowest-income cohort pays $13.37 (CA$17.33).

Which income cohort pays higher retail prices relative to the cost that their payments impose on merchants varies between the United States and Canada. In the United States, lower-income consumers, who use less costly payment methods, pay some of the merchant cost imposed by higher-income consumers.[28] Higher-income consumers use more payment methods that are more costly for merchants, and the cost that higher-income consumers incur via merchant pass-through is less than the cost they impose on merchants. Relative to how much it costs the merchants to process their payments, each consumer in the highest-income cohort pays $13 less on average per month through retail prices. In contrast, every consumer in the lowest-income cohort pays $0.6 more.

In Canada, in contrast, the lowest- and the highest-income cohorts pay approximately the amount they impose on merchants as acceptance cost, while consumers in the middle four income cohorts pay from $2.26 to $4.09 less than their cost. Consumers in the highest-income cohort use the most costly payment method for merchants—premium rewards credit cards—more than those in any other income cohort; however, they also reduce merchant cost by using debit cards for relatively large-value purchases. Unlike in the United States, the merchant cost of accepting a debit card payment does not increase with the transaction value in Canada, and thus using a debit card rather than a credit card for large-value purchases reduces the cost for merchants.

[28] When the merchant pass-through rate is lower than 100 percent, some of the merchant cost may be recovered by reducing merchants' profit, or by lowering other costs, such as employee compensation or marketing costs.

b. Rewards

The rewards amount increases with income in both the United States and Canada (Figure 7). In the United States, a consumer in the lowest-income cohort receives, on average, $2.08 in credit and debit card rewards per month, while a consumer in the highest-income cohort receives $19.23. The credit card rewards amount increases with income, but there is no clear relationship between the debit card rewards amount and income. The vast majority of rewards are from credit cards. Even for the lowest-income cohort, which has the highest share of debit card rewards, debit card rewards account for only 24 percent of total rewards received. In Canada, a consumer in the highest-income cohort receives $14.25 (CA$18.46) in rewards from credit cards each month, on average, while a consumer in the lowest-income cohort receives only $1.90 (CA$2.46).

Both U.S. and Canadian consumers in the higher-income cohorts receive a greater rewards amount relative to their total POS purchase amount (Figure 8). In the United States, the ratio of the rewards amount to the purchase amount is 0.70 percent for the highest-income cohort, which is the highest ratio among all income cohorts, while the lowest- and second-lowest-income cohorts have the lowest ratios, at 0.26 percent and 0.24 percent, respectively. In Canada, the top two income cohorts have the highest ratio, at 0.61 percent, while the lowest-income cohort has the lowest ratio, at 0.24 percent.

In both countries, the differences across income cohorts can be explained by higher-income consumers' larger overall spending and their tendency to use premium rewards credit cards. Compared with lower-income consumers, higher-income consumers spend more overall, use rewards credit cards more often, and are much more likely to own premium rather than basic rewards cards (Figure 3). As explained in the preceding section, premium rewards credit cards have a higher rewards rate than basic rewards credit cards, which in turn have a higher rewards rate than rewards debit cards (in the United States only).

U.S. consumers generally receive greater rewards than Canadian consumers do across all income cohorts (Figure 7). However, relative to the POS purchase amount, rewards are not always greater for U.S. consumers than for Canadian consumers. U.S. consumers in the lowest- and highest-income cohorts have higher ratios of rewards to the POS purchase amount compared with their Canadian counterparts, but U.S. consumers in the middle four income cohorts have lower ratios than their Canadian counterparts do (Figure 8). These results have two implications.

First, in the United States, the highest-income consumers receive disproportionally higher rewards than the rest of the country's consumers. Second, in Canada, the lowest-income consumers receive disproportionally lower rewards than the rest of the country's consumers.

c. Consumer fees to financial institutions

In both countries, the consumer fees paid to financial institutions generally increase with income in absolute terms and decrease with income as a share of the POS purchase amount. A couple of key differences, however, can be observed between the United States and Canada.

First, in the United States, the aggregate amount of the three consumer fees paid to financial institutions—annual credit card fees, monthly bank account fees, and per transaction fees—varies only slightly across income cohorts, while in Canada the aggregate amount is higher for the top three income cohorts than it is for the bottom three income cohorts (Figure 9). The difference in the fee amounts between the lowest-income cohort and the highest-income cohort is only $0.70 in the United States ($1.95 versus $2.65) but about $2.50 (CA$3.24) in Canada. Canadian consumers in the bottom three income cohorts pay from $3.25 to $4.45 (CA$4.21 and CA$5.77) per month on average, while those in the top three income cohorts pay from $5.27 to $5.75 (CA$6.83 and CA$7.45). The differences in fee amounts across income cohorts in Canada stem mainly from the higher annual credit card fees paid by higher-income consumers. The bank account fee amount and per-transaction fee amount, by contrast, do not vary substantially or monotonically across income cohorts. In the United States, though the magnitude of each difference between income cohorts is smaller than it is in Canada, the annual credit card and ATM cash withdrawal fee amounts increase as income increases, while the bank account fee amount decreases as income increases.

Second, across all income cohorts, Canadian consumers pay higher consumer fees than U.S. consumers do in both absolute terms and as a percentage of the purchase amount (Figure 10). The total fee amount paid by Canadian consumers is more than double the amount paid by their U.S. counterparts in almost every income cohort. This is driven by the fact that Canadian consumers pay higher monthly bank account fees and per transaction fees compared with U.S.

consumers.[29] In terms of the ratio, Canadian consumers pay about two to three times more than their U.S. counterparts.

d. Net pecuniary cost

The net pecuniary cost is calculated from the three components discussed above by subtracting rewards from the sum of the merchant cost pass-through and consumer fees paid to financial institutions. It generally increases with income in both the United States and Canada (Figure 11). In the United States, a consumer in the lowest-income cohort pays $11.26 per month on average, and a consumer in the highest-income cohort pays $22.61. In Canada, a consumer in the lowest-income cohort pays $14.72 (CA$19.08) per month, and a consumer in the highest-income cohort pays $31.60 (CA$40.95).

Of the three components, the largest in both countries is the merchant cost pass-through, followed by rewards. This implies that consumers are unaware of the largest component of their net pecuniary cost associated with their payments at the POS, because the merchant cost pass-through is embedded in retail prices and therefore not transparent to consumers. In the United States, rewards are less than half the size of the merchant cost pass-through, and consumer fees are less than one-sixth the size. In Canada rewards and consumer fees are about 35 percent and 25 percent, respectively, relative to the merchant cost pass-through.[30]

All three components of the cost (and benefit) associated with payments generate distributional effects across income cohorts in both countries. Rewards increase with income, as explained above. Due to merchant cost pass-through, all consumers pay the same ratio of merchants' cost of accepting payments to the purchase amount, even though higher-income consumers generate higher costs for merchants relative to their purchase amount. In the United States, consumer fees paid to financial institutions do not vary across income cohorts in the absolute amount, but because lower-income consumers spend less, they pay fees that are a higher

[29] Figure 9 shows that Canadian consumers also pay higher per-transaction fees per person compared with U.S. consumers. Such difference could exist because consumers can be charged per-transaction fees for both cash withdrawals and debit purchases in Canada, while only ATM withdrawals trigger these types of fees in the United States. Recall, however, that for the United States, only a portion of the estimated total ATM withdrawal fees were allocated to POS cash purchases. For Canada, total per-transaction fees were used due to a lack of data.

[30] Our results suggest that, associated with their POS purchases in 2018, U.S. consumers as a whole paid $73.37 billion for merchant cost pass-through and $6.95 billion for fees to financial institutions and received $21.06 billion as rewards, and Canadian consumers as a whole paid $8.51 billion (CA$11.02 billion) for merchant cost pass-through and $1.70 billion (CA$2.21 billion) for fees to financial institutions and received $2.65 billion (CA$3.43 billion).

percentage of their purchase amount. In Canada, the fee amount paid to financial institutions also increases with income.

Although the net pecuniary cost amount generally rises with income, the ratio of the net pecuniary cost to the purchase amount generally declines with income (Figure 12). In both countries, the ratio is the highest for the lowest-income cohort, at 1.41 percent in the United States and 1.88 percent in Canada; and the ratio is the lowest for the highest-income cohort, at 0.82 percent in the United States and 1.35 percent in Canada. The results imply that merchant cost pass-through, rewards, and consumer fees paid to financial institutions have regressive distributional effects in both countries.

Compared with U.S. consumers, Canadian consumers incur a higher net pecuniary cost across all but the third-highest-income cohort. The difference in the net pecuniary cost between the two countries ranges from $0.08 to $9. The ratio of net pecuniary cost to the purchase amount is also higher for Canadian consumers than it is for U.S. consumers across all income cohorts. In both countries, the ratio generally decreases with income, but the patterns are different. In both countries, the highest-income cohort has a disproportionally lower net pecuniary cost than any other income cohort. In Canada, the lowest-income cohort has a disproportionally high net pecuniary cost even when compared with the middle four income cohorts. In contrast, in the United States, the two lowest-income cohorts have a disproportionally high net pecuniary cost.

3.2. Alternative assumptions for robustness checks

Consumers' net pecuniary cost, especially the merchant cost pass-through, is greatly affected by how merchants serve consumers: whether they serve consumers from all cohorts, a subset, or a single cohort; the percentage of their payment acceptance cost that they pass through to consumers; and whether their pass-through is uniform across all goods and services they sell. In the base case scenario, we assume that each merchant serves consumers from all income cohorts and passes through 90 percent of its payment acceptance cost to consumers by raising retail prices uniformly across all goods and services. In this section, we relax those assumptions, as well as an assumption that merchants in the same country incur identical costs per transaction as long as the transactions are identical, and show that the regressive distributional effects of payment card pricing and merchant pass-through are robust.

- *Relaxing the assumption that merchants serve all income groups*

We consider two alternative scenarios to our base case scenario in which each merchant serves consumers from all income cohorts. The first alternative scenario assumes that each merchant serves consumers from a subset of income cohorts; more precisely, each merchant serves either consumers from the bottom three income cohorts or consumers from the top three income cohorts. In this scenario, merchants distribute the cost of accepting payments across consumers from only three income cohorts instead of all six income cohorts. The second alternative scenario assumes that each merchant serves consumers from a single cohort only.[31]

Figure 13 shows how net pecuniary cost as a percentage of the purchase amount would be affected by these scenarios assuming the merchant pass-through rate of 90 percent. In the United States, as the number of income cohorts each merchant serves decreases (from all, to a subset, to a single cohort), the net pecuniary cost for the bottom two income cohorts decreases and that of the top income cohort increases. When each merchant serves a single income cohort, the difference in the ratio of net pecuniary cost to the purchase amount between the bottom and the top income cohorts is 0.11 percentage point, a significant decline from the 0.59 percentage point difference in the base case scenario.

In Canada, the effects are more complex. In the scenario where merchants serve a subset of income cohorts, the regressive effect is larger than in the base case scenario. The net pecuniary costs of the bottom three income cohorts are higher than those in the base case scenario, while the costs of the top three income cohorts are lower. This result is due to the inverse-U-shaped relationship between income and the ratio of merchant cost to the purchase amount (Figure 5). The third- and second-lowest-income cohorts have the highest and the third-highest share of merchant costs, respectively, and—as a result—merchants serving only the bottom three income cohorts would incur merchant costs that are a higher percentage of the purchase amount compared with merchants serving all income cohorts. The latter merchants can pass some of the costs imposed by the second- and third-lowest cohorts on to both the bottom and top cohorts, while the former merchants can do so to the bottom cohorts only. In the scenario where merchants serve a single income cohort, both the bottom and top cohorts would experience a decline in their net pecuniary cost as a percentage of the purchase amount. This is

[31] Gans (2018) argues that merchants have a heterogeneous mix of cash and card payments, depending on the preferences of their customer base.

because these two cohorts impose significantly lower merchant costs as a percentage of purchase amount compared with the middle four income cohorts. The difference between the ratios of the bottom and top income cohorts remains at 0.52 percentage point, close to the 0.53 percentage point difference in the base case scenario, indicating that a regressive distributional effect persists.

While the specific effects of these scenarios vary between the United States and Canada, the bottom three income cohorts always have a net pecuniary cost that is higher as a percentage of the purchase amount compared with the top income cohort. Thus, regressive distributional effects of payment card pricing and merchant pass-through exist in all three scenarios.

- *Relaxing the assumption of merchants' pass-through*

Merchants may differentiate their pass-through rates depending on various factors, including market competition, relative price elasticity of demand and supply, store-specific brand versus national brand, and others.[32] Merchants in a thin-margin sector such as gas stations and grocery stores may have higher pass-through rates than other merchants. Merchants may set higher pass-through rates on goods and services with highly inelastic demand, such as necessity goods. Merchants may set lower pass-through rates for goods of their own brand compared with the rates for goods of other brands to promote their own brand. As additional robustness checks, we consider two additional pass-through rates—75 percent and 100 percent—which are common across all goods and services. We also consider cases in which merchant pass-through rates vary by income cohort.

Figure 14 shows the net pecuniary cost as a percentage of the purchase amount when assuming a pass-through rate of 75 percent and when assuming a rate of 100 percent. An increase in the pass-through rate that is the same (in percentage points) across all income cohorts would increase consumers' cost relatively more for income cohorts that have a higher ratio of pass-through amount to purchase amount. When each merchant serves all income cohorts, the ratio of pass-through amount to purchase amount is the same across all cohorts. Thus, lowering (raising) merchants' pass-through rate would reduce (increase) net pecuniary costs uniformly (by the same percentage points) across all income cohorts, keeping the difference unchanged

[32] Gans (2018) argues that merchants can selectively increase prices for goods that are preferred by cash or card users.

between the bottom and top cohorts in net pecuniary cost as a percentage of the purchase amount.

In the United States, when each merchant serves a subset or a single income cohort, the difference between the bottom and top income cohorts in the ratio of net pecuniary cost to purchase amount would increase (decrease) as merchants' pass-through rate decreases (increases) (Panel A); by contrast, this difference is barely affected by changes in the pass-through rate in Canada (Panel B). The ratio of pass-through amount to purchase amount in the United States is higher for the top income cohort than for the bottom cohort both when each merchant serves a subset and when each merchant serves a single cohort. Therefore, an increase (decrease) in the pass-through rate by the same amount (in percentage points) across all income cohorts would raise (lower) the net pecuniary cost for the top income cohort relatively more (in percentage points) than it would for the bottom income cohort, narrowing (widening) the difference in the net pecuniary cost. By contrast, in Canada, the ratio of pass-through amount to purchase amount is slightly lower for the bottom cohort than for the top cohort when each merchant serves a subset of cohorts, and the ratio of pass-through amount to purchase amount is approximately the same for the bottom and top income cohorts when merchants serve a single cohort. Unlike in the United States, an increase (decrease) in the pass-through rate by the same amount across all income cohorts would slightly widen (narrow) the difference between the net pecuniary costs for the bottom and top income cohorts when each merchant serves a subset of income cohorts, and it would have almost no effect on the difference in net pecuniary costs when merchants serve a single income cohort.

Figure 15 shows the merchant pass-through rate for each income cohort that generates a net pecuniary cost as a percentage of the purchase amount that is equal across all income cohorts. We set the merchant pass-through rate for the top income cohort at 90 percent and consider the scenario in which a merchant serves a single income cohort. We choose this scenario because regressive distributional effects are smaller in this scenario than in the other two scenarios, especially in the United States. Even in this scenario, the regressive effect persists, unless the merchant pass-through rate for the lowest-income cohort is 82 percent or lower in the United States and 59 percent or lower in Canada.

In the United States, a relatively small difference between the pass-through rates for the bottom income cohort and the top income cohort is sufficient to equalize the two cohorts' net

pecuniary cost as a percentage of the purchase amount (and thus for the regressive effect to disappear). This is because even if the top and bottom income cohorts face the same pass-through rate, in the scenario where merchants serve a single income cohort, the pass-through amount relative to the purchase amount is already much smaller for the bottom income cohort than the top cohort, partly offsetting the difference in the ratio of net pecuniary cost associated with rewards and consumer fees paid to financial institutions. A small decline in the pass-through rate for consumers in the bottom income cohort would remove the remaining difference. By contrast, in Canada, a sizable decline in the pass-through rate for the bottom income cohort (as well as other cohorts) is needed for the regressive effect to disappear. When the bottom and top income cohorts face the same pass-through rate, the pass-through amount relative to the purchase amount is almost identical for the top and bottom income cohorts. Therefore, in order to remove the difference in the ratio of net pecuniary cost associated with rewards and consumer fees solely through the reduction in the pass-through rate, a large reduction for the bottom income cohort is needed.

- *Relaxing the assumption that merchants incur identical cost per transaction*

In the base case scenario, we assume that merchants in the same country incur an identical cost per transaction as long as the transactions are identical. However, in reality merchant costs likely vary, partly because interchange fees vary by POS merchant sector (such as grocery stores, gas stations, and general retail) and by merchant size. We test whether the regressive effect remains if the bottom three income cohorts shop only at merchants that have the lowest credit card interchange fees, under scenarios where a merchant serves a subset or a single cohort. In the United States, the largest supermarkets have the lowest interchange fees, while in Canada, gas stations have the lowest interchange fees and the largest supermarkets have the second-lowest. Based on the fee schedules of Visa and Mastercard, we assume that those merchants' proportional (to the transaction value) cost of processing a non-rewards and basic

rewards credit card transaction is lower than the cost for other POS merchants by 0.59 percentage point in the United States and 0.29 percentage point in Canada.[33]

Figure 16 shows net pecuniary costs as a percentage of the purchase amount assuming a merchant pass-through rate of 90 percent for all income cohorts. In the United States, the difference between the net pecuniary costs for the bottom income cohort and the top income cohorts is 0.35 percentage point in a scenario where a merchant serves a subset of income cohorts, but the difference is only 0.04 percentage point in a scenario where a merchant serves a single income cohort.[34] In contrast, in Canada, the difference is more than 0.4 percentage point in both scenarios, implying that the regressive effect largely remains.

4. Discussion

Our results suggest that all three components of net pecuniary cost—merchant cost pass-through, rewards, and consumer fees paid to financial institutions—generate regressive distributional effects. In this section, we first discuss a few potential ways to reduce the regressive distributional effects. We then discuss caveats to our analysis, which accounts for direct effects of these potential changes but cannot incorporate subsequent (unintended) effects on various parties, including consumers, merchants, credit card issuers, and depository institutions. For example, substantial reductions in credit card rewards and interchange fees may reduce regressive distributional effects caused by credit card rewards and merchant cost pass-through, but such reductions may subsequently change the behavior of credit card issuers; some may raise other fees, some may limit credit supply, and some may even exit the market. Such changes could harm lower-income consumers. Thus, assessing the overall effects of any potential

[33] The largest supermarkets' interchange rate for non-rewards credit cards in 2018 was 1.15 percent for both Mastercard and Visa in the United States and 1.22 percent to 1.23 percent in Canada. Gas stations' interchange rate for non-rewards credit cards was 1.17 percent to 1.18 percent in Canada. These merchants were also assessed association dues (0.125 percent to 0.13 percent), network access fees, acquirer fees, and other fees.

[34] Both assumptions—that each merchant serves a single income cohort and those merchants serving the bottom three income cohorts have the lowest interchange fees—are less realistic than alternative assumptions.

change would require careful analysis incorporating subsequent effects in the context of specific market conditions.

4.1. Potential ways to reduce regressive distributional effects

We discuss three potential ways to decrease regressive distributional effects: (1) by reducing credit card rewards along with interchange fees, (2) by making consumers aware of merchant cost pass-through, and (3) by changing the fee structure associated with bank accounts. Our analysis here considers direct effects only.

- *Reducing credit card rewards along with interchange fees*

Lower credit card rewards would diminish regressive effects through two channels: One is directly through rewards, which are received predominantly by higher-income consumers, and the other is through merchant cost pass-through, because lower rewards would reduce credit card issuers' cost and in turn allow the issuers to reduce the interchange fees without any detrimental effect on their net revenues.

To show how a reduction in credit card rewards accompanied by a reduction in credit card interchange fees would affect the regressive effects, we consider a hypothetical situation in which credit card rewards rates decline by 0.25 percentage point from the current basic rewards rate (1.0 percent in the United States and 0.75 percent in Canada) and the current premium rewards rate (1.5 percent in both countries). We assume that such modest reductions would not affect consumers' payment choice, which aligns with findings in previous studies. Using Canadian data, Arango et al. (2015) find that changes in the credit card rewards amount have a small or inelastic effect on the probability of paying with credit cards, although whether any rewards were received has a relatively large effect. Using U.S. survey data, Ching and Hayashi (2010) show that the majority of rewards card transactions would be replaced with non-rewards card transactions if rewards were removed, but that consumers would not reduce their overall credit card use.[35] We also assume that issuers would not change either their other fees or credit supply. The 0.25 percentage point reduction in the rewards rate enables issuers to reduce interchange fees by 0.204 percentage point in the United States and by 0.212 percentage point in

[35] Some experiments, however, have shown that credit card rewards would increase consumer adoption of credit cards (Camera et al. 2016).

Canada across non-rewards, basic rewards, and premium rewards credit cards, without any detrimental effect on their net revenues.

In this hypothetical situation, more than 50 percent of U.S. consumers would experience a reduction in net pecuniary cost, as long as each merchant serves all or a subset of income cohorts, or merchant pass-through rate is sufficiently high when merchants serve a single income cohort (Table 2). In Canada, more than 40 percent of consumers would experience a reduction in net pecuniary cost as long as merchant pass-through rate is close to 100 percent. In particular, lower-income consumers would be most likely to benefit from the reductions in credit card rewards and interchange fees, and thus the regressive distributional effects would be eased. For example, if each merchant serves all income cohorts and the merchant pass-through rate is 90 percent, then the net pecuniary cost would be reduced for the bottom two income cohorts and the third-highest-income cohort in the United States and for the bottom two income cohorts in Canada.

- *Making consumers aware of merchant cost pass-through*

Another potential way to reduce regressive distributional effects is to make consumers aware that merchant costs of accepting payments vary by payment method, and that some of those costs are passed on to consumers as higher retail prices. Though merchants are largely free to differentiate prices at checkout based on the payment method, which would make consumers aware of merchant payment acceptance cost as well as pass-thorough, they choose not to do so. Alternatively, merchants could provide consumers with clear and transparent information regarding the relative costs of using various payment methods. For example, merchants could display their average costs of accepting credit cards, debit cards, and cash, thereby inducing consumers to choose less costly payment methods without differentiating retail prices or restricting payment choice.

While there is some literature on the effects of differentiating prices based on payment method (for example, Bolt et al. 2010), there is scant empirical evidence that informing consumers about the relative costs of accepting various payment instruments affects consumer payment choice. An exception is Jonker et al. (2017), who find some evidence that marketing campaigns might be effective in changing consumer payment choice. Through experiments,

Aydogan and Van Hove (2015) find that "nudging" consumers at the point of sale to alter their payment choice, such as by displaying posters with pro-card slogans, has a short-lived effect on some consumers. Story et al. (2020) show that different forms of nudging interventions could steer consumers toward adoption of mobile payments. Educated consumers may decide whether (and how) to incorporate cost information into their decisions about payment method.

- *Changing the fee structure associated with bank accounts*

Regressive distributional effects associated with consumer fees paid to financial institutions occur mainly through the payment of monthly bank account fees in the United States, and through the payment of both monthly bank account fees and per-transaction fees in Canada. In fact, in 2003, eight Canadian banks committed to providing low-cost checking account plans that meet the basic banking needs of economically disadvantaged Canadians (Gibney et al. 2014). If there were no such commitments, the regressive effects associated with monthly bank account fees may be even greater in Canada. In contrast, in the United States, banks have raised customers' checking account costs by decreasing the availability of free accounts, raising monthly fees, and increasing minimum balance requirements, all in response to the regulatory cap on debit card interchange fees, which became effective in 2011 (Manuszak and Wozniak 2017). As it did in Canada, offering low-cost accounts to low-income U.S. consumers would reduce the regressive effects associated with monthly bank account fees. For example, if the monthly bank account fees assessed to U.S. consumers in the bottom income cohort were cut by half, the difference between the consumer fees that the lowest-income cohort pays to financial institutions as a percentage of the POS purchase amount and the fees that the highest-income cohort pays would decline from 0.15 percent to 0.08 percent.

In Canada, a potential additional way to address the regressive effects is to increase the transaction limits associated with checking accounts, thereby directly reducing the regressive effects through per-transaction over-the-limit fees. For example, if there were no transaction limits associated with the checking accounts offered to Canadian consumers in the lowest-income cohort and as a result the per-transaction fee amount they pay fell by 50 percent, the difference between the consumer fees paid to financial institutions as a percentage of POS

purchases by the highest-income cohort and the fees paid by the lowest-income cohort would decline from 0.17 percent to 0.11 percent.

4.2. Caveats

There are several caveats to our analysis above. Our explicit and implicit assumptions may not hold in reality. Subsequent effects of potential changes could offset the direct effects discussed above.

- Although we consider different rates of pass-through from merchants to consumers, we implicitly assume a 100 percent pass-through rate of the interchange fee reduction from merchant acquirers to merchants. However, it is possible that the acquirers' pass-through rate is less than 100 percent, especially for smaller U.S. merchants.[36] In Canada, in contrast, under the Code of Conduct for the Credit and Debit Card Industry, acquirers must break out interchange fees from other fees charged to merchants, and merchants are allowed to cancel their contracts with acquirers that fail to pass through an interchange fee reduction. If the acquirers' pass-through rate is less than 100 percent, the decline in net pecuniary cost for lower-income consumers would be smaller, and thus the reduction in regressive distributional effects would also be smaller.
- While a small reduction in rewards rates and an associated reduction in interchange fees may not change consumers' or issuers' behavior, which we explicitly assume, a larger reduction—such as eliminating rewards entirely—may cause a change in the behavior of both consumers and issuers. For example, instead of attracting customers with rewards, issuers may do so by enhancing convenience or speed, which potentially could adversely affect security. Furthermore, a simple reduction in interchange fees could have unintended consequences: Card issuers may not reduce rewards along with interchange fees, and/or they might raise other fees to compensate for their lost revenues. This may hurt lower-income consumers especially, as their fees may increase and thus access to credit may become more costly. In an extreme

[36] In the United States, smaller merchants tend to choose their acquirer's "bundled" fee structure, of which the simplest kind involves a single flat fee rate—for example, 3 percent of the value of a transaction—that includes all the different parts of the fees charged, for all types of cards and all brands. As a result, smaller merchants may not see an immediate reduction in interchange fees. For more details, see Hayashi (2013).

case, some issuers might also withdraw from issuing credit cards or focus on issuing credit cards only to the most profitable consumers.

- We implicitly assume that low-cost bank accounts include the same service features as bank accounts that are typically offered to moderate- or average-income consumers. However, if low-cost bank accounts include limited service features or charge additional fees for certain service features (such as an alert service via mobile banking), lower-income consumers would not necessarily experience a reduction in net pecuniary cost by gaining access to low-cost accounts.
- Increasing transaction limits associated with checking accounts for Canadian consumers may increase consumers' use of debit cards. Since debit cards impose the lowest acceptance cost on merchants (for sufficiently large transaction values) in Canada, this would likely decrease merchant costs that are passed on to consumers. Thus, this secondary effect of increasing transaction limits associated with checking accounts might also reduce regressive distributional effects caused by merchant cost pass-through.

5. Conclusion

When consumers make payments, they directly receive benefits or pay costs, such as credit card rewards, bank account fees, and ATM fees. Consumers also pay another cost—typically without being aware of it—in the form of higher retail prices. In the United States and Canada, merchants do not typically differentiate prices at checkout, but instead pass through their costs of accepting payment methods to all consumers, even though credit cards are more expensive for them to accept than either debit cards or cash. As a result, credit card transactions are cross-subsidized by cheaper debit and cash payments. Because, compared with low-income consumers, high-income consumers are more likely to hold rewards cards, tend to hold cards with higher rewards levels, and tend to spend more on those cards, these cross-subsidies across payment methods likely become transfers from low-income to high-income consumers.

Using data from the United States and Canada, we quantify the net pecuniary cost of using cash, credit cards, and debit cards to consumers in a range of income cohorts. The net costs include the merchants' cost of accepting payments that is passed on to consumers, fees paid to financial institutions, and rewards received from credit or debit card issuers. We find that in the

United States and Canada, the net pecuniary cost as a percentage of purchase amount is highest for the bottom income cohort and lowest for the top cohort, indicating regressive distributional effects in both countries. The net cost is higher for Canadian consumers, as they pay higher fees to their financial institutions and receive lower rewards, on average, compared with their U.S. counterparts.

There are a few potential ways to mitigate regressive distributional effects. One is by reducing credit card rewards along with credit card interchange fees to the level where issuers' net interchange fee revenues remain the same. While we show that a small reduction in credit card rewards and an associated reduction in interchange fees may alleviate the regressive effects—reducing the net pecuniary cost for more than 50 percent of U.S. consumers and more than 40 percent of Canadian consumers, including lower-income consumers—the effect of more drastic changes to rewards rates and/or interchange fees requires further research. Another way to address regressive distributional effects is to provide consumers with clear and transparent information regarding the relative costs of using various payment methods. The effect of this practice may be subtle compared with the effect of merchants' differentiating retail prices based on payment methods; nevertheless, educated consumers may make informed decisions about their payment method. An additional way to mitigate the regressive effects is to change the fee structure associated with bank accounts. Offering low-cost bank accounts to low-income U.S. consumers and increasing transaction limits associated with bank accounts in Canada may reduce the regressive effects directly and/or reduce the effects indirectly through reducing merchants' cost of accepting payment methods.

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Table 1: Average Value and Number of POS Purchases per Consumer per Month by Payment Instrument and by Income Cohort

Panel A: U.S.

	Annual Household Income (in US$)					
	< $25,000	$25,000 - $49,999	$50,000 - $74,999	$75,000 - $99,999	$100,000 - $149,999	$150,000+
Share of consumers	23%	18%	18%	13%	16%	12%
Value of transactions (in US$)						
Cash	$260	$322	$272	$306	$413	$284
Credit cards	$170	$252	$483	$533	$794	$1,653
Reward credit cards	$130	$191	$418	$460	$680	$1,274
Non-reward credit cards	$40	$61	$65	$73	$114	$379
Debit cards	$370	$545	$570	$1,217	$798	$817
Reward debit cards	$121	$73	$90	$232	$101	$116
Non-reward debit cards	$249	$472	$480	$985	$697	$701
All transactions (cash+credit+debit)	$800	$1,120	$1,324	$2,056	$2,005	$2,755
Number of transactions						
Cash	13.7	15.3	14.4	13.2	11.3	11.8
Credit cards	4.0	6.5	10.2	12.9	13.3	21.8
Reward credit cards	3.0	5.0	9.0	11.5	12.2	18.9
Non-reward credit cards	1.0	1.5	1.2	1.4	1.1	2.8
Debit cards	11.0	14.1	17.0	18.5	19.2	15.1
Reward debit cards	2.7	3.1	2.8	5.6	2.5	1.5
Non-reward debit cards	8.3	11.0	14.2	12.8	16.7	13.6
All transactions (cash+credit+debit)	28.7	35.9	41.6	44.6	43.9	48.7

Source: 2018 SCPC and DCPC. The number of consumers and the number of transactions are weighted using the SCPC weights. For 63 consumers, or 2 percent of the respondents, income was missing.

Panel B: Canada

	Annual Household Income (in CA$)					
	< $25,000	$25,000 - $44,999	$45,000 - $64,999	$65,000 - $84,999	$85,000 - $134,999	$135,000+
Share of consumers	9%	15%	19%	16%	28%	13%
Value of transactions (in CA$)						
Cash	$420	$352	$253	$299	$223	$276
Credit cards	$317	$716	$805	$1,068	$1,128	$1,818
Debit cards	$278	$371	$329	$406	$498	$949
All transactions (cash+credit+debit)	$1,015	$1,439	$1,388	$1,773	$1,850	$3,043
Number of transactions						
Cash	20.4	16.4	13.9	11.4	13.3	12.1
Credit cards	6.2	15.5	16.8	14.7	17.7	22.7
Debit cards	8.6	9.3	7.7	11.2	13.3	12.5
All transactions (cash+credit+debit)	35.2	41.2	38.4	37.4	44.3	47.3

Source: 2017 MOP DS

Table 2: Effects of Reducing Credit Card Rewards by 0.25 Percentage Point and Associated Reduction in Credit Card Interchange Fees on Net Pecuniary Cost

Panel A: U.S.

Merchant serving	All		Subset		Single
Pass-through rate	100%	90%	100%	90%	100%
Ratio of net pecuniary cost to purchase amount at issuers' net revenue-neutral interchange fee					
< $25,000	1.53%	1.38%	1.44%	1.30%	1.35%
$25,000 - $49,999	1.50%	1.35%	1.41%	1.27%	1.32%
$50,000 - $74,999	1.31%	1.16%	1.22%	1.08%	1.37%
$75,000 - $99,999	1.32%	1.17%	1.38%	1.23%	1.18%
$100,000 - $149,999	1.21%	1.06%	1.27%	1.11%	1.21%
$150,000+	1.02%	0.87%	1.08%	0.92%	1.29%
Changes in ratio before and after elimination and reduction (percentage points)					
< $25,000	-0.03	-0.03	-0.02	-0.01	-0.00
$25,000 - $49,999	-0.03	-0.03	-0.01	-0.01	-0.00
$50,000 - $74,999	0.00	0.01	0.02	0.03	0.00
$75,000 - $99,999	-0.02	-0.01	-0.03	-0.02	0.00
$100,000 - $149,999	0.01	0.02	-0.00	0.01	0.00
$150,000+	0.04	0.05	0.03	0.04	-0.01

Panel B: Canada

Merchant serving	All		Subset		Single
Pass-through rate	100%	90%	100%	90%	100%
Ratio of net pecuniary cost to purchase amount at issuers' net revenue-neutral interchange fee					
< $25,000	2.01%	1.83%	2.09%	1.90%	1.87%
$25,000 - $44,999	1.85%	1.68%	1.93%	1.75%	1.92%
$45,000 - $64,999	1.75%	1.57%	1.82%	1.64%	1.92%
$65,000 - $84,999	1.74%	1.57%	1.71%	1.54%	1.71%
$85,000 - $134,999	1.67%	1.49%	1.71%	1.47%	1.76%
$135,000+	1.54%	1.36%	1.51%	1.33%	1.35%
Changes in ratio before and after elimination and reduction (percentage points)					
< $25,000	-0.06	-0.05	-0.05	-0.03	-0.00
$25,000 - $44,999	-0.02	-0.00	-0.00	0.01	-0.00
$45,000 - $64,999	-0.00	0.01	0.01	0.02	-0.00
$65,000 - $84,999	0.00	0.01	-0.00	0.02	-0.00
$85,000 - $134,999	0.01	0.03	0.01	0.02	0.01
$135,000+	0.00	0.02	-0.00	0.01	-0.00

Figure 1: The Four-party Credit Card Payment Market

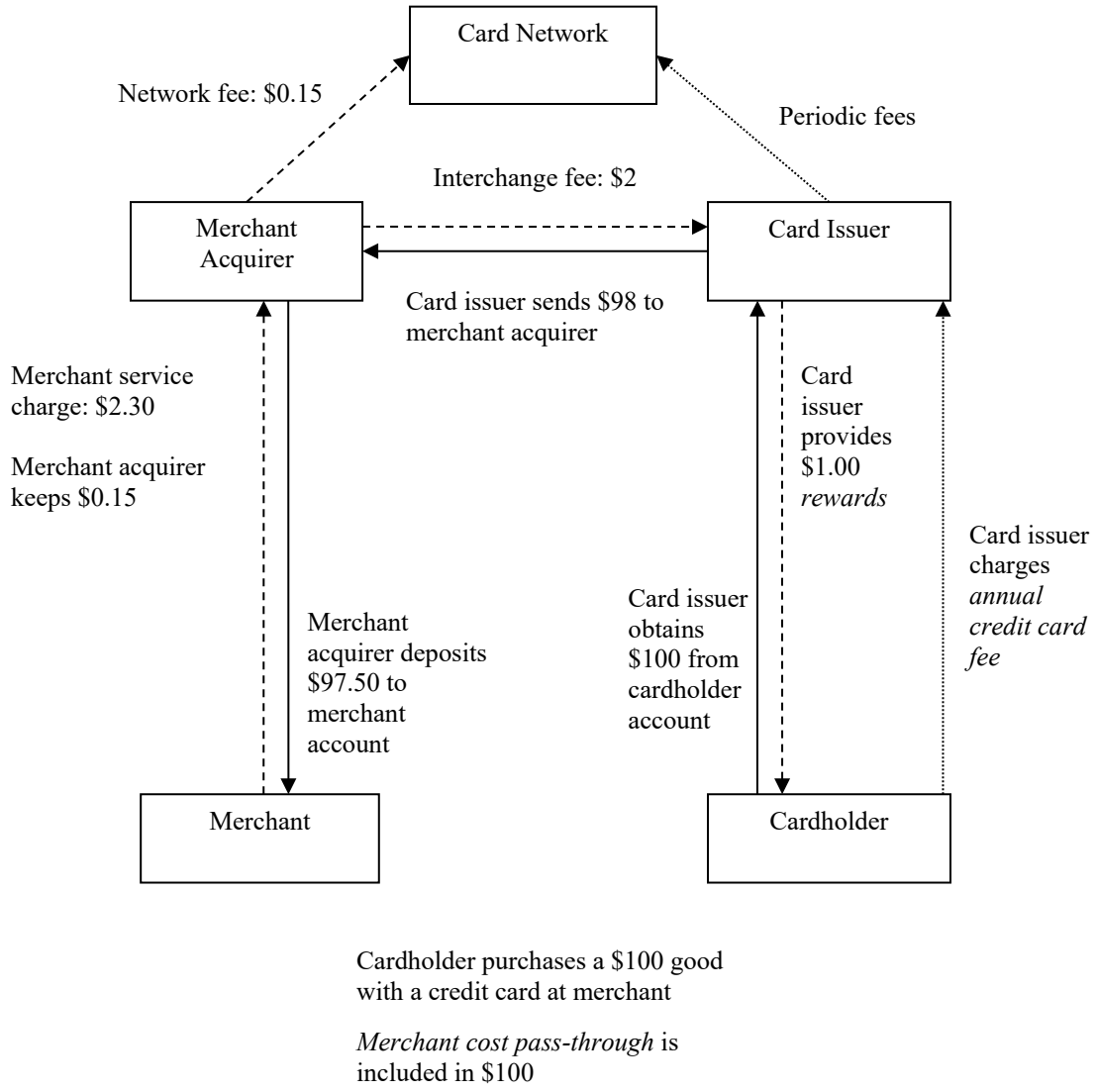
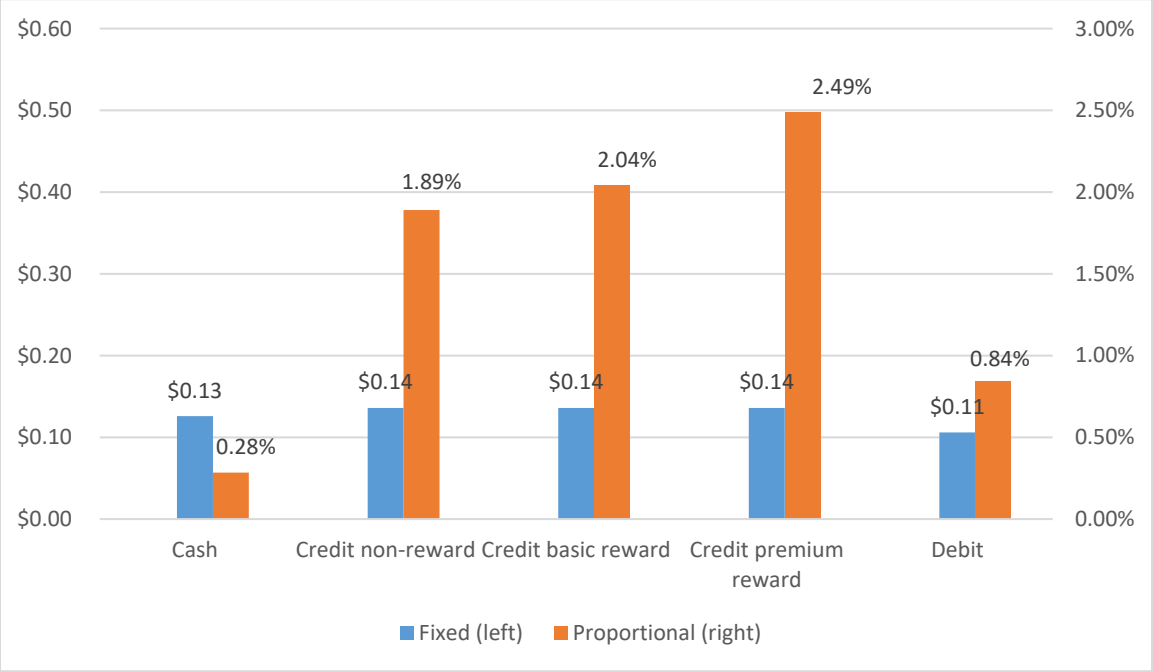


Figure 2: Merchant Cost per Transaction by Payment Instrument: Fixed per Transaction and Proportional to the Value of a Transaction

Panel A: U.S.



Panel B: Canada

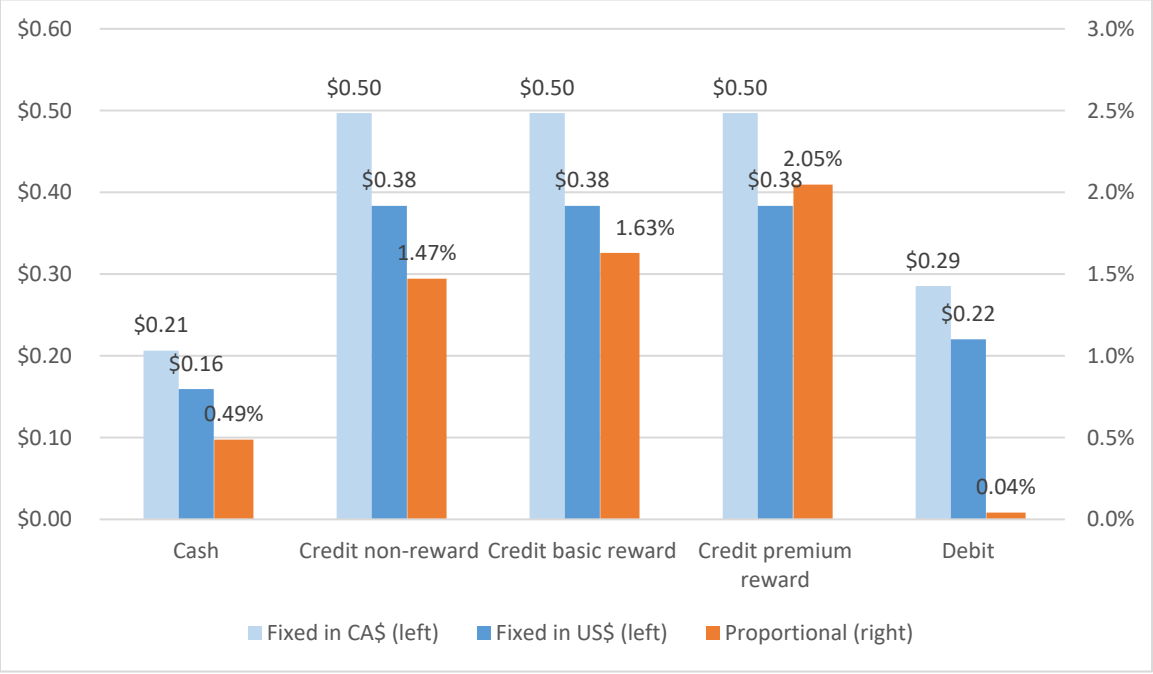
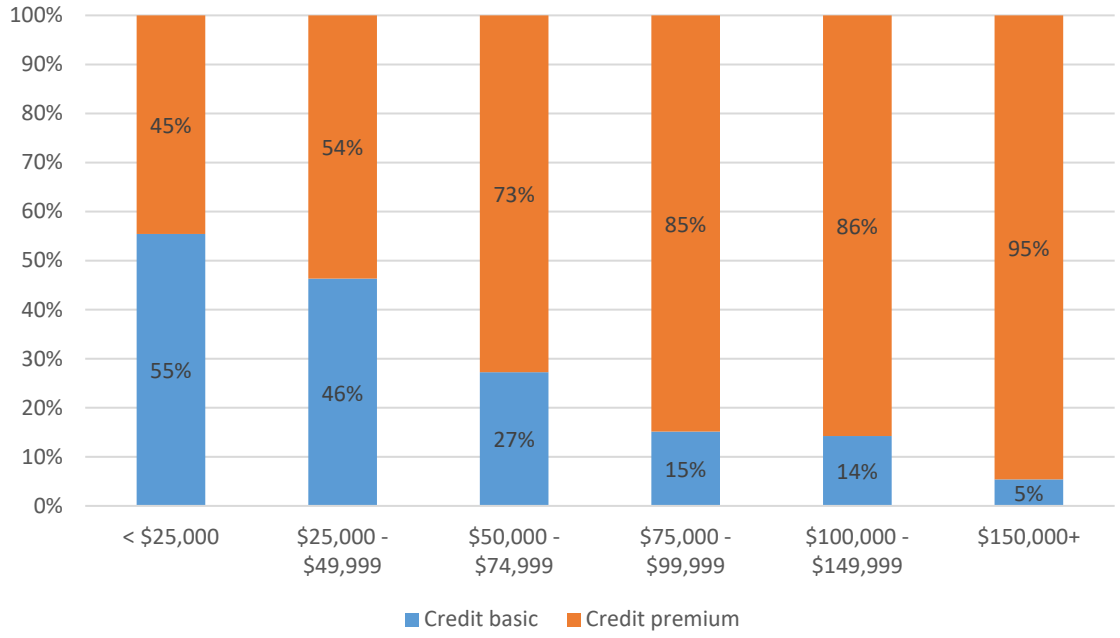


Figure 3: Distribution of Reward Credit Card Ownership by Income Cohort

Panel A: Distribution between Basic and Premium Cards in the U.S.



Panel B: Distribution among Non-reward, Basic, and Premium Cards in Canada

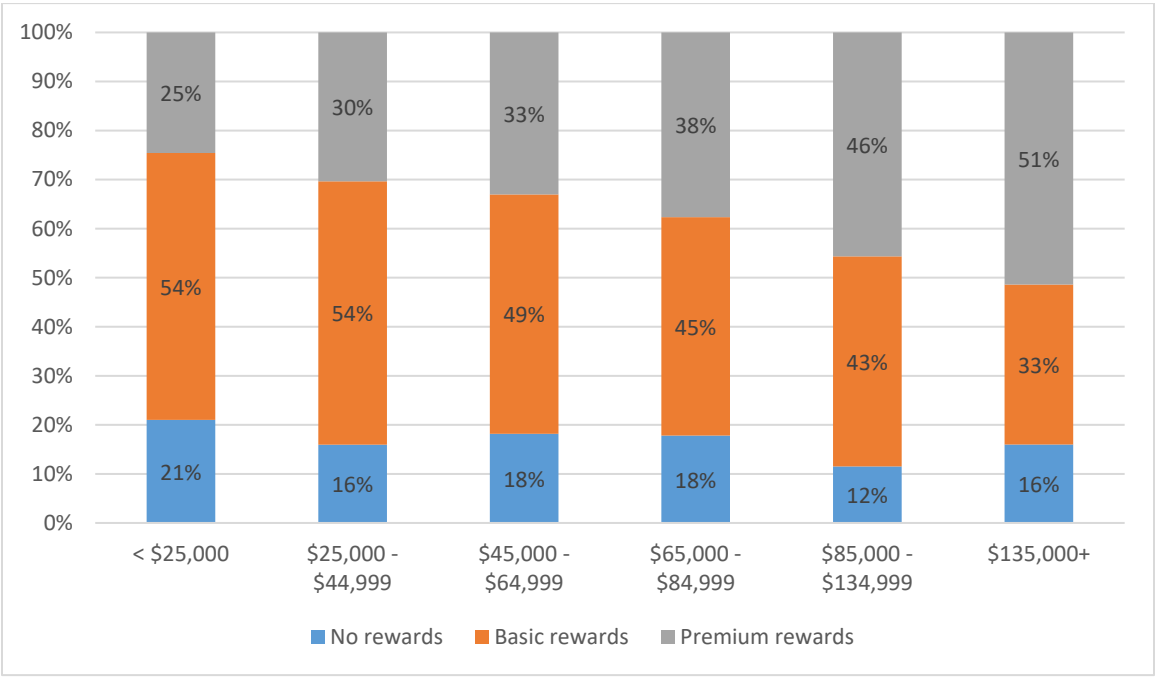


Figure 4: Merchant Acceptance Cost per Consumer per Month by Income Cohort (in US$)

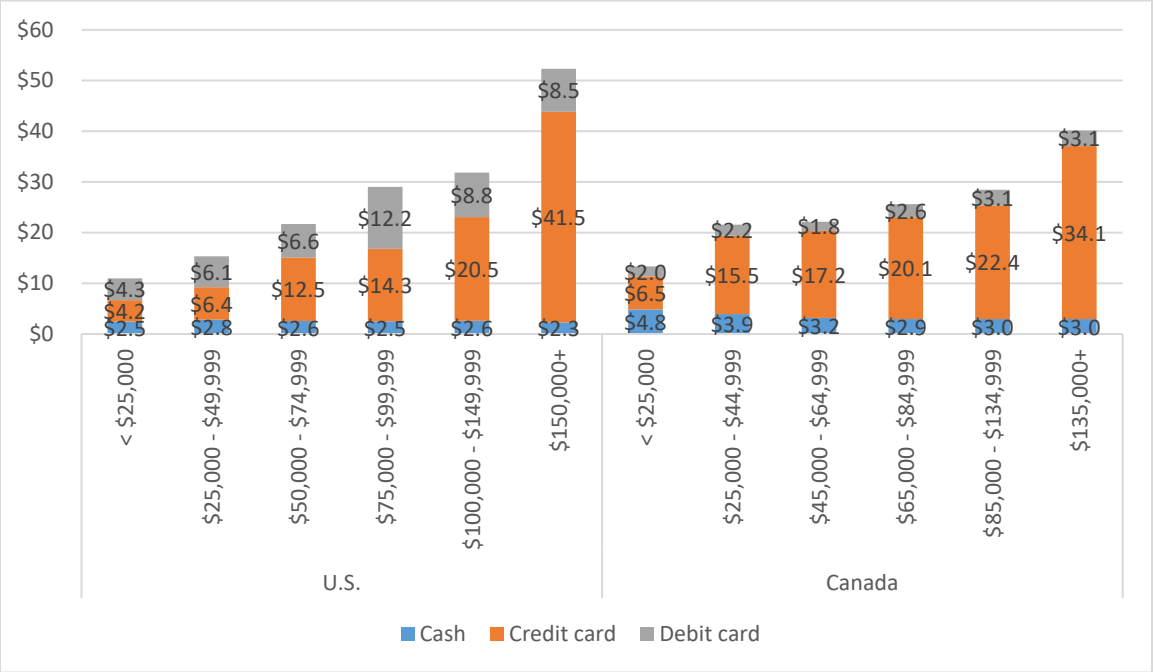


Figure 5: Ratios of Merchant Cost and Merchant Cost Pass-through to POS Purchase Amount by Income Cohort

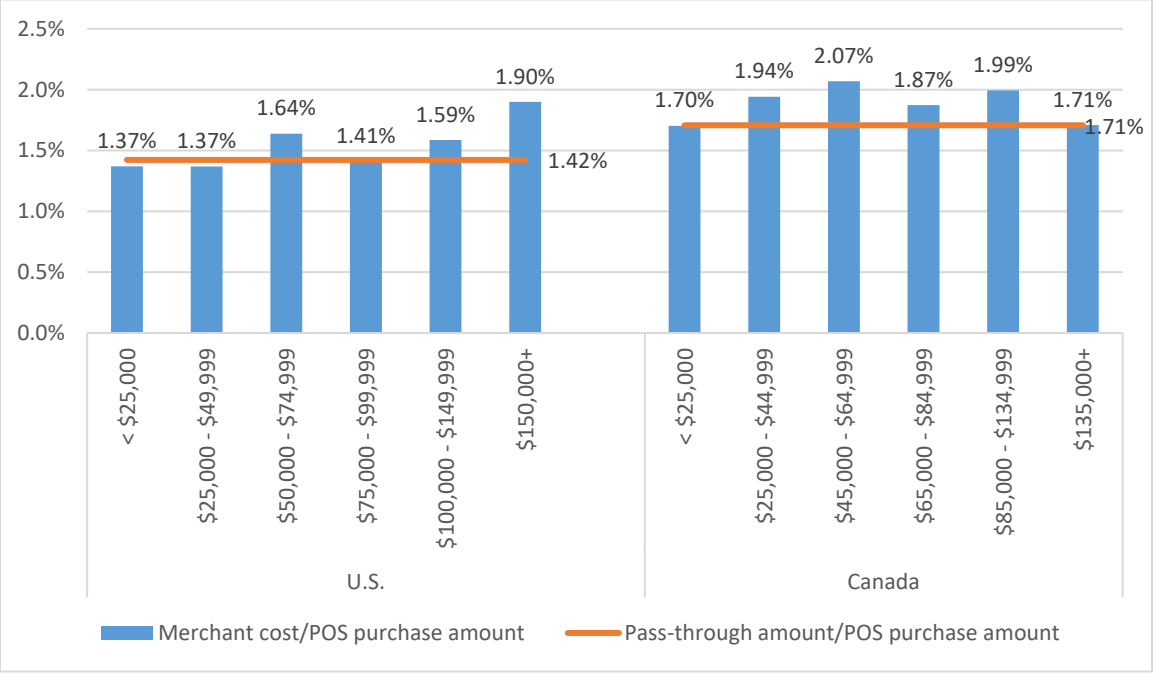


Figure 6: Merchant Cost Pass-through per Consumer per Month by Income Cohort (in US$)

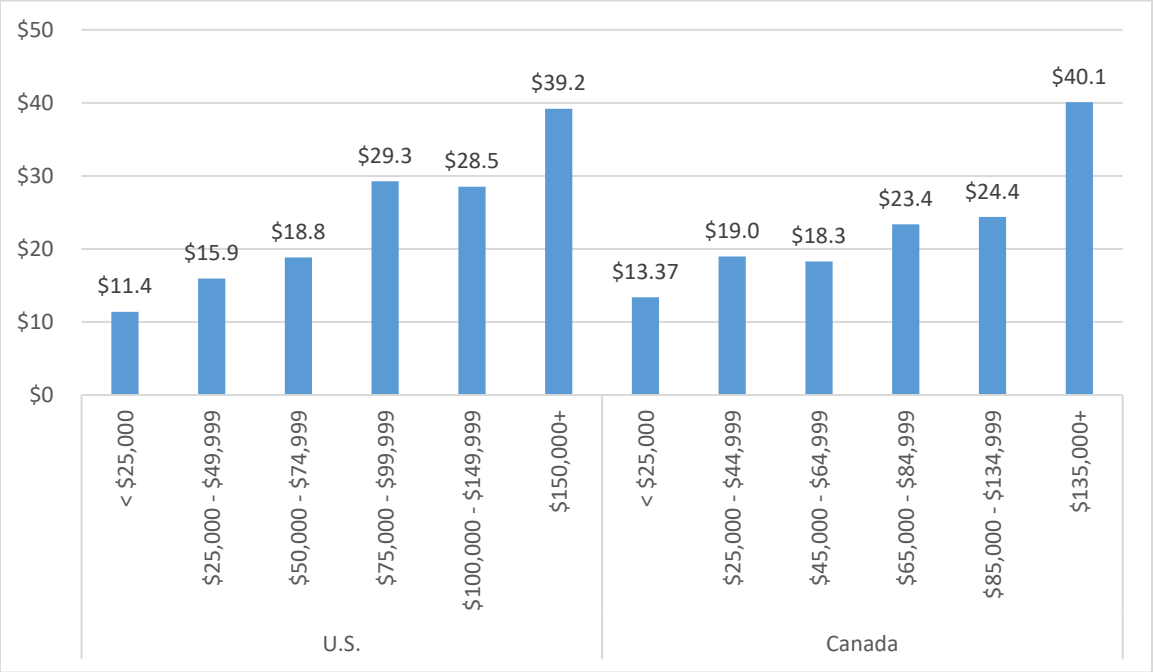


Figure 7: Rewards per Consumer per Month by Income Cohort (in US$)

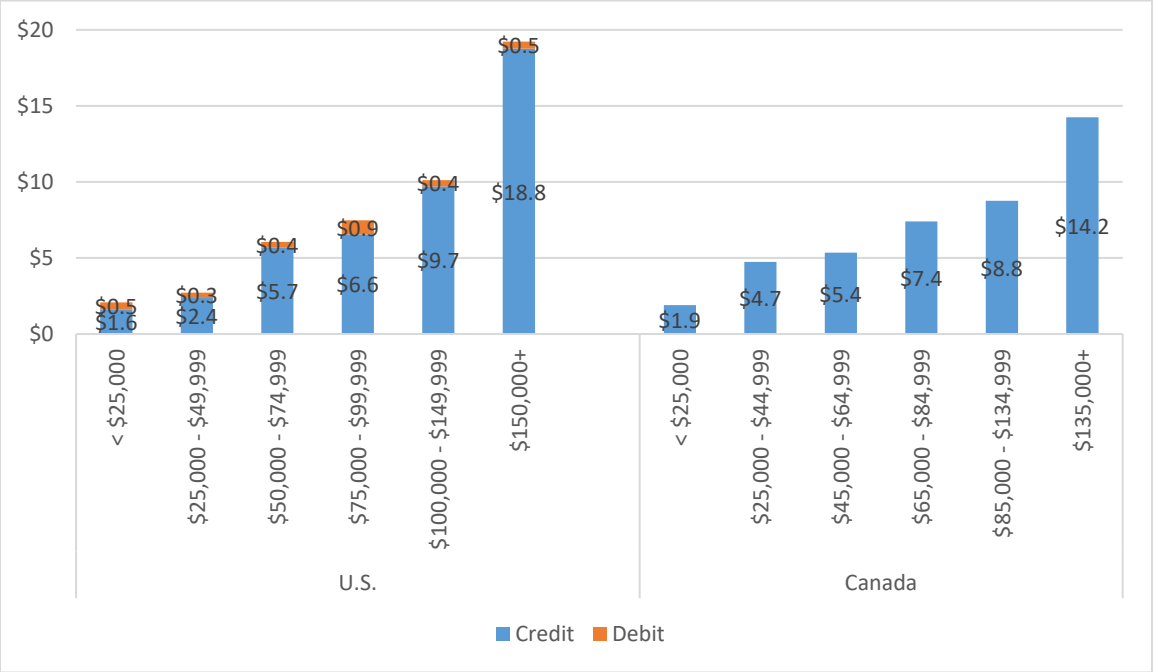


Figure 8: Ratio of Rewards to POS Purchase Amount by Income Cohort

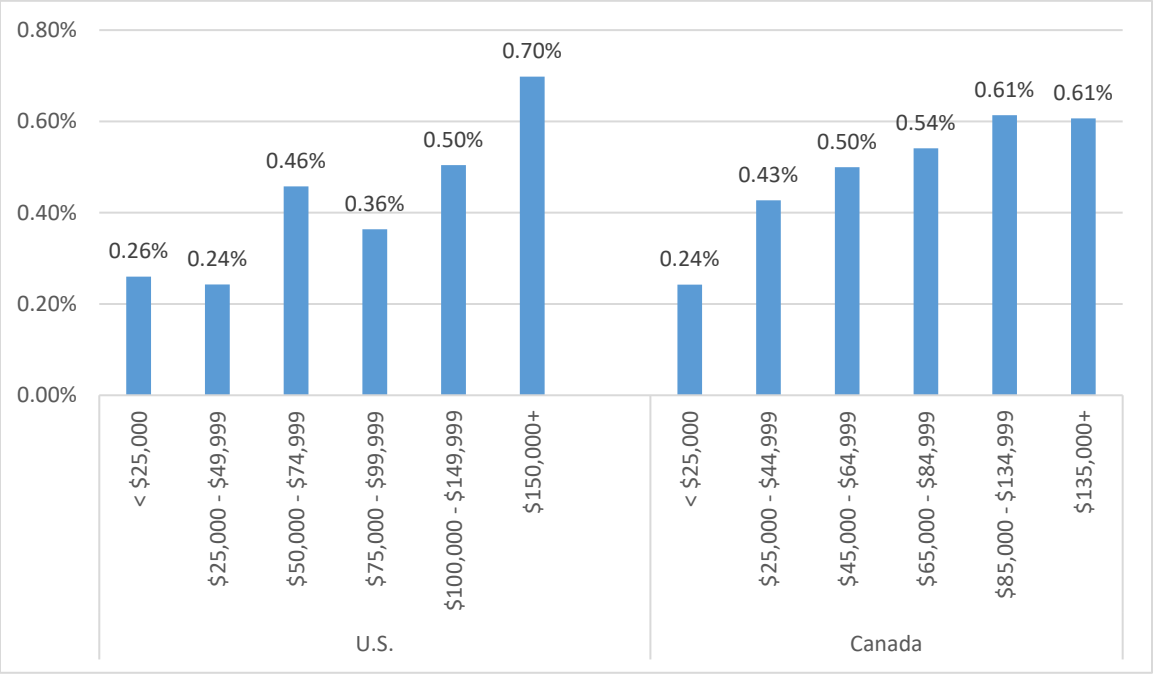


Figure 9: Consumer Fees to Financial Institutions per Consumer per Month by Income Cohort (in US$)

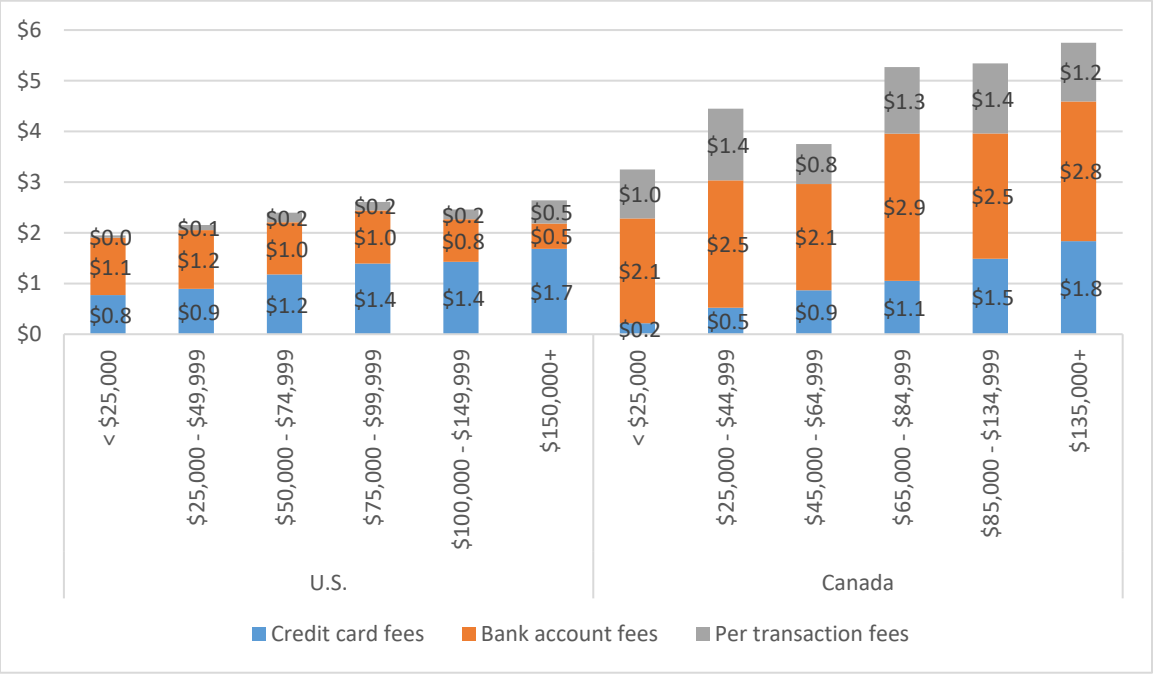


Figure 10: Ratio of Consumer Fees to POS Purchase Amount by Income Cohort

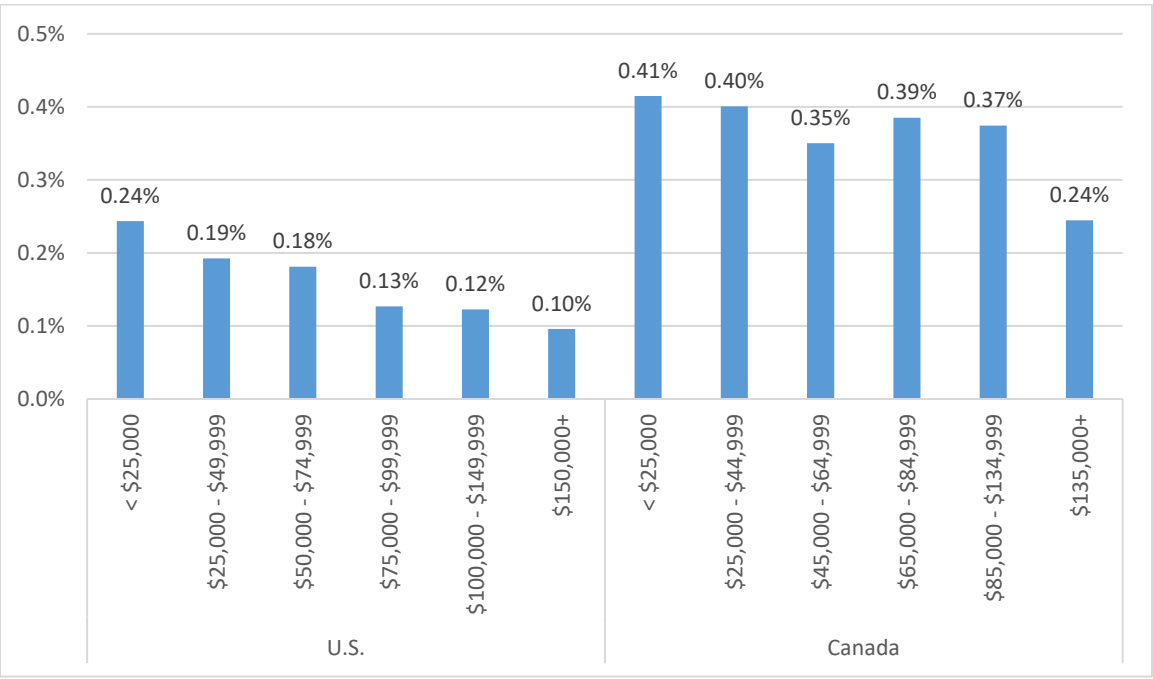
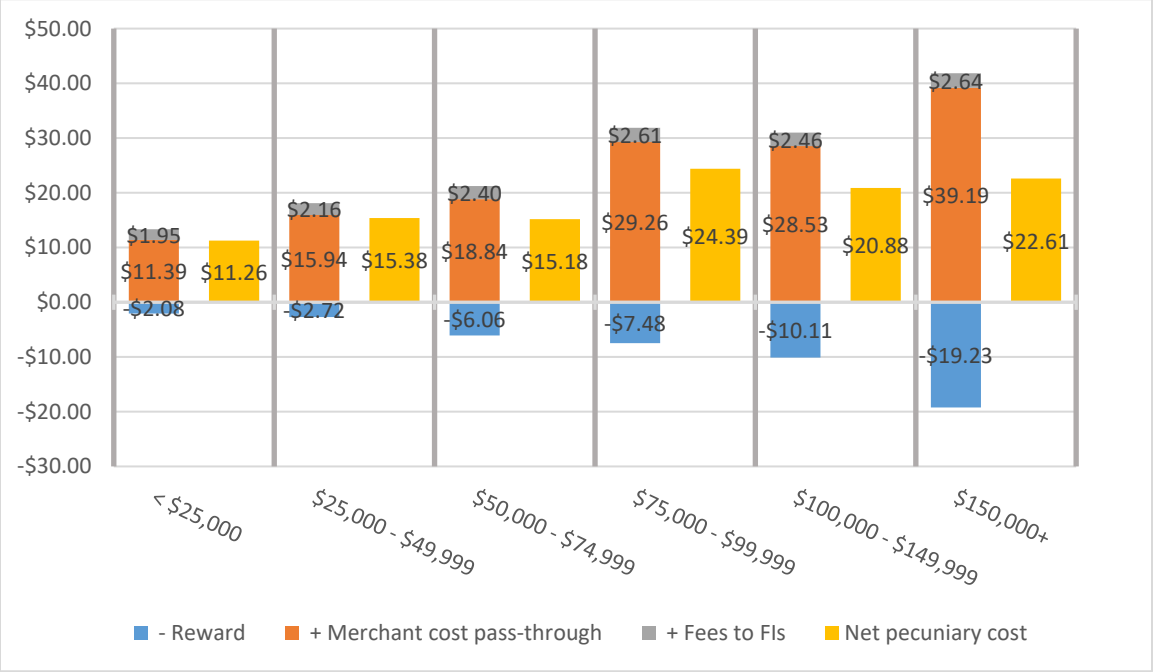


Figure 11: Rewards, Merchant Cost Pass-through, Fees to Financial Institutions, and Net Pecuniary Cost per Consumer per Month by Income Cohort

Panel A: U.S. (in US$)



Panel B: Canada (in US$)

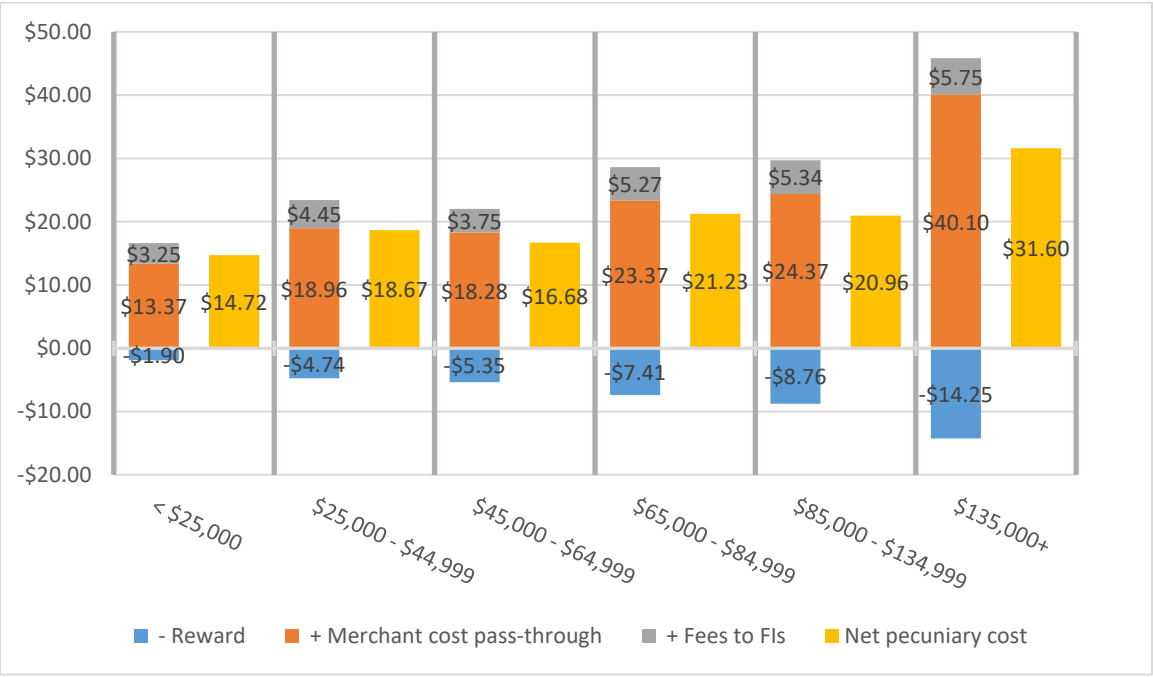


Figure 12: Ratio of Net Pecuniary Cost to POS Purchase Amount

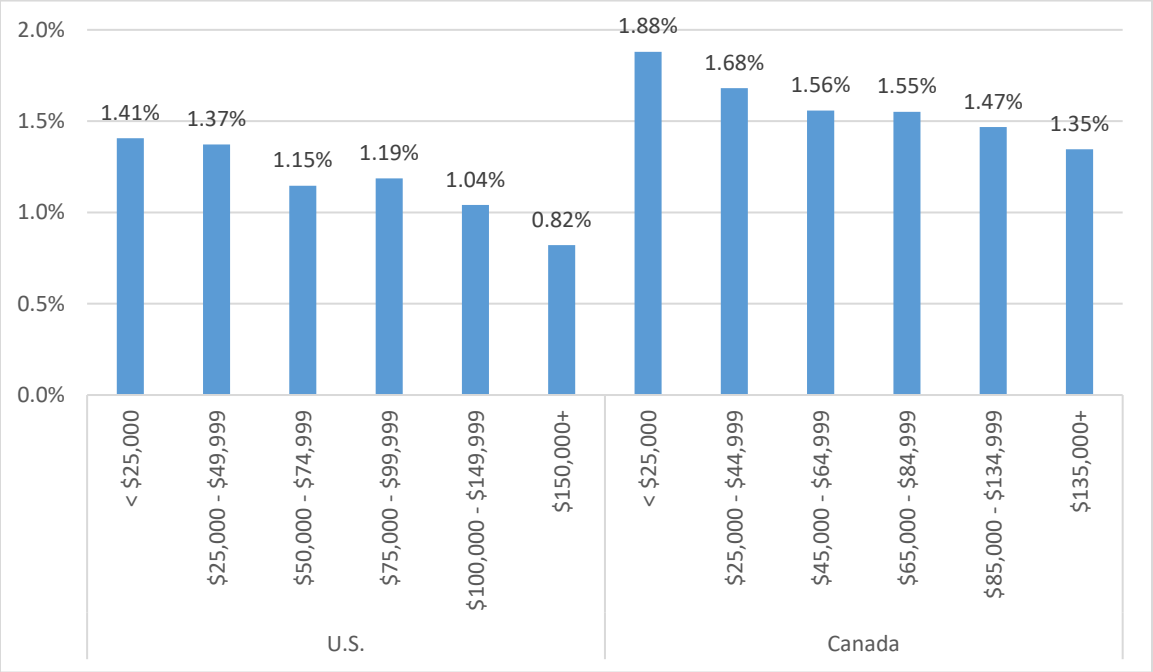


Figure 13: Net Pecuniary Cost as a Percentage of POS Purchase Amount by Income Cohort under Alternative Scenarios with 90% Merchant Pass-through Rate

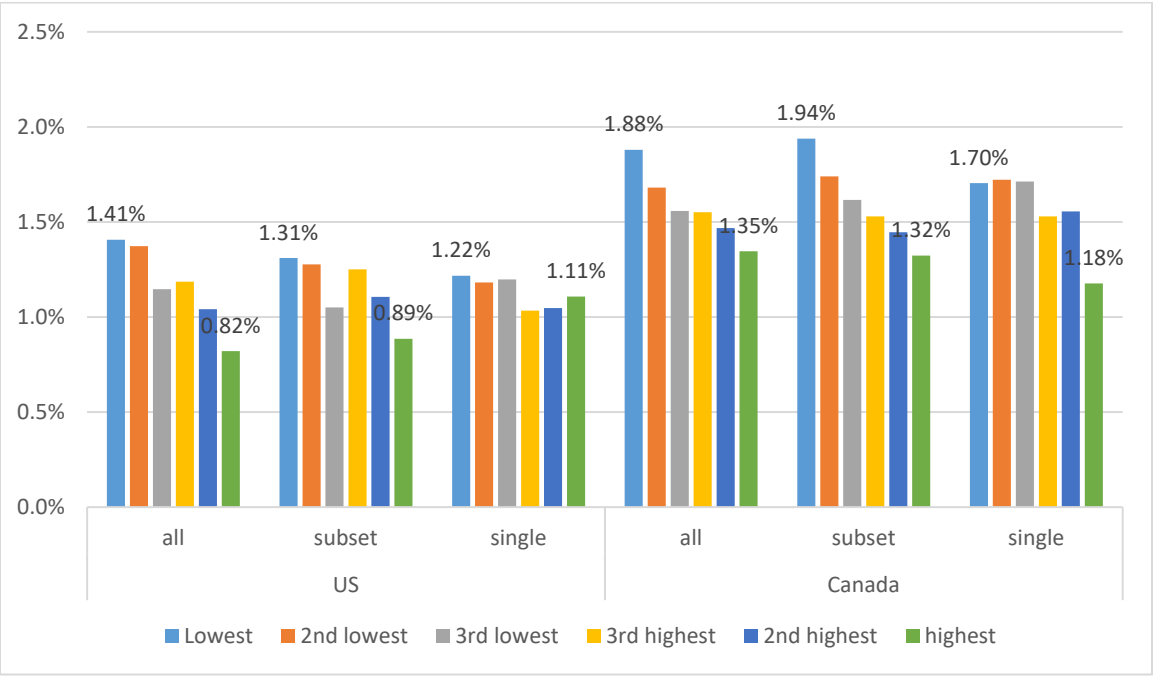
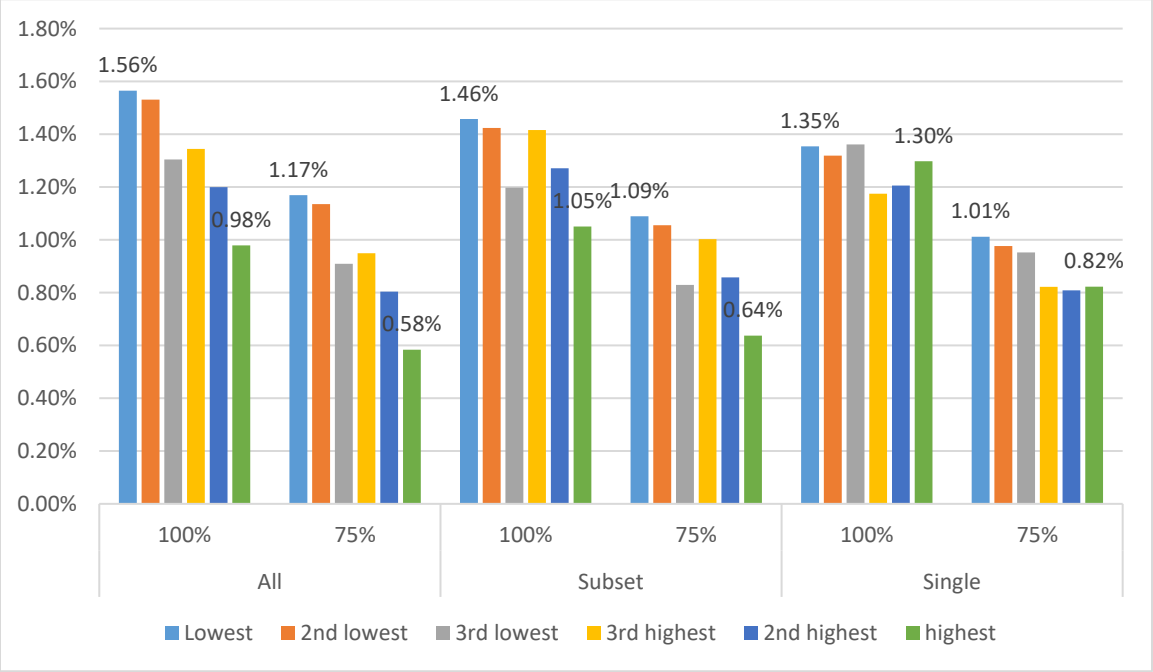


Figure 14: Net Pecuniary Cost as a Percentage of POS Purchase Amount by Income Cohort under Alternative Scenarios with 100% and 75% Merchant Pass-through Rates

Panel A: U.S.



Panel B: Canada

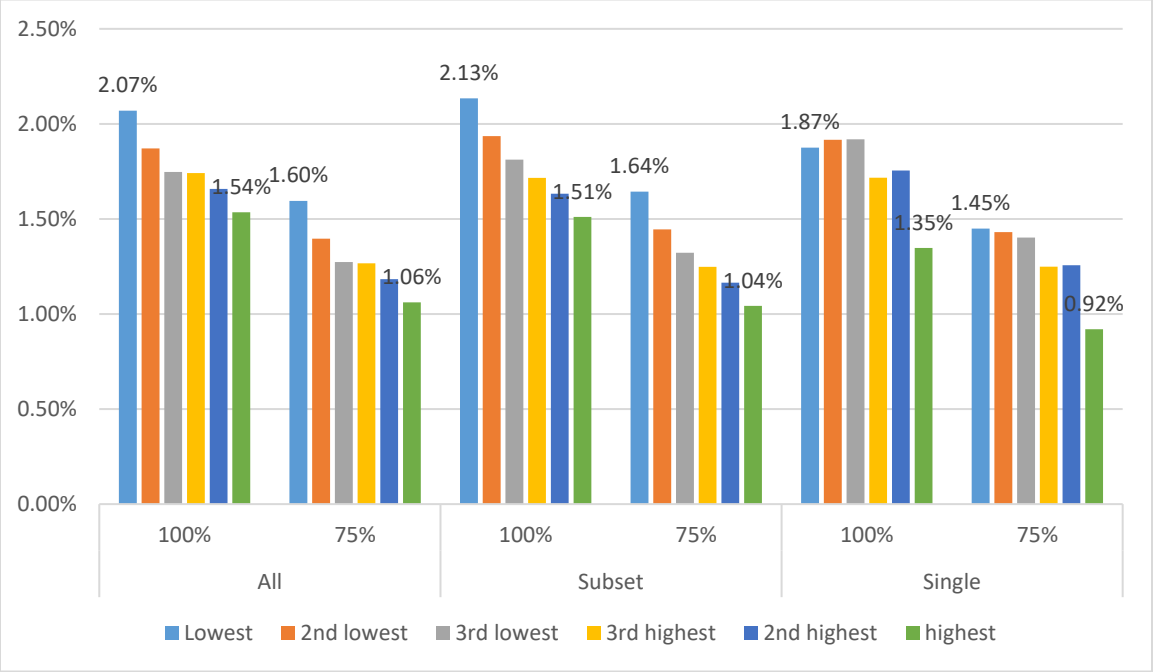


Figure 15: Merchant Pass-through Rates that Generate Equal Net Pecuniary Costs as a Percentage of POS Purchase Amount across All Income Cohorts When Merchants Serve a Single Cohort

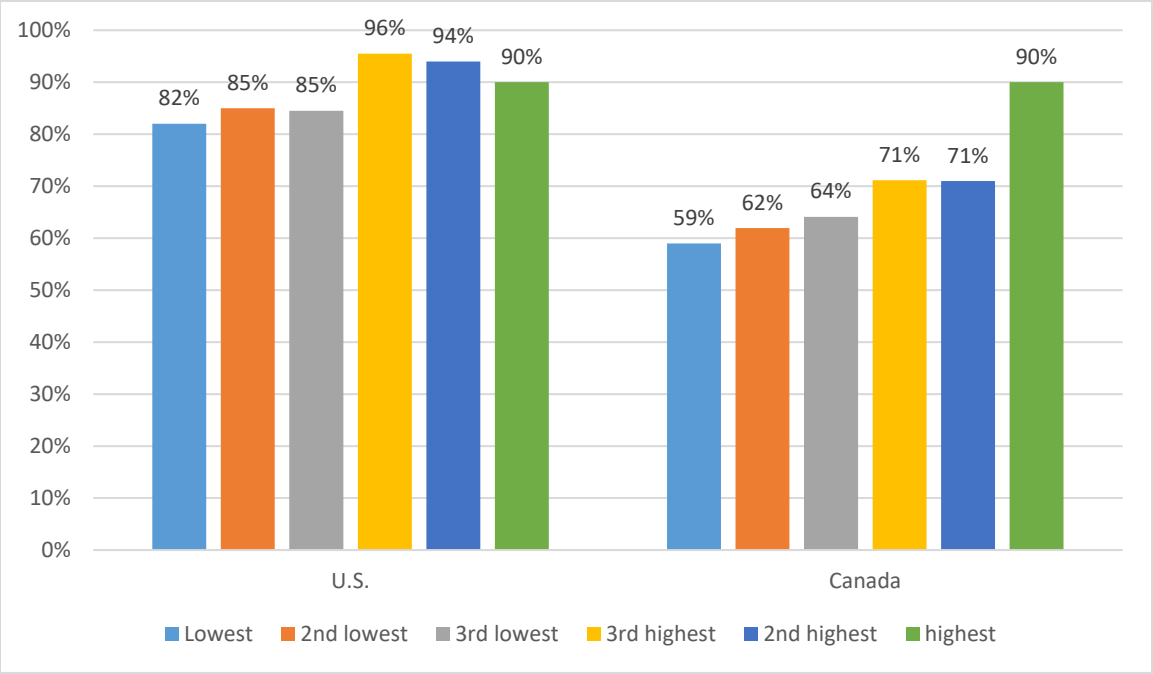
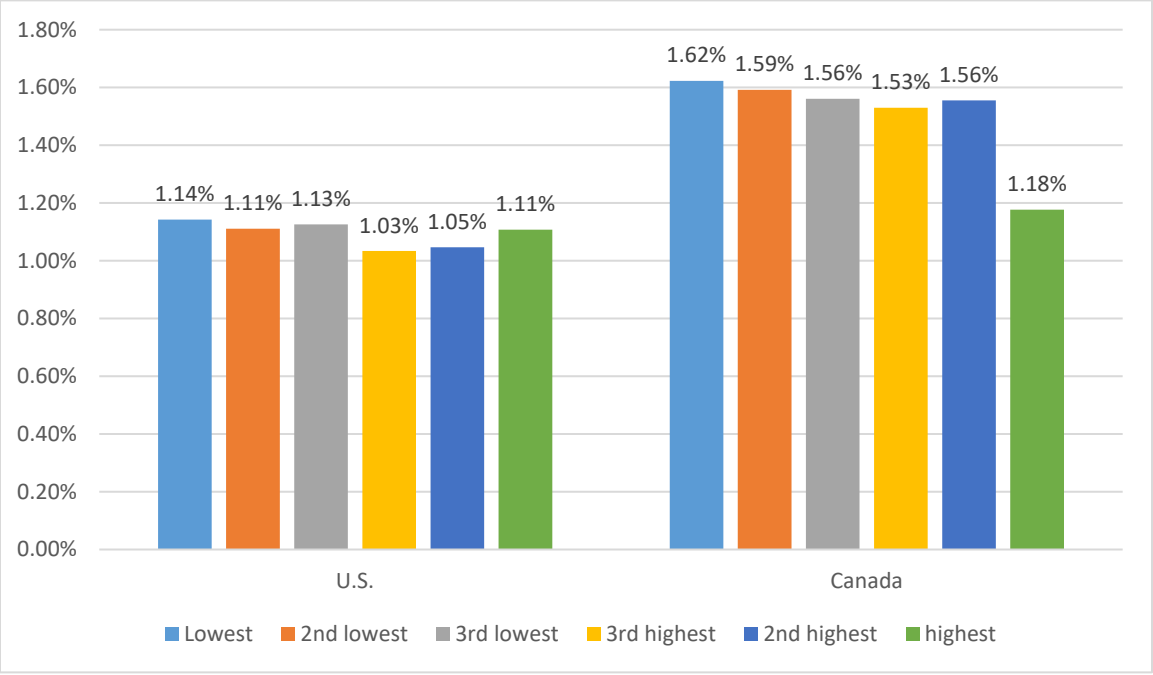


Figure 16: Net Pecuniary Cost as a Percentage of POS Purchase Amount by Income Cohort with Varying Merchant Costs When Merchants Serve a Single Cohort



Appendix A: Additional Tables and Figures

Table A1: Rewards, Merchant Cost Pass-through, Consumer Fees to Financial Institutions, Net Pecuniary Cost, and Merchant Cost per Consumer per Month by Income Cohort (Base Case Scenario)

Panel A: U.S. (in US$)

	Annual Household Income					
	< $25,000	$25,000 - $49,999	$50,000 - $74,999	$75,000 - $99,999	$100,000 - $149,999	$150,000+
Rewards	$2.08	$2.72	$6.06	$7.48	$10.11	$19.23
Credit card	$1.59	$2.43	$5.70	$6.55	$9.71	$18.76
Debit card	$0.49	$0.29	$0.36	$0.93	$0.40	$0.46
Merchant cost pass-through	$11.39	$15.94	$18.84	$29.26	$28.53	$39.19
Consumer fees to financial institutions	$1.95	$2.16	$2.40	$2.61	$2.46	$2.64
Annual credit card fees	$0.77	$0.90	$1.18	$1.39	$1.43	$1.68
Monthly bank account fees	$1.13	$1.16	$1.03	$1.05	$0.84	$0.50
Per transaction fees	$0.04	$0.10	$0.19	$0.17	$0.19	$0.46
Net pecuniary cost	$11.26	$15.38	$15.18	$24.39	$20.88	$22.61
Merchant cost	$10.97	$15.33	$21.69	$29.03	$31.82	$52.32
Cash	$2.46	$2.84	$2.58	$2.53	$2.60	$2.30
Credit card	$4.21	$6.40	$12.50	$14.28	$20.45	$41.59
Debit card	$4.29	$6.09	$6.61	$12.22	$8.77	$8.49
POS purchase amount	$800.24	$1,120.17	$1,324.11	$2,056.43	$2,005.15	$2,754.61
As a percent of POS purchase amount						
Rewards	0.26%	0.24%	0.46%	0.36%	0.50%	0.70%
Merchant cost pass-through	1.42%	1.42%	1.42%	1.42%	1.42%	1.42%
Consumer fees to financial institutions	0.24%	0.19%	0.18%	0.13%	0.12%	0.10%
Net pecuniary cost	1.41%	1.37%	1.15%	1.19%	1.04%	0.82%
Merchant cost	1.37%	1.37%	1.64%	1.41%	1.59%	1.90%

Sources: 2018 SCPC and DCPC and authors' calculations.

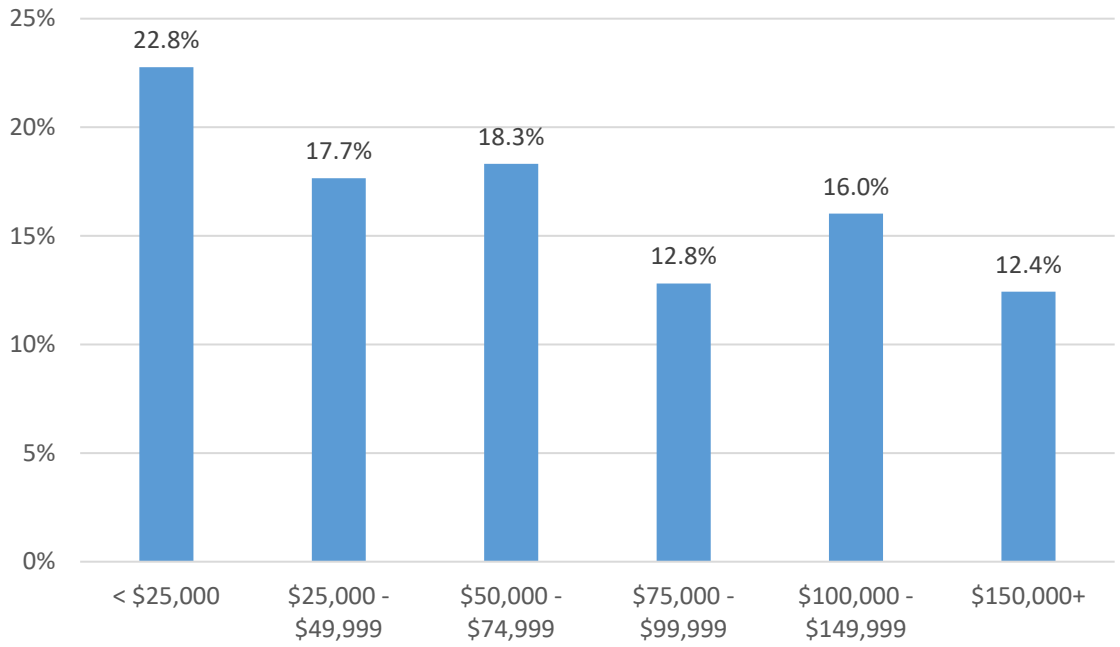
Panel B: Canada (in CA$)

	Annual Household Income					
	< $25,000	$25,000 - $44,999	$45,000 - $64,999	$65,000 - $84,999	$85,000 - $134,999	$135,000+
Rewards	$2.46	$6.14	$6.93	$9.60	$11.35	$18.46
Merchant cost pass-through	$17.33	$24.57	$23.69	$$30.28	$31.58	$51.96
Consumer fees to financial institutions	$4.21	$5.77	$4.86	$6.83	$6.92	$7.45
Annual credit card fees	$0.28	$0.68	$1.12	$1.36	$1.93	$2.38
Monthly bank account fees	$2.68	$3.26	$2.71	$3.76	$3.20	$3.57
Per transaction fees	$1.25	$1.83	$1.02	$1.70	$1.79	$1.50
Net pecuniary cost	$19.39	$24.64	$22.04	$28.05	$27.72	$41.88
Merchant cost	$17.28	$27.95	$28.71	$33.21	$36.88	$52.01
Cash	$6.27	$5.10	$4.10	$3.82	$3.83	$3.85
Credit card	$8.44	$20.05	$22.27	$26.02	$29.05	$4.20
Debit card	$2.57	$2.80	$2.34	$3.38	$4.01	$3.97
POS purchase amount	$1,014.87	$1,439.18	$1,387.58	$1,773.20	$1,849.50	$3,043.06
As a percent of POS purchase amount						
Rewards	0.24%	0.43%	0.50%	0.54%	0.61%	0.61%
Merchant cost pass-through	1.71%	1.71%	1.71%	1.71%	1.71%	1.71%
Consumer fees to financial institutions	0.41%	0.40%	0.35%	0.39%	0.37%	0.24%
cNet pecuniary cost	1.88%	1.68%	1.56%	1.55%	1.47%	1.35%
Merchant cost	1.70%	1.94%	2.07%	1.87%	1.99%	1.71%

Sources: 2018 MOP, 2018 PCS, and authors' calculations.

Figure A1: Income Distribution

Panel A: U.S. (2018 SCPC)



Panel B: Canada (2017 MOP)

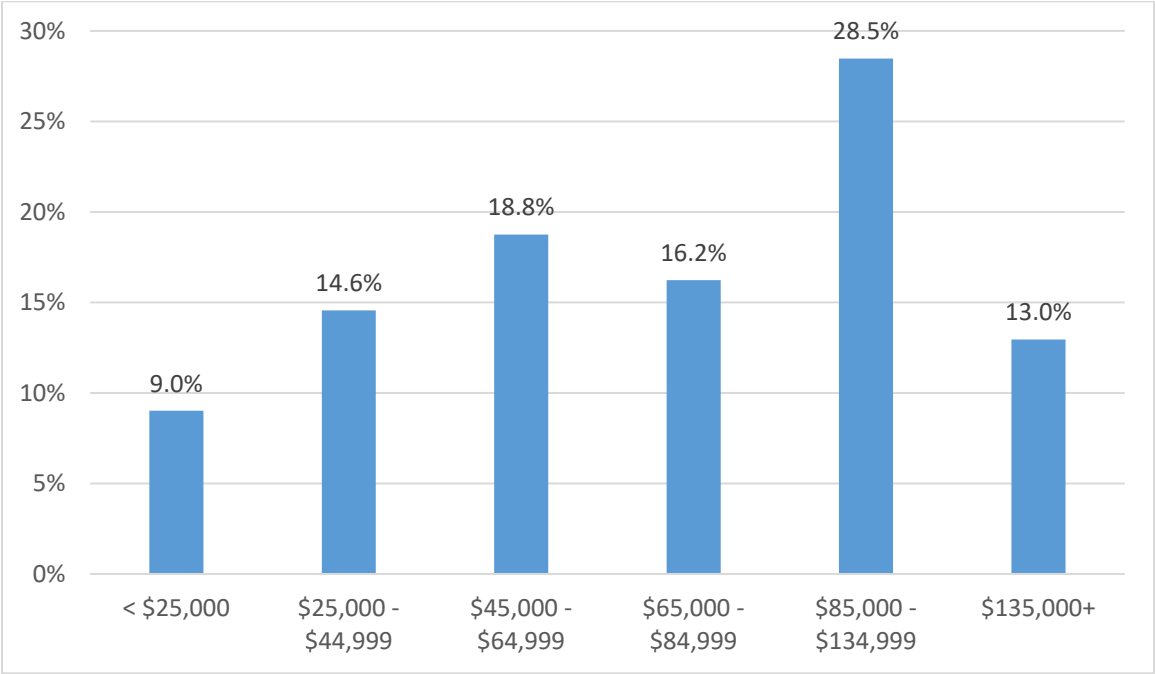
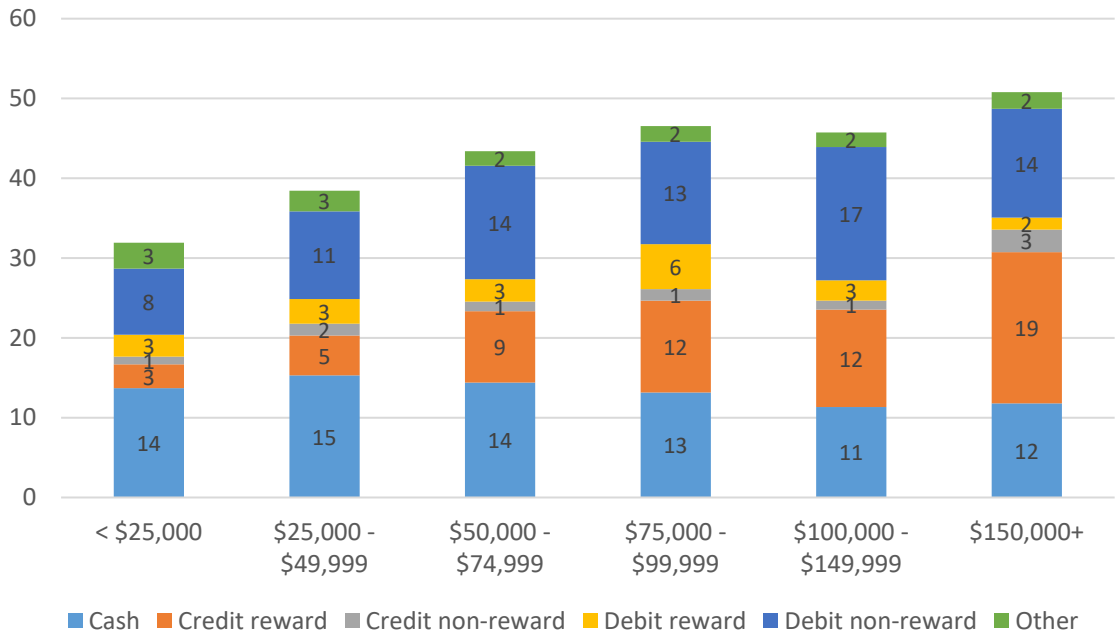


Figure A2: Number of POS Purchases per Consumer per Month by Income Cohort

Panel A: U.S.



Panel B: Canada

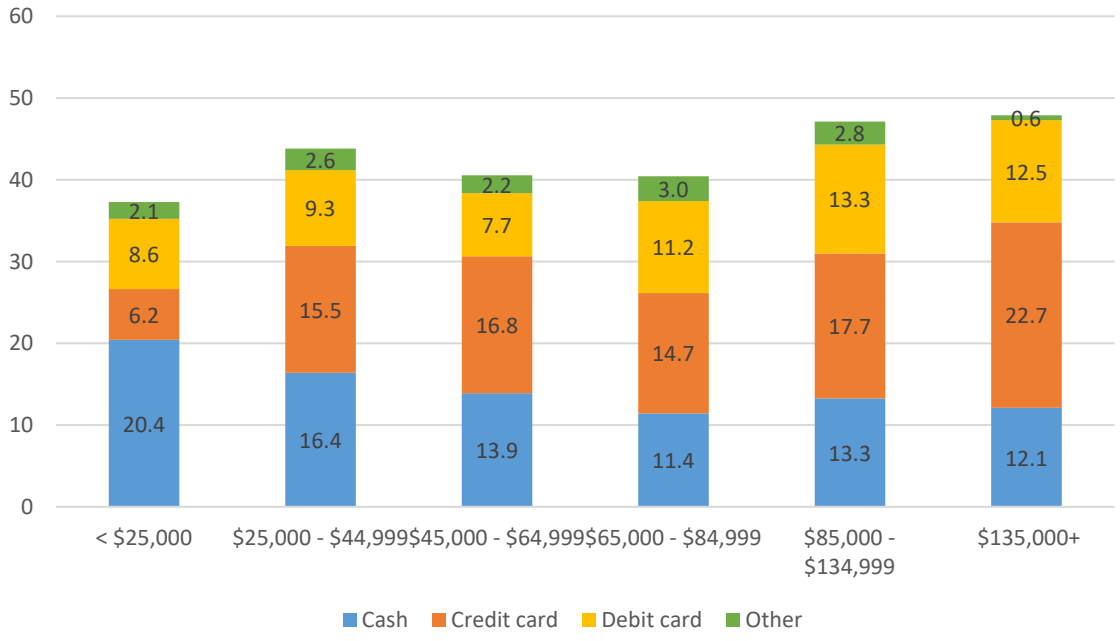
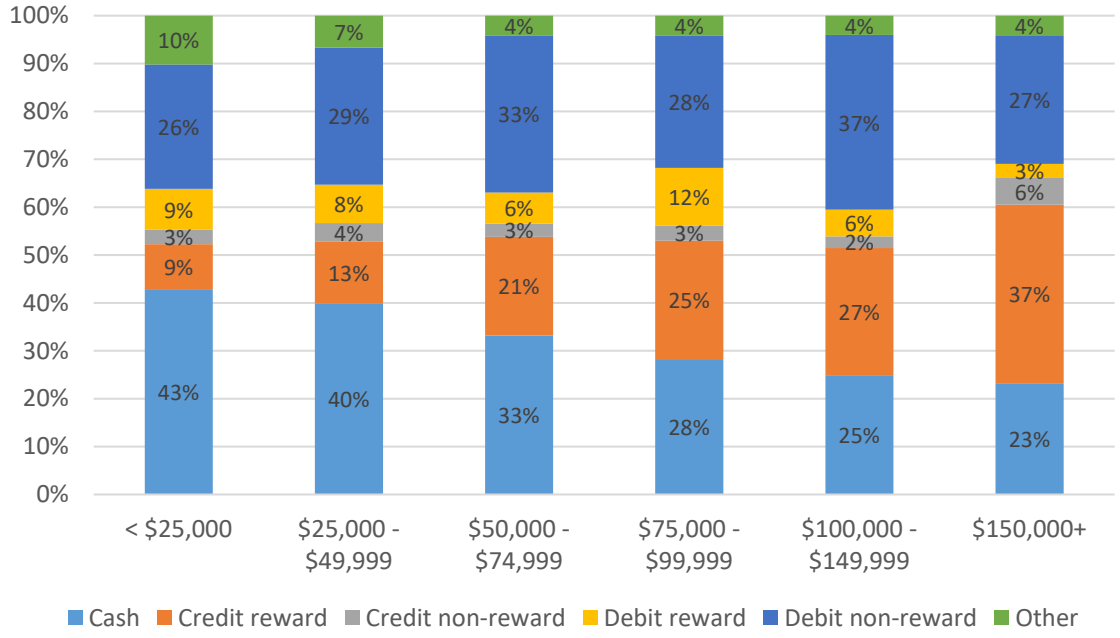


Figure A3: Share of Number of POS Purchases per Consumer by Income Cohort

Panel A: U.S.



Panel B: Canada

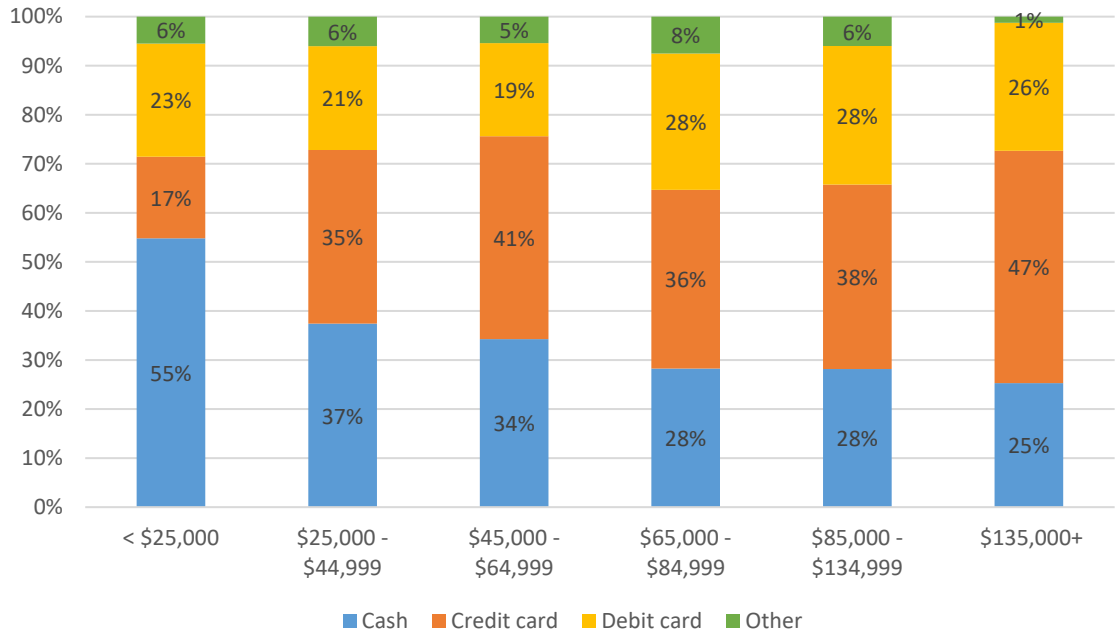


Figure A4: Value of POS Purchases per Consumer per Month by Income Cohort

Panel A: U.S. (in US$)



Panel B: Canada (in CA$)

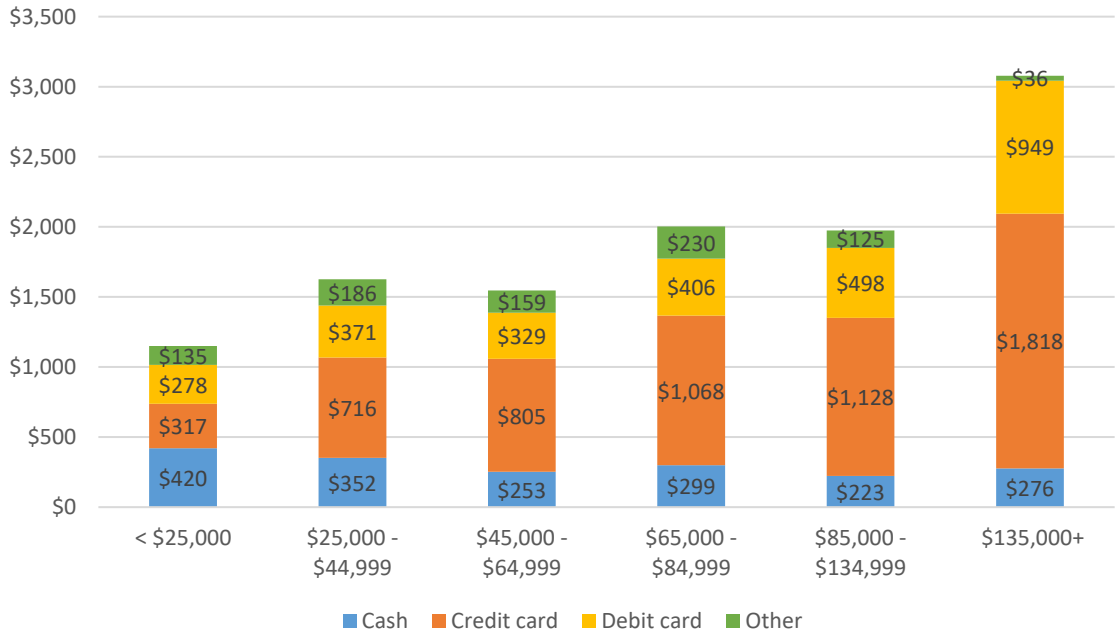
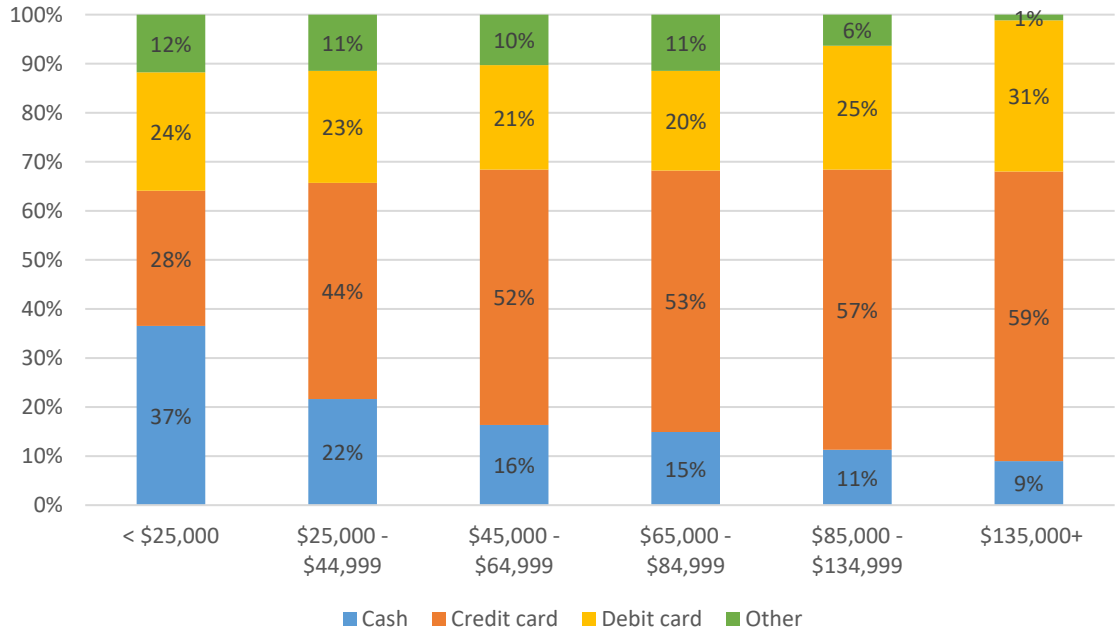


Figure A5: Share of Value of POS Purchases per Consumer by Income Cohort

Panel A: U.S.



Panel B: Canada



Appendix B: Details on Calculations for the United States

Merchant cost calculation

To obtain merchant cost data, we use the Bank of Canada 2015 Retailer Survey on the Cost of Payment Methods but apply U.S. data to estimate the average merchant cost per transaction for cash, debit cards, and credit cards. We obtain the number of U.S. merchants by size from the 2012 Economic Census. More than 95 percent of merchants are classified as small, defined as those with fewer than 50 employees. Small merchants as a whole generated 23.3 percent of the total sales, and we use that share to allocate cash, debit card, and credit card transactions between small and large merchants for cost calculations, both in number and in dollar value.

The total number and value of debit and credit card transactions in the United States are from the 2018 Federal Reserve Payments Study (FRPS). Debit card transactions include those conducted with debit cards and general purpose prepaid cards; credit card transactions include those conducted with general purpose credit cards. The total number and value of cash transactions are derived from the 2018 Survey of Consumer Payment Choice (SCPC) and the 2018 Diary of Consumer Payment Choice (DCPC) survey data. For the total value of cash transactions, we multiply the number of cash transactions by $23.31, the average value of a cash purchase in the 2018 DCPC.

The total number and value of cash, debit card, and credit card transactions are allocated between small and large merchants according to the sales ratio mentioned above. The total cost of accepting cash, debit card, and credit card payments is based on the Bank of Canada Retailer Survey, but by using United States–specific information as follows: merchant service charge, the average wage for cashiers and back-office workers (from the U.S. Bureau of Labor Statistics Retail Trade Earnings and Hours), cash theft and fraud as a percentage of cash sales (from the National Retail Security Survey), the fraud and chargeback rate for cards (derived from Hayashi et al. 2018 and FRPS), and the average terminal rental cost (using the low end of $30 to $100 per month listed on merchant acquirers' websites). We then calculate the average fixed cost and proportional cost per transaction for each of the three payment methods.

Consumer fees to financial institutions

To derive credit card annual fees, we use the Consumer Credit Card Market report from the Consumer Financial Protection Bureau (Consumer Financial Protection Bureau 2019). The report provides average annual credit card fees per card and the prevalence of those fees by credit score tier. For example, the average annual credit card fee *per card* for prime consumers equals the average annual fee per fee-charging card for prime consumers multiplied by the prevalence rate of annual fees for prime cardholders. We obtain the average number of general purpose credit cards held by consumers in each credit tier from the Equifax credit bureau data. The average annual credit card fee *per person* in a given credit score tier equals the average fee per card in the tier multiplied by the number of cards per person in the tier. We map each credit score tier to income cohorts by using self-reported credit scores in the SCPC to calculate the average credit card annual fee payment for each income cohort. The average credit card annual fee per person is lowest for the lowest-income cohort and highest for the highest-income cohort ($20.49 versus $32.27). We assume there are no annual fees for debit cards because banks rarely charge periodic fees specifically for debit cards in the United States.

To obtain monthly bank account fees, we use the 2019 checking account and ATM fee study from Bankrate.com.[37] According to the study, the minimum balance requirement to waive a monthly fee with a non-interest-bearing checking account is about $622, on average. The average monthly service fee for a non-interest-bearing account was $5.57 in 2018. The 2018 SCPC and 2018 DCPC provide data on checking account adoption and checking account balances, which give us the share of consumers in each income cohort who have checking account balances below the minimum threshold. Because the share of consumers who have checking account balance below $622 is smaller for higher-income cohorts, the average monthly bank account fee is lower for higher-income cohorts.

To obtain the average monthly ATM fee amount for each income cohort, we use the same Bankrate.com study that we use above. According to the study, the cost of an out-of-network ATM withdrawal in 2018 was $4.68 (the sum of a foreign fee and a surcharge). Using the DCPC data, we calculate the average number of ATM cash withdrawals per month for each income cohort. We assume that 14.11 percent of those ATM cash withdrawals are out-of-network, based

[37] Accessed at https://www.bankrate.com/banking/checking/checking-account-survey/.

on GAO (2013). The average monthly ATM fee amounts are highest among the highest-income cohort and lowest among the lowest-income cohort; the other four income cohorts have average monthly ATM fee amounts that are similar to each other's.

These consumer fees are allocated to cash, credit card, and debit card transactions made at POS (by separating transactions made for other purposes, such as bill payments, online purchases, and person-to-person transfers). We use allocation keys based on SCPC and DCPC data, as summarized in Table B1.

Table B1: Allocation Keys Used in Consumer Fee Estimation for the U.S.

Type of fees	Credit card fee	Bank account fee	ATM fee
Allocation key	Share of credit card POS transactions in total credit card transactions in value	Share of debit card POS transactions in total bank account product payments in number	Share of cash POS transactions in total cash transactions in value
< $25,000	45%	38%	39%
$25,000 - $49,999	47%	43%	43%
$50,000 - $74,999	53%	44%	67%
$75,000 - $99,999	57%	45%	76%
$100,000 - $149,999	57%	44%	73%
$150,000+	63%	42%	83%

Appendix C: Details on Calculations for Canada

Merchant proportional cost for accepting a credit card payment

Merchant costs for credit card fees from the 2015 Retailer Survey on the Cost of Payment Methods do not reflect the reductions in 2015, because data were collected for the year 2014. To incorporate these reductions, we adjust the proportional cost incurred by merchants for accepting a credit card payment in the following way. Using publicly available information on Visa and MasterCard interchange fees for 2014 and 2018, we compute the decreases for the three rewards card types (no rewards, basic rewards, and premium rewards) for two types of POS merchants, namely supermarkets and gasoline stations. Taking the average of these declines across card networks and merchant types, we obtain the following adjustments to the interchange fees relative to the average interchange rate in 2014 (Table C1).

Table C1: Interchange Fee Adjustments for 2018 Relative to the 2014 Average Interchange Fee

Reward card type	Adjustment
No rewards	-0.500%
Basic rewards	-0.343%
Premium rewards	0.075%
Average (weighted by transaction value)	-0.200%

Rewards

The 2017 MOP SQ collects information on the respondent's main credit card, defined as the credit card that is used most often for day-to-day purchases. We use a question on the type of rewards available to the respondent from their main credit card to estimate the proportion of rewards and non-rewards credit card owners in Canada. The 2015 PCS further provides information on which types of rewards credit cards each respondent owns. Using an ordinal logit model, we estimate the probability of Canadian consumers within each income cohort owning basic rewards and premium rewards cards.

We then derive the average rewards rate (including non-rewards) for each income cohort as follows:

$$\overline{r_i} = \hat{P}_i(\text{non-rewards=1}) \times 0 + \hat{P}_i(\text{basic rewards=1}) \times r_b + \hat{P}_i(\text{premium rewards=1}) \times r_p \,,$$

where $\overline{r_i}$ is the average rewards rate for income cohort *i*, P_i(card type=1) is the probability of income cohort *i* consumers' owning a given card type, and r_b and r_p are basic and premium

rewards rates, respectively. We assume the basic and premium rewards rates to be 0.75 percent and 1.5 percent in Canada. We also assume Canadians earn no rewards on their debit cards.

Based on our estimation results, higher-income consumers are more likely to carry premium rewards cards, while lower-income consumers tend to carry non-rewards and basic rewards cards. Among credit card owners in the lowest-income cohort, 21 percent carry a main card with no rewards, 54 percent carry a basic rewards card, and 25 percent carry a premium rewards card. In the highest-income cohort, only 16 percent carry a main credit card without rewards, 33 percent carry a basic rewards card, and 51 percent have a premium rewards card. As a result, the average rewards rate increases as income increases (0.78 percent for the lowest-income cohort versus 1.02 percent for the highest-income cohort).

Consumer fees to financial institutions

The 2017 MOP SQ collects the annual fee on the respondent's main credit card in a categorical fashion using six brackets of values. We use the midpoint value of each bracket for estimating the average annual credit card fees for each income cohort, and rescale it to a monthly fee.

Annual credit card fees pertain to the various types of transactions made with a credit card: not only POS purchases but also online purchases, bill payments, and cash advances. We perform allocation as follows. We first calculate the ratio of credit card cash advances to credit card purchases (in value) in 2018 from Technology Strategies International (2019) and then apply this ratio uniformly across income cohorts. We next use the 2019 online Canadian Financial Monitor (CFM) survey to estimate the share of the POS credit card purchase amount in the total (POS and online) credit card purchase amount.[38] The microdata allow us to estimate this share by income cohort. We find that it does not vary greatly or monotonically with income.[39] Due to a lack of data, Canadian estimates do not account for the fact that a portion of the annual credit card fee amount should be allocated to bill payments made with credit cards. To this extent, the Canadian credit cards fee amount pertaining to POS purchases may be overstated.

[38] Details about the online CFM survey, a syndicated study by Ipsos, are available in Felt and Laferrière (2020).
[39] By contrast, the corresponding allocation key for the United States accounts for bill payments and online purchases but not cash advances, and it increases monotonically with income. The Canadian and U.S. results may be reconciled if bill payments represent a higher share of credit card payments for low-income cohorts than for high-income cohorts in Canada.

The 2017 MOP SQ collects information on the respondent's main bank account, defined as the bank account that is used most often for day-to-day purchases. This information includes the name of the financial institution where the bank account is held as well as the name of the account. We match bank account names with data provided by the FCAC on banking fees. When the exact name of the bank account is not known, we instead use the self-reported monthly account fee "normally charged for having the account" collected in the SQ. Importantly, the monthly fees actually paid by consumers might differ from the official pricing reported in the FCAC data or the self-reported "normal" fee due to students/seniors status, multi-product rebates, or minimum balance requirements. To account for the possible difference, we use a question in the MOP SQ asking the respondent whether the account fee on their main bank account was waived last month.

Periodical bank account fees pertain to the various types of transactions made from the account. The main bank account is defined as the bank account that is used most often for day-to-day purchases, but such an account is also typically used for paying regular household bills via electronic fund transfers (EFTs) or checks. Checks are also sometimes used to pay for purchases. Since no information on bill payments is available in the MOP SQ or DSI, we use external data (Payments Canada) for allocating bank account fees across the following two types of transactions: (1) transactions from a bank account related to day-to-day purchases using a debit card or cash and (2) other transactions from a bank account. Based on the number of debit card transactions and ABM withdrawals (relative to the total number of outgoing transactions) reported in Tompkins and Galociova (2019), we apportion 63 percent of the monthly bank account fees to debit card and cash payments. This allocation procedure is applied homogenously across income cohorts.[40] Allocation keys used in Canadian estimations are summarized in Table C2.

Per-transaction fees paid by Canadian consumers for debit card transactions (cash withdrawals and debit card purchases) are estimated based on a question in the MOP SQ asking the respondent the amount of the fee they were charged for making additional debit card transactions (for example, a debit card purchase, ABM withdrawals, etc.) the previous month. Additional debit card transactions are transactions beyond the "free" debit transactions included

[40] The corresponding allocation key for the United States, which is estimated by income cohort, varies only slightly across cohorts.

with their account package. Due to a lack of data, we do not apportion Canadian per-transaction costs between POS cash and debit card purchases and other cash and debit card transactions (such as cash transfers and online debit card purchases).[41]

Table C2: Allocation Keys Used in Consumer Fee Estimation for Canada

Type of fees	Credit card fee	Bank account fee	Per-transaction fee
Allocation key	Share of credit card POS transactions in the sum of POS, online and cash advance credit card transactions in value	Share of debit card transactions (ABM withdrawals and debit card purchases) in total outgoing bank account transactions in number	
< $25,000	55%	63%	100%
$25,000 - $44,999	61%	63%	100%
$45,000 - $64,999	63%	63%	100%
$65,000 - $84,999	59%	63%	100%
$85,000 - $134,999	62%	63%	100%
$135,000+	58%	63%	100%

[41] By contrast, for the United States, ATM withdrawal fees are allocated across cash purchases and other cash transactions. Variations of this allocation key across income cohorts are important, as the highest-income cohort's value share of cash purchases in total cash payments is double that of the lowest-income cohort. We perform sensitivity analyses applying the U.S. allocation key to Canadian data and find our results for Canada are quite robust, due to the small size of average per-transaction fees per person.