Who Gains and Who Loses from Credit Card Payments? Theory and Calibrations[*]

Scott Schuh[†]   Oz Shy[‡]   Joanna Stavins[§]

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Abstract

Merchant fees and reward programs generate an implicit monetary transfer from "cash" users to credit card users because merchants generally do not set differential prices for card users to recoup the costs of merchant fees. On average, each cash-using household transfers $50 to households that use credit cards, and each credit card using household receives a subsidy of $240 every year. Among card users, the benefits are unequal— card users with unpaid revolving debt ("revolvers") pay a transfer of $511 and those without debt ("convenience" users) receive a subsidy of $833. Because credit card spending and rewards are positively correlated with household income, cash-to-card transfers are regressive. On average, the lowest-income household ($20,000 or less annually) pays $63 and the highest-income household ($150,000 or more annually) receives $823 every year.

Keywords: credit cards, cash, payments, merchant fees, rewards, regressive transfers, no-surcharge rule.

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[†]*E-mail*: Scott.Schuh@bos.frb.org   Research Department, Federal Reserve Bank Boston, 600 Atlantic Avenue, Boston, MA 02210, U.S.A. *SDG*

[‡]*E-mail*: Oz.Shy@bos.frb.org   Research Department, Federal Reserve Bank Boston, 600 Atlantic Avenue, Boston, MA 02210, U.S.A.

[§]*E-mail*: Joanna.Stavins@bos.frb.org   Research Department, Federal Reserve Bank Boston, 600 Atlantic Avenue, Boston, MA 02210, U.S.A.

1.   Introduction

The typical consumer is largely unaware of the full ramifications of paying for goods and services by credit card. Faced with many choices—cash, check, debit or credit card, etc.—consumers naturally consider the costs and benefits of each payment instrument and choose accordingly. For credit cards, consumers likely think most about their benefits: delayed payment—"buy now, pay later"—and the rewards earned—cash back, frequent flier miles, or other enticements. What most consumers do not know is that their decision to pay by credit card involves merchant fees, retail price increases and nontrivial transfers of income from cash to card payers and from low-income to high-income consumers.

In contrast, the typical merchant is acutely aware of the ramifications of his customers' decisions to pay with credit cards. For the privilege of accepting credit cards, U.S. merchants pay banks a fee that is proportional to the dollar value of the sale. The merchant's bank then pays a proportional interchange fee to the consumer's credit card bank.[1] Naturally, merchants seek to pass the merchant fee to their customers. Merchants may want to recoup the merchant fee only from consumers who pay by credit card. In practice, however, credit card companies impose a "no-surcharge rule" (NSR) that prohibits U.S. merchants from doing so, and most merchants are reluctant to give cash discounts.[2] Instead, merchants mark up their retail prices for all consumers by enough to recoup the merchant fees from credit card sales.

This retail price markup for all consumers results in users of credit cards being subsidized by "cash" users (those who do not pay with credit cards), a result that was first discussed in Carlton and Frankel (1995), and later in Frankel (1998), Katz (2001), Gans and King (2003),

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[1]Shy and Wang (2011) show that card networks extract higher surplus from merchants using proportional merchant fees (rather than fixed, per-transaction fees). The amount of surplus that card networks can extract increases with the degree of merchants' market power.

[2]Card associations allow U.S. merchants to give cash discounts under certain restrictions. However, cash discounts are not widely observed. Frankel (1998) argues that a prohibition on credit card surcharges can have effects different from those resulting from a prohibition on cash discounts, because card surcharges allow merchants to vary their charges according to the different merchant fees they pay on different cards, whereas a cash discount is taken from a single card price.

and Schwartz and Vincent (2006). For simplicity, we refer to consumers who do not pay by credit card as cash payers, where "cash" represents all payment instruments other than credit cards: cash, checks, debit and prepaid cards, etc.—all of which represent non-credit payments from current assets with little or no float.[3] "Subsidize" means that merchant fees are (fully or partially) passed on to all buyers in the form of higher retail prices regardless of the means of payments buyers use to pay. Thus, cash buyers must pay higher retail prices to cover merchants' costs associated with the credit cards' merchant fees.

Chakravorti and Emmons (2003) point out that the subsidy received by credit card users may not be shared equally between credit card users who carry high-interest revolving debt ("revolvers") and those who do not ("convenience" credit card users), a distinction we quantify for the first time in this paper. Because these fees are used to pay for rewards given to credit card users, and since cash users do not receive rewards, cash users also finance part of the rewards given to credit card users. Similarly, as indicated in Chakravorti and Emmons (2003), revolvers face extremely high interest rates to partially cover the rewards given to all card users including those to do not borrow.

If the previously described cross-subsidies result from heterogeneity in consumer preferences and utility between cash, card (convenience) and card (revolving) payments, then they may be innocuous in terms of consumer and social welfare. However, U.S. data show that credit card use is highly positively correlated with consumer income. Consequently, these subsidies involve a regressive transfer of income from low-income to high-income consumers. This regressive transfer is amplified by the disproportionate distribution of rewards, which are proportional to credit card sales, to high-income credit card users.[4] Frankel (1998, Footnote 85) was the first to connect the wealth transfers to average income of groups of con-

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[3]McAndrews and Wang (2008) demonstrates the possibility of a subsidy in the opposite direction (from card users to cash users) in cases where merchants' cost of handling cash exceeds merchants' card fees. McAndrews and Wang's definition of cards includes debit cards, which are less costly (when used with a PIN) than credit cards, whereas in our paper debit cards are included as part of "cash." Humphrey et al. (1996) and Humphrey et al. (2006) also provide evidence that electronic payment instruments, such as debit cards, are less costly than paper instruments, such as cash or check. Again, however, we focus only on credit cards, which have high merchant fees and are more costly than other payment instruments, paper or electronic.

[4]See Hayashi (2009) and her references for a comprehensive overview of card reward programs.

sumers (that is, lower-income non-cardholders subsidizing higher-income cardholders). This idea was later discussed in Carlton and Frankel (2005, pp. 640–641), Frankel and Shampine (2006, Footnote 19), and Semeraro (2009).[5]

Our contribution to this line of research is that we are the first to compute calibrated estimates of who gains and who loses from credit card payments in the aggregate (U.S.) economy. We propose a simple, model-free accounting methodology to compute all credit-card related transfers among consumers by comparing the costs imposed by individual consumer payment choices with actual prices paid by each buyer, augmented by consumers decisions to revolve unsecured credit card debt. Our methodology computes dollar-value estimates of the actual transfers from cash payers to card payers, distinguishing between convenience and revolving card users, as well as transfers between low-income to high-income households. A related paper by Berkovich (2009) estimates the total amount transferred from non-rewards consumers to rewards consumers in the United States resulting from gasoline and grocery purchases only.[6]

Our results indicate that cash users and revolving credit card users subsidize convenience credit card users by non-trivial amounts each year. On average, each cash-using household transfers $50 to households that use credit cards and each credit card using household receives a subsidy of $240 every year. Among card users, the benefits are unequal—card users with unpaid revolving debt ("revolvers") pay a transfer of $511 and those without debt ("convenience" users) receive a subsidy of $833. Because credit card spending and rewards are positively correlated with household income, cash-to-card transfers are regressive. On average, the lowest-income household ($20,000 or less annually) pays $63 and the highest-income household ($150,000 or more annually) receives $840 every year.

We take as given the well-established, seminal result of Rochet and Tirole (2006) con-

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[5]Similar points were made recently in *New York Times* articles by Floyd Norris, "Rich and Poor Should Pay Same Price," October 1, 2009; and by Ron Lieber, "The Damage of Card Rewards," January 8, 2010.

[6]This estimated transfer is about $1.4 billion to $1.9 billion, and rewards are found to have a disproportionate impact on low-income minorities that resemble a regressive tax on consumption. These estimates focus exclusively on rewards transfers and do not account for the full range of transfers from low- to high-income consumers resulting from merchant fees and a lack of price differentiation among payment instruments.

cerning the critical role of an interchange fee between acquiring and issuing banks in the two-sided credit card market, a result that notes that the optimal level of the interchange fee is an empirical issue.[7] By incorporating both merchant fees and card rewards rates, we can assume that the interchange fee lies between these rates and is set exogenously within the banking sector that includes issuers, acquirers, and card networks.[8] We also take as given the decision by merchants to accept payment instruments by assuming a "mature" market in which all merchants accept all instruments, but we evaluate the sensitivity of our results to variation in the distribution of household shopping patterns across merchants and variation in the extent of merchants' pass-through of merchant fees to retail prices. Credit card payments produce a regressive transfer among households for all empirically relevant specifications of shopping patterns, even when low-income and high-income households shop in separate stores. However, as pass-through of the payment costs to retail prices falls below 50 percent, the transfer reverses and become progressive.

We want to be clear that we do not allege or imply that banks or credit card companies have designed or operated the credit card market intentionally to produce a regressive transfer from low-income to high-income households. We are not aware of any evidence to support this allegation or any *a priori* reason to believe it. However, the existence of a non-trivial regressive transfer in the credit card market may be a concern that U.S. individuals, businesses, or public policy makers wish to address. If so, our analysis suggests several principles for further study, consideration, and potential action. Policy actions toward interchange fees, both internationally (credit cards) and in the U.S. Dodd-Frank financial reform legislation (debit cards), typically have been motivated by concerns about competition in

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[7]A complete list of contributions to two-sided markets is too long to be included here. The interested reader can consult Chakravorti and Shah (2003), Gans and King (2003), Rochet (2003), Wright (2003), Roson (2005), Evans and Schmalensee (2005), Armstrong (2006), Schwartz and Vincent (2006), Bolt and Chakravorti (2008), Hayashi (2008), Rysman (2009), and Verdier (2011). For a comprehensive empirical study of interchange fees, see Prager et al. (2009).

[8]Carroll (1997) provides motivation for credit cards to help consumers smooth income in the face of income and wealth shocks and achieve optimal consumption plans. However, the actual impact of credit card borrowing on consumer and social welfare is complicated, as can be seen from literature, including Brito and Hartley (1995), Gross and Souleles (2002), Chatterjee et al. (2007), and Cohen-Cole (Forthcoming). Rochet and Wright (2010) build a model of credit card pricing that explicitly takes into account credit functionality.

payment card markets and pricing. Our analysis provides a different but complementary motivation—eliminating a regressive transfer—for potential policy intervention in the credit card market, which may not be relevant for debit cards.

Section 2 documents three basic facts about card card use. Section 3 and 4 characterizes the major players in the credit card markets (households, merchants, and banks). Section 5 demonstrates a simple "accounting" of transfers from cash to card users and from low-to high-income buyers. Section 6 provides sensitivity analysis focusing on different pass-through of merchant fees. Section 8 concludes with policy implications. Appendix A provides an analytical model of consumer payment choice.

2. Basic Facts about Credit Cards

This section establishes three basic facts about credit cards: (i) consumer credit card use has been increasing, (ii) consumer credit card use and rewards are positively correlated with household income, and (iii) the incidence of credit card borrowing is not strongly correlated with income, although the burden of credit card revolving debt is heavier on low-income households.

2.1 Credit cards in the economy

Over the last two decades, payment cards have enjoyed increased popularity in all sectors of the economy. Our research focuses on credit and charge cards used by households only. Figure 1 shows that the fraction of households who have a credit card (adopters) has been steady at about 70–75 percent during the past two decades, reflecting the maturity of the market. However, the percentage of total consumption expenditure paid for by credit card clearly increased during the same period.[9] Assuming that merchants fees did not decrease, revenue

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[9]Both series were taken from the Survey of Consumer Finances (SCF), which asked consumers about the amount of credit card charges they had in the previous month (variables *x412 x420 x423 x426*) since 1989 ("Consumption spending volume") and about credit card adoption (variable *x410*) since 1989 ("Credit card adoption rate"). The denominator of the consumption spending share series is the Personal Consumption Expenditure.
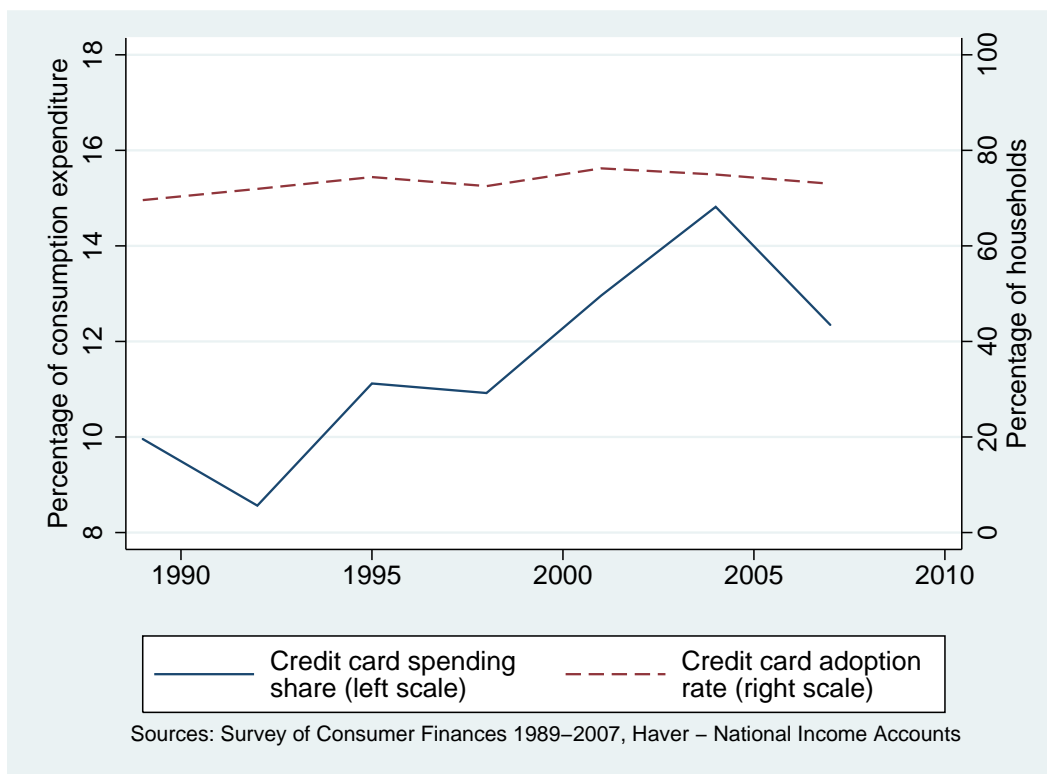
Figure 1: Credit card adoption and spending rates.

from merchant fees, which are proportional to credit card spending, also increased to an estimated $42 billion in 2007.[10] Consumer credit card spending accounts for approximately half of all credit card spending in 2007, based on the total credit card spending numbers from the SCF ($1.21) trillion and the Call Reports ($1.96) trillion, where the former only includes consumer's spending while the latter encompasses all credit card spending.

2.2 Card use and income

The literature has found a positive relationship between income and credit card adoption [see Stavins (2001), Mester (2003), Bertaut and Haliassos (2006), Klee (2006), Zinman (2009a)], but there has been less focus on the relationship between income and credit card use (see Schuh and Stavins (2010) for an exception). The Survey of Consumer Finances provides

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[10]Total credit card spending, which includes business and government expenditures, was constructed from the Federal Deposit Insurance Corporation's Call Report data (series *rcfdc223* and *rcdfc224*). We then assumed a two percent merchant fee.

data on the dollar values charged by consumers on their credit cards, which we define here as use. These data reveal a strong positive correlation between consumer credit card use and household income, as shown in Table 1.[11] (The unequally sized income categories are

Annual income	Have a credit card (%)	Credit card spending			
		Average monthly ($)		Share of total spending (%)	
		Revolvers	Convenience	Revolvers	Convenience
Under $20,000	42	461	343	6.2	3.8
$20,000–49,999	67	380	650	6.0	6.0
$50,000–79,999	87	521	1,170	8.0	8.5
$80,000–99,999	91	773	1,647	9.8	10.3
$100,000–119,999	93	1,012	1,854	11.4	11.4
$120,000–149,999	97	1,370	2,084	11.5	15.3
Over $150,000	97	3297	5,771	9.2	26.2
Low income (< $100,000)	68	490	847	7.3	7.1
High income (≥ $100,000)	96	1,927	4,146	9.9	21.9
Whole sample	73	779	1,874	8.4	13.3

Table 1: Households' credit card adoption rates and new monthly charges by annual household income. *Source*: 2007 Survey of Consumer Finances, authors' calculations.

as reported in published aggregate data from the Consumer Expenditure Survey.) The proportion of households who have (adopted) at least one credit card increases monotonically with income (first column). Average new monthly charges on all credit cards held by a household also increases monotonically with income among households who have adopted credit cards (second and third columns).[12] Interestingly, the average new charges are higher for revolvers than for convenience users in the lowest income bracket, but lower in the other income categories. And the share of credit card spending in total household consumption also increases monotonically with income (fourth and fifth column).[13] Again the asymmetry

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[11]Data on the number of transactions consumers make with credit cards, which are available from the new Survey of Consumer Payment Choice (SCPC), also reveal a positive correlation between income and use.

[12]The new charge numbers are based on the following question from the 2007 SCF: "On your last bill, roughly how much were the new charges made to these [Visa, MasterCard, Discover, or American Express] accounts?" Because merchant fees are proportional to the amount charged on credit cards, regardless of whether the cardholder pays his monthly balance or carries it over to the next month, total new credit card charges for each household is the relevant measure of credit card use.

[13]The share of credit card spending in household income actually decreases with household income, however, because the marginal propensity to consume falls with household income.

between the lowest and the two highest income brackets is remarkable, while the poorest households mostly revolve the richest ones primarily pay off their credit card balances within a month.

The data also reveal a strong positive correlation between consumer credit card rewards and household income, as shown in Table 2. The share of credit card holders earning any type of rewards increases monotonically with income. A similar pattern is visible for each of the major types of rewards as well: cash back, frequent flyer miles, discounts, and others.

Income	Any Reward	Cash Back	Airlines Miles	Discounts	Other Rewards
Under $20,000	48	27	17	13	8
$20,000–49,999	50	28	17	11	10
$50,000–79,999	62	35	26	13	12
$80,000–99,999	68	38	36	15	11
$100,000–119,999	71	37	33	16	15
$120,000–149,999	82	44	39	19	25
Over $150,000	75	33	48	15	19
Low income ($< \$100,000$)	57	32	23	12	10
High income ($\geq \$100,000$)	77	37	40	16	19
Whole sample	61	33	27	13	12

Table 2: Percentage (%) of credit card adopters receiving credit card rewards. *Source*: 2007–2008 Consumer Finance Monthly survey conducted by the Ohio State University.

Most of our analysis splits the consumer population into two income groups: low-income households ($< \$100,000$ per year) and high-income households ($\geq \$100,000$). This decision is motivated by the need for parsimony in modeling and by the significant differences in credit card behavior between these two broad income groups. Table 1 shows that credit card spending by high-income consumers is nearly five times higher in dollar value, and more than triple in percentage terms for convenience users, than credit card spending by low-income consumers. Table 2 shows that high-income consumers are 20 percentage points more likely to receive credit card rewards. These differences between the lowest-income (less than $20,000 per year) and the highest-income ($150,000 per year or more) households' credit card spending and rewards is markedly greater.[14]

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[14]Income is not the only factor that is positively correlated with credit card use. Schuh and Stavins

2.3 Credit card borrowing and income

While credit card adoption and use are positively correlated with income, the incidence of credit card borrowing tends to be more similar across households, as shown in Table 3, which helps to evaluate the ideas of Chakravorti and Emmons (2003). The incidence of revolving debt by low-income and high-income households is similar whether reported by consumers (33 and 31 percent, respectively) or measured by actual incidence (43 and 48 percent, respectively). This similarity in the incidence of revolving credit between income groups belies the conventional notion that credit card debt is predominantly a problem for low-income households.

	Low-income	High-income
Revolving debt (reported incidence)	32.9%	30.7%
Revolving debt (actual incidence)	43.2%	47.5%
Revolving debt (revolvers)	$6,252	$11,709
Percent of income (revolvers)	16.4%	8.1%
Interest rate (card holders/revolvers)	12.35%/12.31%	12.60%/11.65%
Annual interest payment (debt × interest rate)	$759	$1303
Percent of income (revolvers)	1.9%	0.9%
Aggregate interest revenue (payment × households)	$30.9 billion	$13.4 billion
Annual rewards	$2.7 billion	$5.8 billion

Table 3: Revolving credit activity by household income group. *Source*: 2007 Survey of Consumer Finances, authors' calculations.

However, the burden of debt is greater for low-income households, in accordance with conventional wisdom. First, the average interest rate for low-income revolvers was moderately higher than for high-income revolvers (12.31 versus 11.65 percent, respectively).[15] In dollar terms, the average amount of outstanding revolving debt and the average revolving interest payment were both roughly twice as large for high-income households as for low-

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(2010) estimated the use of payment instruments as a function of various characteristics of these instruments, employing a 2006 survey of U.S. consumers. They found that, after controlling for income, the characteristics of convenience, cost, and timing of payment have a statistically significant effect on credit card use.

[15]The interest rates in Table 3 are for all credit card holders (first rate) and the debt-weighted average for all revolvers (second rate). The other figures are averages over the entire income group except for the last two rows.

income households. Yet as a percentage of income the burden on low-income households and high-income households was twice as large on the former (16.4 versus 8.1 percent for debt, and 1.9 versus 0.9 percent for debt service, respectively). It should also be noted from Table 1 that high-income households spend five times more on credit cards, which naturally means they benefit from the float period more than low-income families.

Table 3 has important implications for revolving credit interest revenues for banks. The last two rows of Table 3 reveal that both income groups pay more than enough interest to cover the credit card rewards earned by that group. Thus, it seems unlikely that interest from either group cross-subsidizes the rewards of the other.

3. The Payments Market

Figure 2 illustrates a simplified version of the U.S. payments market that frames the computation of aggregate transfers. The quantitative fees and costs portrayed in Figure 2 represent benchmark estimates of recent conditions in the U.S. payments market calibrated from the best available data.

The market has three types of agents: buyers (consumers), merchants, and "banks." Buyers can have high or low incomes and pay by credit card or cash (meaning all non-credit card payments). Merchants sell a representative good to all consumers.[16] Finally, "banks" represents the financial market that provides credit card payment services. It includes banks that issue cards to consumers ("issuers"), banks that receive card payments from merchants ("acquirers"), and card companies (Visa or MasterCard are examples) that facilitate interactions among banks and between banks and their customers.[17] The literature on two-sided markets analyzes the details of the "banks" and merchant markets but tends to abstract

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[16]Obviously, this assumption is not strictly true for all markets, but it is necessary to compute the transfers, given the lack of micro data on payment choice at the level of individual transactions. It also greatly simplifies the modeling task by avoiding the need to have search and matching of individual consumers, merchants, and goods—a level of detail for which proper data are not currently available anyway—in addition to payment choice.

[17]Until recently, Visa and MasterCard were owned by banks. Visa became public in early 2008, and MasterCard in 2006.

from consumer heterogeneity, which precludes analysis of transfers among consumers. Our study takes the opposite approach.
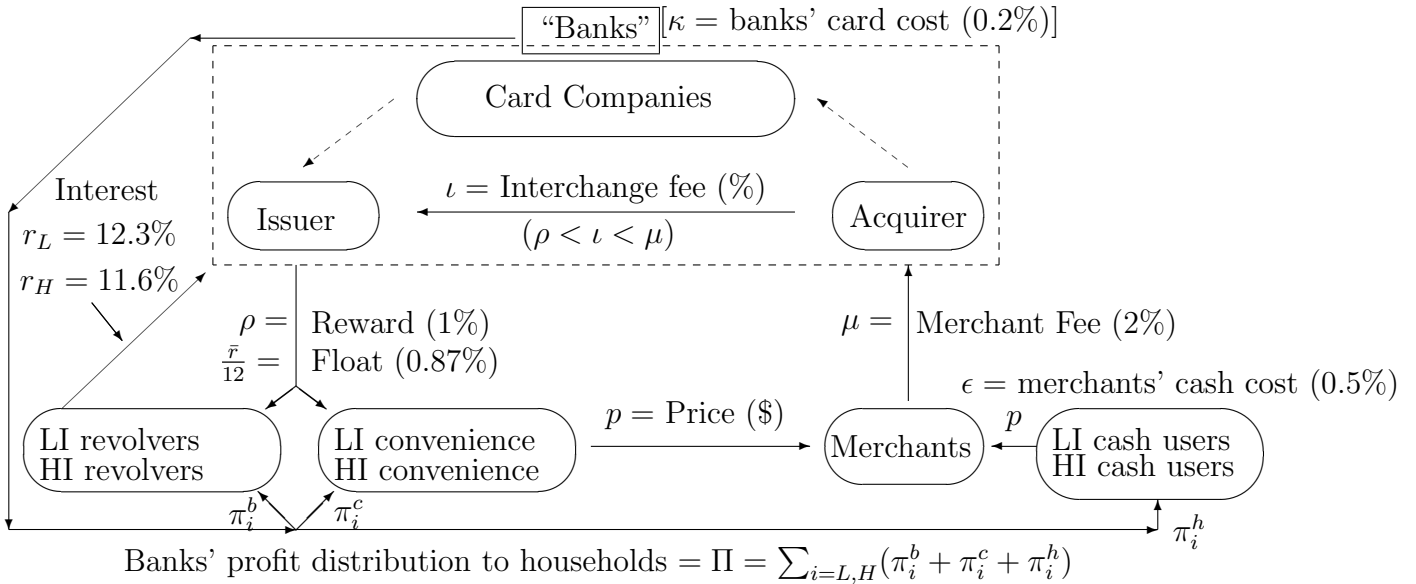

Figure 2: Fees and payments in a simple market with a card network. *Notes*: 1. LI, HI refer to low and high income households. 2. Banks' profit distribution (dividends) to households not plotted. 3. For simplicity only one merchant is illustrated.

It is instructive to walk through Figure 2 and follow the flow of payments starting from the households as it goes through the merchants and the banks before going back to the households. Buyers purchase a good for an endogenously determined price, p, using cash or credit card according to buyers' preferences for the payment instruments. Merchants incur a cost with either payment choice. For cash, merchants bear a cost, denoted $0 \leq \epsilon < 1$, associated with handling cash transactions. Thus, the merchants' cost of accepting a cash transaction is $\epsilon \cdot p$.[18] For credit cards, merchants pay a fee, μ, to banks (acquirers) that is proportional to card sales. Thus, the merchants' cost of accepting a credit card transaction is $\mu \cdot p$.

Table 4 displays estimates of merchants' costs of accepting "cash" (including several

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[18]As drawn, the cash-handling cost ϵ is a proportional cost. However, the actual cost of handling cash may include a fixed cost as well. Footnote 19 presents estimates of the cost of handling cash where ϵ could be interpreted as average cost that includes possible fixed costs because the data do not distinguish well between fixed and marginal costs.

payment instruments) and credit cards. The limited available data suggest that a very rough estimate of the per-dollar merchant effort of handling currency (notes and coins) is $\epsilon = 0.5$ percent.[19] Other components of "cash" have somewhat higher estimates, especially debit cards used without a PIN, which we would prefer to group with credit cards. However, the data needed for our analysis on the individual components of "cash" are not available. The available data suggest that a reasonable estimate of the merchant fee across all types of cards, weighted by card use, is $\mu = 2$ percent.[20]

"Cash"	0.5%
Currency	0.5%
Debit card (PIN)	0.58-1.14%
Check	1.2%
Debit card (No PIN)	1.75%
"Credit cards"	2.0%

Table 4: Cost of handling payment instruments. *Sources:* Currency and Check are from Table 2-2 of Garcia-Swartz, Hahn, and Layne-Farrar (2006), Debit cards from Figure 1 in Hayashi (2009), and Footnote 6 in Shy and Wang (2011).

Card buyers receive a partial rebate of the merchant fee from banks (issuers) in the form of card rewards, ρ, that are proportional to card sales and are given to encourage credit card use.[21] Thus, card buyers receive reward income of $\rho \cdot p$. Available data suggest that a reasonable estimate of the reward rate is $\rho = 1$ percent.[22] However, according to Table 2,

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[19]Garcia-Swartz, Hahn, and Layne-Farrar (2006) report that the marginal cost of processing a $54.24 transaction (average check transaction) is $0.43 (or 0.8 percent) if it is a cash transaction, and $1.22 (or 2.25 percent) if it is paid by a credit/charge card. The study by Bergman, Guibourg, and Segendorf (2007) for Sweden found that the total private costs incurred by the retail sector from handling 235 billion Swedish Crown (SEK) worth of transactions was 3.68 billion SEK in 2002, which would put our measure of cash-handling costs at $\epsilon = 1.6$ percent. For the Norwegian payment system, Gresvik and Haare (2009) estimates that private costs of handling 62.1 billion Norwegian Crown (NOK) worth of cash transactions incurred by the retailers was 0.322 billion NOK in 2007, which would imply $\epsilon = 0.5$ percent.

[20]Merchant fees in the United States were in the range of $40–$50 billion in 2008; see, for example, "Card Fees Pit Retailers Against Banks," *New York Times*, July 15, 2009. This range approximately equals 2 percent of the U.S. credit card sales for that same year in the Call Report data for depository institutions. Actual merchant fees are complex and heterogeneous, varying over card types and merchant category. We estimate merchant fees across cards as follows: general purpose (Visa, MasterCard, and Discover) 2 percent; American Express 2.2 percent; and specific purpose (branded) 1 percent, see Hayashi (2009) for some numbers.

[21]To fund rewards, banks use revenue from merchant fees and possibly other sources, such as annual fees or interest from revolving credit card debt.

[22]One-percent cash back is widely observed. Most airline mileage and other points systems also have an

only 55 percent of low-income credit card holders receive rewards, compared with 75 percent of high-income card holders. For this reason, the representative (average) card user in either income group will not receive the full reward, ρ, but only ρ multiplied by the fraction of credit cards with rewards among all credit cards carried by this income group. Therefore, we set $\rho_L = 0.57$ and $\rho_H = 0.79$ to be the *effective* reward rates received by an average household belonging to income groups L (low) and H (high), respectively.[23]

Credit card buyers have an additional benefit and cost. Convenience users of credit cards benefit from a month worth of float measured by $\bar{r}/12$, where $\bar{r}$ can be viewed as the per-dollar cost of commercial banks to provide this float. We derive an estimate of $\bar{r} = 10.5$ percent in Section 4. On the other hand, credit card revolvers must pay an interest rate r to banks according to their income level, as indicated in Table 3.

The merchant fee and reward rate are closely related to pricing decisions that are internal to banks. Acquirers pay a proportional fee, ι, to issuers. When the card issuer and card acquirer are owned by different financial institutions, ι is called an interchange fee. Because interchange fees involve the fixing of fees by competing card issuers, they have triggered many debates and court cases against card organizations by antitrust authorities and merchant associations.[24] Typically, banks make profits by setting $\rho < \iota < \mu$, which we assume holds. Our analysis of the transfers among consumers requires only the merchant fee and reward rate and not the inclusion of the interchange fee.

Banks also incur costs κ of providing credit card payment services. The best available data suggest a reasonable estimate is $\kappa = 0.2$ percent, which we derive as follows. The resource costs of credit card payments consists of the network fees plus losses due to fraudulent transactions. For credit card transactions, roughly 85–90 percent of the merchant fee is

approximate cash value of about $\rho = 1$ percent.

[23]Parameters ρ_L and ρ_H are set to be equal to the credit-card-spending-weighted average of the adoption numbers in the top half of Table 2, which explains the slight difference from 0.55 and 0.75. In practice, the actual reward rate could be even lower, because holders of reward credit cards do not claim all of their rewards or they let the rewards expire, but we do not have data on the rate at which and how many consumers actually claim their rewards.

[24]Some court cases in the United States and worldwide are discussed in Bradford and Hayashi (2008).

the interchange fee paid to issuers. The remaining 10–15 percent goes to the card networks and acquirers in the form of various other small and fixed fees (switch fee, surcharge fee, network access fee, etc.), which are a rough estimate for the resource cost of operating the credit card network. According to Sullivan (2010) issuers reported $1.24 billion in credit card fraud losses for 2006. The FRPS reports $2.12 trillion in credit card payments for that year, hence credit card fraud losses are estimated to be around 0.06 percent of total credit card transactions.

A central feature of this payment market is that regardless of whether buyers choose cash or credit card, U.S. merchants tend to charge the same price, p, despite incurring different costs from the two payment instruments. Under the no-surcharge rule, merchants cannot charge credit card buyers a higher price than the price they charge cash buyers to recoup the extra cost ($\mu - \epsilon \approx 1.5$ percent in our calculations). However, under certain conditions card companies do allow the merchant to offer a discount to cash buyers.[25] Nevertheless, while some U.S. merchants have offered cash discounts from time to time, they generally do not do so widely or consistently. One reason may be the cost of offering two prices. Another reason may be concerns about adverse customer reactions to differential pricing and especially to penalizing card buyers, who tend to be higher-income households and to buy more goods.

4. Agents and Data

This section provides a more detailed description of the agents in our simplified economy that were introduced in the previous section. It also documents the data used to measure agents' activity, which are key inputs used to compute the transfers in the next section.

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[25]For example, Section 5.2.D.2 of Visa U.S.A. April 2008 operating regulations states that "A Merchant may offer a discount as an inducement for a Cardholder to use a means of payment that the Merchant prefers, provided that the discount is clearly disclosed as a discount from the standard price and, non-discriminatory as between a Cardholder who pays with a Visa Card and a cardholder who pays with a 'comparable card'." See also Footnote 2.

4.1 Households

In our calculations, we distinguish between low- and high-income households indexed by $i = L, H$. Within each income group we distinguish between cash users, convenience card users and card borrowers (revolvers). Within the same income group every household is assumed to be identical except for their payment choice and the amount of outstanding credit card debt that they may carry. We assume that some households *exclusively* use cash for all of their transactions, others only use credit cards (but always pay off their balances at the end of the grace period), yet others only use credit cards but do not pay off their balances in full.[26]

In the real world, most households use both cash and credit cards. It is true that households without credit cards (roughly one in four) are literally cash-only households, but it is unlikely that any households strictly use credit cards only. Our aggregate transfer calculations cannot account for within-household heterogeneity of payments, a refinement we leave for future research with better data. The reason we do this characterization is twofold: (i) we do not have spending data by payment instrument at the household level and (ii) Appendix B shows that this assumption does not affect our results about transfers between income groups. In light of this discussion, our results about transfers across payment instruments should be interpreted as a cash payment subsidizing a credit card payment, not necessarily as a cash payer subsidizing a card payer, since the latter categories do not have real life counterparts.

The data needed to calculate the transfers are sales revenues (credit card and total) and the number of buyers. Sales are measured by consumption from the National Income and Product Accounts (NIPA) and Consumer Expenditure Survey (CEX), which were $S =$ \$9.83 trillion in 2007.[27] About 42 percent of this consumption does not involve a payment instrument choice for consumers, for example, imputed rental of owner-occupied housing,

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[26]Note that in our calculations we only use spending data on goods/services where we believe both cash and credit cards could potentially be used.

[27]For more details about the CEX data source, see Harris and Sabelhaus (2000).

employer-provided health insurance, and fees paid for financial services, and thus we exclude this portion of spending from the calculations.[28] Let $N = N_L + N_H$ be the total number of buyers (low and high income households combined). Buyers are measured by the number of households, as reported by the Census Bureau, which was $N = 116.0$ million in 2007. The proportions of high- and low-income households, credit card spending and debt data, as well as stock holdings are obtained from the Survey of Consumer Finances (SCF).[29] For reasons described earlier, we set $100,000 as the cutoff level of household income (denoted I).

When sorting the households within an income group according to payment instruments, we assign the total spending done with a payment instrument to the respective group of households. For example, we find that all low-income households who report that they have no credit card debt spent $0.23 trillion in 2007 using their credit cards, so we assign this figure to the group of low income convenience users. To have an estimate of the number of households who belong to an income/payment instrument category, we assume that the disposable income of each household within the same income group is the same. This will essentially make the distribution of the number of households proportional to the spending shares within the income groups.

Our data reflect the well-known fact that consumption and income are distributed unevenly across households, as shown in Table 5, which converts the information in Table 1 into a form that is useful for computation of the transfers. Low-income buyers account for 81 percent of all households but only 58 percent of transactions. Low-income buyers also tend to favor cash payments: 70 percent of all households are low-income cash buyers, and 50 percent of all transactions are conducted by low-income cash buyers. In addition, high-income households have a disproportionately higher share of credit card transactions (about $13/42 \approx 31$ percent) than their population share (19 percent). Overall, the data show that high-income households make greater use of credit cards.

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[28]We thank Tim Chen (`Nerdwallet.com`), Leon Majors (Phoenix Marketing International), and Jay Zagorsky (Boston University) for helping us clarify whether credit cards can be used for mortgage payments.

[29]Zinman (2009b) compares the SCF with industry data and finds that the two sources match up well on credit card charges and fairly well on account balance totals.

| | Distribution of Households | | | | | |
| | Total (millions) | | | Shares | | |
	I_L	I_H	Total	I_L	I_H	Average
Total	94	22	116	81	19	100
Cash users	81	15	96	70	13	83
All credit card users	13	7	20	12	6	17
Convenience users	7	5	11	6	4	10
Revolvers	7	2	9	6	2	8
	Distribution of Spending					
	Total ($ trillions)			Shares		
	I_L	I_H	Total	I_L	I_H	Average
Total	3.3	2.4	5.7	58	42	100
Cash users	2.8	1.6	4.5	50	29	79
All credit card users	0.5	0.7	1.2	8	13	21
Convenience users	0.2	0.5	0.7	4	9	13
Revolvers	0.2	0.2	0.5	4	4	8

Table 5: Distribution of households and spending.

4.2 Merchants

Merchants supply one "good," which could be either a product or a service. This assumption is necessary because of a lack of data on payment choice for individual goods; in any case, many payments are made for a basket of different goods. Similar to Wang (2010), we model a "mature" card market in which all merchants accept payment cards and cash. Thus, consumers do not have to search for a merchant who accepts their preferred payment instrument, and merchants do not have to decide which payment instruments to accept to attract consumers. This matching problem is interesting and potentially important for the analysis, but considerably more complex and left for future research.

However, the distribution of household shopping across merchants affects the calculation of the transfers. For example, if high-income households only used credit cards and low-income households only used cash, and there was complete separation of shopping by households across merchants, there would be no transfers from credit card payments. Such polar cases almost surely do not hold in the real world, but there is likely some partial separation of payments by household throughout the market along at least two dimensions.

Some merchants primarily attract high-income households based on their luxury goods with higher prices. Other merchants primarily attract high-income households based on their neighborhoods because households tend to separate geographically by income.[30] Regardless of the reason, differential shopping patterns will lead households to face heterogeneous markups across merchants and thus pay different amounts for their payment choices.

To account for the fact that high-income and low-income households may shop in different proportion at merchants, we assume there are two merchants (for simplicity) with different shares of households as customers. Denote by λ_H, λ_L the fractions of high-income and low-income buyers who shop at merchant 1. Therefore, if $\lambda_H = \lambda_L = 1$ (or $= 0$), all households in an income group shop at the same merchant, whereas if $\lambda_H = \lambda_L = 0.5$, both income groups are equally split between stores. In contrast, if $\lambda_H = 0 \neq 1 = \lambda_L$, households belonging to different income groups shop at entirely different places.

Households belonging to income group $i = L, H$ are assumed to spend an exogenously-given fraction λ_i of their income at merchant 1 and fraction $1 - \lambda_i$ at merchant 2. Unfortunately, we do not have any hard data to calibrate the household shopping distributions, but it seems reasonable to avoid the unlikely polar cases of full separation and equal shopping patterns. We arbitrarily assume that 30 percent ($\lambda_L = 0.3$) of low-income households and 70 percent ($\lambda_H = 0.7$) of high-households go to merchant 1 (and vice versa for merchant 2), so merchant 1 primarily serves high-income households and merchant 2 primarily serves low-income households. However, Section 6.2 (see Figures 3) explores the sensitivity of the transfer estimates to variation in the distribution of shopping patterns.

Let M_1 and M_2 denote the cost per one dollar of sales of handling a payment for merchants 1 and 2 resulting from having to pay a percentage fee μ on credit card transactions

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[30]The business practices of national retailers tends to reduce the effects of geographic separation. The local chain stores of national retailers may have a wide mix of households and credit card spending shares across locations, but the national retailers usually pay merchant fees to credit card companies based on the retailers total U.S. credit card sales, not by chain location. Furthermore, in general, the national retailers do not charge their local chain stores differentially for merchant fees by credit card share, and they tend to avoid differential pricing of (common) goods across stores for all reasons, including variation in local payment costs. Hence chain stores in both low-income and high-income neighborhoods will end up using a nationwide markup. We thank Bob Turley for pointing this out based on his interviews with national retailers.

or bear a proportional cost of ϵ on handling cash. Then, for $i = H, L$,

$$M_1 \stackrel{\text{def}}{=} \left[\frac{\sum_i \lambda_i (S_i^c + S_i^b)}{S} \right] \mu + \left[\frac{\sum_i \lambda_i S_i^h}{S} \right] \epsilon \tag{1}$$

$$M_2 \stackrel{\text{def}}{=} \left[\frac{\sum_i (1 - \lambda_i)(S_i^c + S_i^b)}{S} \right] \mu + \left[\frac{\sum_i (1 - \lambda_i) S_i^h}{S} \right] \epsilon.$$

In other words, the payment cost markup is a sales-weighted average of the merchant fee and cash handling costs associated with each payment instrument.

A key question to ask at this point is the extent to which merchants pass their costs of handling payment instruments (1) on to their customers. As shown in Weyl and Fabinger (2009), an increase in cost may in general result in more or less than 100 percent increase in price. However, Appendix C shows that the cost of accepting payment instruments differ substantially from the unit production cost because the former is proportional to the price and not to the unit cost of production. In fact, merchant's cost of accepting payment instruments acts very much like an ad-valorem tax. Thus, the merchant markup is independent of the market structure. Therefore, in what follows, we will refer to the merchant per-dollar cost of accepting payment instruments (1) as markups and assume 100 percent pass-through as the benchmark. However, Section 6.3 explores the sensitivity of the transfer estimates to variation in the pass-through, from incomplete (less than 100 percent) to over-surcharging (more than 100 percent).

4.3 Banks

Our analysis focuses on banks' credit card activities only and ignores all other services. Banks have two sources of profit from credit card services. First, they earn profits from merchant fees, net of the resource costs incurred and rewards paid to card holders, which is given by $\sum_{i=H,L} (\mu - \kappa - \rho_i)(S_i^b + S_i^c)$. Banks bear the cost of funding the rewards programs (ρ) and the resource costs of payment service (κ). By the resource cost of providing the credit card service we mean the costs associated with maintaining the card network infrastructure and

19

the losses associated with fraudulent transactions.[31]

The second source of bank profits is credit card lending. Let $\bar{r}$ denote banks' alternative cost of funding credit card debt. Banks have to fund both the credit card debt and the period of float extended to convenience users (only), which we assume to be one month. Banks collect interest payments from revolvers (only), which is $\sum_{i=H,L} r_i^b S_i^b$. The goal of this paper is to identify the sources of income that banks can use to fund the various benefits associated with credit cards, such as rewards. To do that, it is not enough to simply measure the total interest income, because what matters is the extra profit that can be used to fund benefits (that other bank services do not offer), such as making interest-free loans to convenience users. This profit will be measured as $r_i^b - \bar{r}$ per dollar loaned to revolving households. Therefore, we define aggregate bank profit from credit card services by

$$\Pi \stackrel{\text{def}}{=} \sum_{i=H,L} \left\{ \underbrace{(\mu - \kappa - \rho_i)(S_i^b + S_i^c)}_{\text{(Net of rewards) merchant fee profit}} + \underbrace{(r_i^b - \bar{r})S_i^b}_{\text{Interest profit}} - \underbrace{\frac{\bar{r}}{12}S_i^c}_{\text{Float cost}} \right\}. \tag{2}$$

Note that Π is divided (via stock ownership) among the three types of households, so that $\Pi = \sum_{i=H,L} \left(\pi_i^b + \pi_i^c + \pi_i^h \right)$. We do not have data on bank stock holdings by household income, so we assume that it is the same as the holdings of all stocks by households. In the 2007, the SCF shows that high-income households held 73 percent of all stocks.

The alternative cost of credit card lending ,$\bar{r}$, is set to a level so that bank profits (Π) equal 18.25 percent[32] of total bank income ($\mu \sum_i (S_i^b + S_i^c) + \sum_i r_i S_i^b$). This results in a 10.5 percent ($\bar{r} = 0.105$) alternative cost, which is fairly close to the 12.83 percent unsecured line of credit rates reported in the 2007 SCF.

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[31]The cost of handling cash does not enter the banks profit function since we assume that cash handling is done by the merchant. This assumption is innocuous since the resource cost of handling cash is paid by customers; that is, we could make an alternative assumption in which banks incur the cost of cash and collect ϵS^h from the merchants.

[32]This was the profit over total income figure in the Call Reports in 2007.

5. Transfer Accounting

This section introduces a simple, model-free approach to computing the implicit monetary transfers among consumers that result when some buyers pay with credit cards and others pay with "cash." At this point we do not set up a rigorous economic model because one is not needed for the computation of the transfers. However, we provide a simple model of consumer payment choice in Appendix A for the reader who is interested in mapping the transfer accounting into first principles. Our goal here is to fix terminology and highlight key elements of the flow of transfers.

The primary transfer is from cash buyers to credit card buyers occurring due to the payment decision. Because credit card users can carry over the payment balances from month to month, which causes these revolvers to pay interest to banks, there is a potential transfer occurring from revolvers to convenience users of credit cards. Finally, because credit card use is positively correlated with income, credit card payments also induce a transfer from low-income buyers to high-income buyers. Our methodology decomposes national income account data on consumption into consumer groups defined by payment choice and income level, using micro data on consumption, credit card spending, and related variables (along with the benchmark estimates of payment costs). Our methodology is analogous to the one used by Humphrey, Kaloudis, and Øwre (2004) to estimate cash use in Norway.

5.1 Transfer definitions

Our approach to defining transfers among households is to compare the benefits enjoyed by the users of a payment instrument with the actual amount buyers pay for the choice of a particular payment instrument. Since the flow of money from households through merchants to banks, and back to the households forms a closed loop, the economy-wide costs and benefits should be the same. This, however, does not mean that for every subgroup of the population the costs and the benefits are equalized, which is why we can measure transfers among household groups. For example, uniform pricing (no discount or surcharge for payment

choice) leads to a retail price markup by merchants in which consumers do not face the value of the payment service that they use.

Let $X^h = X_H^h + X_L^h$, $X^c = X_H^c + X_L^c$, and $X^d = X_H^d + X_L^d$ denote the transfer received (subsidy, if positive), or transfer paid (if negative), by cash users, credit card users who do not borrow (convenience), and credit card users who borrow (revolvers) on their credit cards, respectively. Then, for each income group $i = H, L$, the transfer received by ca**sh** users (superscript h) is

$$X_i^h \stackrel{\text{def}}{=} \underbrace{\pi_i^h}_{\text{Banks' dividends}} + \underbrace{\epsilon S_i^h}_{\text{Resource cost of cash payments}} - \underbrace{\left[\lambda_i S_i^h M_1 + (1 - \lambda_i) S_i^h M_2\right]}_{\text{Actually pay}}, \qquad (3)$$

where the price markups, M_1 and M_2, are defined in (1). Therefore, $x^h \stackrel{\text{def}}{=} X^h/(N_L^h + N_H^h)$ measures the transfer per cash-using household, our preferred metric. Cash payments have a resource cost to the economy given by ϵ per dollar. Cash users (and all other buyers) pay the prevailing markup in stores 1 and 2 ($^1 S_i^h M_1$ and $^2 S_i^h M_2$) whereas cash users receive only the service of cash payments for this price, valued at ϵ per dollar spent. Additionally, banks redistribute their profits to shareholders, so that cash payers also receive a fraction of the banks' profits π_i^h.

Similar to (3), the transfer received (paid, if negative) by credit card **c**onvenience users (superscript c) with income level $i = H, L$ is

$$X_i^c \stackrel{\text{def}}{=} \underbrace{\pi_i^c}_{\text{Banks' dividends}} + \underbrace{\kappa S_i^c}_{\text{Resource cost of card payments}} + \underbrace{\rho_i S_i^c}_{\text{Card rewards}} + \underbrace{\frac{\bar{r}}{12} S_i^c}_{\text{Float value}}$$
$$- \underbrace{\left[\lambda_i S_i^c M_1 + (1 - \lambda_i) S_i^c M_2\right]}_{\text{Merchants' costs of cards and cash}}. \qquad (4)$$

Let $x^c \stackrel{\text{def}}{=} X^c/(N_L^c + N_H^c)$ measure the transfer per convenience card paying household. Convenience users, in addition to their share of the profits (π_i^c), also receive credit card services (valued at κS_i^c), rewards ($\rho_i S_i^c$) and one month of interest-free loan ($\frac{\bar{r}}{12} S_i^c$). During their purchases they also have to pay the stores' respective markups $^1 S_i^c M_1 +^2 S_i^c M_2$.

The transfer received (paid, if negative) by credit card users who **b**orrow (superscript b)

22

is

$$X_i^b \stackrel{\text{def}}{=} \underbrace{\pi_i^b}_{\text{Banks' dividends}} + \underbrace{\kappa S_i^b}_{\text{Resource cost of card payments}} + \underbrace{\rho S_i^b}_{\text{Card rewards}}$$
$$- \left\{ \underbrace{\left[\lambda_i S_i^b M_1 + (1 - \lambda_i) S_i^b M_2\right]}_{\text{Merchant's card and cash costs}} + \underbrace{(r_i^b - \bar{r}) S_i^b}_{\text{Banks' interest profit}} \right\}. \tag{5}$$

Let $x^b \stackrel{\text{def}}{=} X^b/(N_L^b + N_H^b)$ measure the transfer per card revolving household. The transfer definition for credit card revolvers looks similar to that of convenience users, with the exception that they make interest payment to the banks $(r_i^b - \bar{r})S_i^b$, and do not receive interest-free loans (interest payments are generally applied from the date of purchase).

The total transfers received by each income group i is the sum of the transfers received by the three payment instrument groups within that income category,

$$X_i = X_i^h + X_i^c + X_i^b \qquad i = L, H \tag{6}$$

5.2   Transfer estimates

Table 6 displays the transfer estimates in billions of 2007 dollars and on a per household basis for the selected values of λs. These two types of estimates are qualitatively equivalent

	Total ($ Billions)			Per household ($)		
	I_L	I_H	Total	I_L	I_H	Average
Total	-7.8	7.8	0	-83	361	0
Cash users	-5.6	0.8	-4.8	-69	52	-50
All credit card users	-2.2	7.0	4.8	-162	1058	240
Convenience users	2.2	7.2	9.4	331	1567	833
Revolvers	-4.4	-0.1	-4.5	-647	-63	-511
Cash users & Revolvers	-10	0.6	-9.4	-114	38	-89

Table 6: Transfers in the payment market by household income and payment instrument. *Note*: Positive (negative) numbers indicate that households using a payment instrument has received a subsidy (paid a transfer).

but not quantitatively, as can be seen in the first row reporting total transfers. In dollar

terms, the transfers sum to zero because the transfer paid by low-income households (-7.8 billion) is the same in absolute value as the subsidy received by high-income households. However, in per-household terms, the transfers do not sum to zero because there are four times as many low-income households as high-income households. Thus, the "pain" of the transfer is smaller for each low-income household because it is spread over more households, while the "gain" of the subsidy is larger for each high-income household because it is reaped by fewer households. In the discussion below, we focus mainly on the per-household figures because they are more tangible and relevant to individual households, but it is important to keep this distinction in mind.

To our knowledge, Table 6 contains the first quantitative estimates for the aggregate economy of transfers between buyers stemming from the choice of payment instrument. Two main results can be drawn regarding the cross-subsidies between cash and credit card users:

Result 1. *Cash users subsidize credit card users.*

(a) The average cash-paying household pays a transfer of $50 ($x^h = -50$) annually.

(b) The average card-paying household receives a subsidy of $240 ($x^d = 240$) annually.

Result 2. *The subsidy received by credit card users is not shared equally; like cash users, credit card revolvers also subsidize credit card holders—those who use their cards for convenience and not borrowing.*

(a) The average card-paying household that revolves debt pays a transfer of $511 ($x^b = -511$) annually.

(b) The average card-paying household that does not revolve debt (convenience user) receives a subsidy of $833 ($x^c = 833$) annually.

(c) Together, the average cash-paying household and the average card-paying household that revolves debt pay a total transfer of $89 ($x^h + x^b = -89$) annually to subsidize convenience users of credit cards.

Next, the following main result can be drawn regarding the effect of the cross-subsidies on households of different income groups:

Result 3. *Low-income households subsidize high-income households.*

(a) The average low-income household pays a transfer of $83 ($x_L = -83$) annually.

(b) The average high-income household receives a subsidy of $361 ($x_H = 361$) annually.

Finally, the following main result raises important behavioral questions about the payment choices of households of different incomes.

Result 4. *Household income is not a sufficient statistic for predicting either household payment choice or transfer paid (subsidy received).*

(a) Some card-paying households with low income manage to avoid revolving debt and receive a subsidy of $331 ($x_L^c = 331$) annually while others with low income revolve debt and pay a transfer of $647 ($x_L^b = -647$).

(b) Some card-paying households with high income still end up revolving debt and paying a transfer of $63 ($x_H^b = -63$) while others with high income receives the largest subsidy of $1,567 ($x_H^c = 1,567$).

The joint heterogeneity of household income and payment choice is intriguing and difficult to explain with existing models. Much more research is needed to understand these outcomes in payment markets.

6. Sensitivity Analysis

This section reports the results of relaxing the assumptions about some key parameters underlying the transfer accounting. We explore variation in household income categories, household shopping patterns, the pass-through of the merchant fee to retail prices, and the role of credit card annual fees.

6.1 Household income categories

Transfer estimates based on two broad income categories significantly understate the magnitude of the transfer between the very lowest-income and very highest-income households,

and they also conceal the strong nonlinearity in the relationship between the transfers and income. Table 7 shows the transfer estimates broken down more finely into seven household income categories to draw out the cross-income results more clearly.

Income range	Transfers received	
	Total ($ Billions)	Per household ($)
Under $20,000	-1.5	-63
$20,000–49,999	-3.4	-89
$50,000–79,999	-2.2	-96
$80,000–99,999	-0.5	-56
$100,000–119,999	-0.6	-89
$120,000–149,999	0.1	10
Over $150,000	8.2	823
Low-income ($< 100,000$)	-7.7	-81
High-income ($\geq 100,000$)	7.7	355

Table 7: Transfers in the payment market by disaggregated income categories.

The average lowest-income household earns less than $20,000 and pays a transfer of $63 each year, while in sharp contrast the average highest-income household earns more than $150,000 and receives a subsidy of $823 each year. In between, the transfer is relatively flat across income groups until household income rises above $100,000 annually then sharply increasing in the highest category (over $150,000). Thus, a very large number of lower-income households each pays a relatively small dollar amount of transfer, while a very small number of higher-income groups receives a relatively large dollar amount of subsidy.[33]

6.2 Household shopping patterns

Figure 3 computes the transfer from low- to high-income households for all possible distributions of income groups between the two merchants. The yellow (bright) areas in Figure 3

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[33]Table 7 implies that the transfers computed with only two income groups may be sensitive to the cutoff income level. We chose a cutoff of $100,000 for the reasons explained in Section 2. The estimates also show that the transfer paid increases nonlinearly with income, so a higher cutoff level is more representative of the transfer paid by the highest income groups. If the cutoff household income is $50,000, which is closer to the poverty level, then low-income households pay a transfer of $XX and high-income households receives a subsidy of $XXX. These estimates suggest a qualitatively similar conclusion.
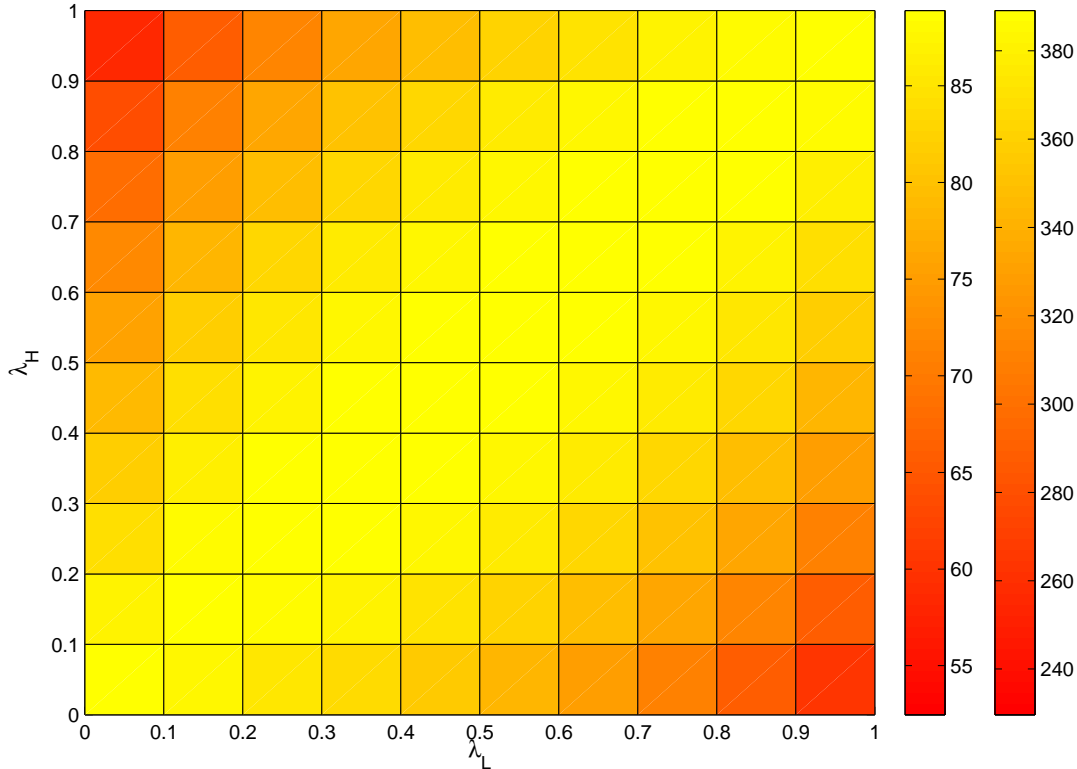
Figure 3: Transfers from Low- to high-income households (left column) and from high- to low-income households (right column) when they shop at different places.

show that the transfer reaches the highest level of $85 per year when they are equally distributed between the two merchants ($\lambda_L = \lambda_H$). The red (dark) areas reflect calibrations when the income groups shop at different places, which shows that the transfer from low- to high-income households is reduced to $55 per year but not eliminated even in the extreme case of complete segregation among the income groups.

At the first glance, this result may look rather surprising, how can cross subsidy between income groups can persist even when low income households shop at totally different locations than high-income households. However, this transfer can be explained by the other terms in the transfer definitions, most notably by the difference in interest payments, float and redistributed profits. (See Section 5.2 for more details.)

The right column in Figure 3 shows the transfers received by high-income households. The transfer received is at the lowest level ($240 per year) when merchants serve different

income groups, and reaches the highest level ($380 per year) in the symmetric distributions given in the yellow areas.

6.3   Merchant fee pass-through

Our simple approach to analyzing the effects of different degrees of pass-through of payment costs into retail prices amounts to assume that merchants set their prices based on a constant markup of M_k, see Appendix C for a standard derivation leading to this result. To compute the transfers while calibrating the pass-through to any value other than 100 percent, we have to make an additional assumption about what happens to the resulting loss (profit) of the merchant. As in Section 5 in the case of bank profits, we redistribute the resulting (change in the) merchants' profit to households based on their observed shares of stock holdings.

Figure 4 shows the sensitivity of our transfer estimates to the pass-through that merchants apply to the costs of handling payment instruments into their price. This figure shows that if merchants do not recoup any payment costs at all (0 percent pass-through) then high-income households will end up subsidizing low-income households. This happens because low-income households contribute a bigger share of the total sales value (58 percent in Table 5), while they receive a smaller part (27 percent) of merchants' profit, which is reduced by the lack of pass-through. As merchants pass-through increases, the direction of the subsidy changes. At around 50 percent pass-through the transfers disappear ($x_L = x_H = 0$). As the pass-through increases beyond 50 percent, the transfers from low- to high-income households also increase. This happens partly due to the redistributive effects of the NSR and partly due to the increase in merchants' profits.

6.4   Credit card annual fees

Credit card annual fees are another potential source of revenue to fund card rewards that could affect the transfer estimates. If credit card holders pay for their rewards with high annual fees, then our transfer calculations would overstate the transfers. However, this
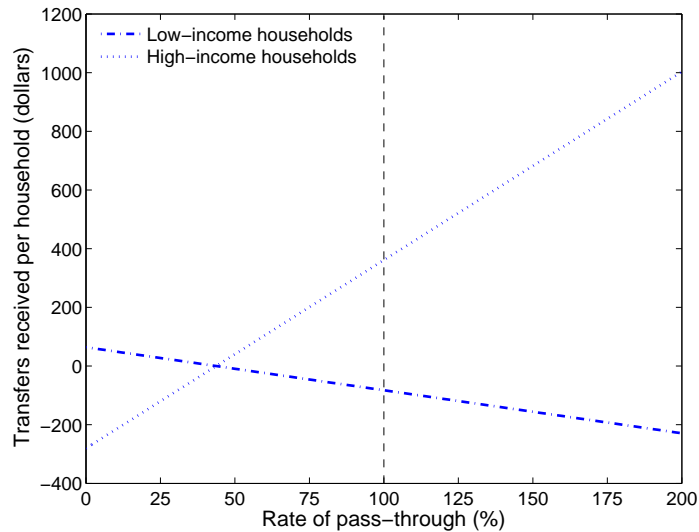
Figure 4: Transfers as a function of the pass-through

possibility is unlikely to be a major factor. According to the 2003 Synergistics Credit Card Market survey, low-income households paid an average annual fee of $5.7, while high-income households paid $7.7. These data imply trivial changes in the transfer estimates.

6.5   Other scenarios

TO BE COMPLETED.

7.   Further discussion

7.1   Policy implications

Our analysis suggests that reducing transfers between consumers, especially between low-income and high-income consumers, may positively affect consumer welfare, but further research is needed to determine the full effects on social welfare. While it is natural to consider public policy initiatives in this endeavor, private sector agents (households, merchants, and banks) could take preemptive actions that would reduce the transfers. However, if private agents are not willing or able to take actions to reduce the transfers, public policy

makers may wish to explore policies that would do so. Our research suggests some general principles and issues with potential implications for public policy:

- *Cost-based pricing*—One condition supporting the transfers is uniform pricing across payment instruments. Allowing and encouraging merchants to charge differential prices according to the costs imposed by payment instruments could help reduce the transfers by reducing payment cross subsidies. Eliminating the NSR may be necessary, but it may not be sufficient to induce differential pricing (for example, see Bolt and van Renselaar (2009)).

- *Full information*—Another condition supporting the transfers is the lack of full information about about merchant fees and other aspects of payment costs that have an impact on retail prices and consumer welfare. Giving all participants in the payments market full information about fees, costs, and price markups, could help to reduce transfers by giving consumers the incentive to make optimal payment choices and by spurring more competition among merchants and banks. For example, the 2010 proposed settlement of the U.S. Department of Justice complaint against Visa and MasterCard gives merchants the right to disclose merchant fees and to steer their customers toward low-cost payment methods through enhanced discounting options.

- *Rewards*—Yet another condition supporting the transfers and encouraging credit card use is the existence of lucrative rewards programs. Reducing rewards, or redistributing the value of the rewards from high-income households to low-income households, would likely reduce credit card use and the regressive transfers.

- *Competition*—If competition in the credit card market is inadequate, efforts to promote alternative payment instruments could help to reduce the transfers. Expanding access to low-cost existing networks, such as the Automatic Clearing House (ACH), is one possibility.

- *Data Collection*—Researchers and policy makers will need more data to estimate/calibrate models and compute welfare to analyze potential policies. For example, our research emphasizes the need for better and more comprehensive data on the cost of payment instruments borne by merchants, buyers, banks, and card networks.

More research is needed before pursuing any of these policy implications. Reducing the merchant fee is likely to reduce the transfers, but it is very difficult to determine the optimal merchant (or interchange) fee. Thus, direct regulation of the merchant (or interchange) fee could actually reduce consumer welfare if the wrong level of the fee were selected. Furthermore, our analysis suggests that regulators should consider the merchant fee and reward rate simultaneously, rather than just the interchange fee.

These policy-related principles are closely related to recent policies enacted to regulate payment card interchange fees worldwide. Policy makers in Australia and Spain, as well as the European Commission, have already taken actions to limit the interchange fees associated with credit cards. Actions taken by various countries are discussed in Bradford and Hayashi (2008). The recent U.S. financial reform bill (officially, the "Dodd-Frank Wall Street Reform and Consumer Protection Act" of 2010), signed into law on July 21, 2010, includes the Durbin Amendment, giving the Federal Reserve responsibility for regulating interchange fees associated with debit cards. In each of these cases, regulation of interchange fees was motivated in part by concerns over an alleged lack of competition in payment card markets. Our analysis provides a different but complementary motivation for policy intervention — income inequality.

7.2 Extensions

Our analysis excludes some issues that may be important factors in a more comprehensive assessment of the transfers associated with credit card spending, which we discuss briefly but leave for future research.

Business credit cards: We have excluded data on credit card spending by business and government, which is about equal in value to consumer credit card spending. If businesses use credit cards at the same establishments as consumers, they would impose further costs on the merchants and raise retail prices even more. If businesses (and their profits) are more likely to be owned by high-income households, then incorporating business use of credit cards into the analysis would increase the transfers from low-income to high-income households.

Congestion (externality) effects: Murphy and Ott (1977) suggests that cash buyers impose more costs on merchants' sales staffs than on card users. If cash transactions take significantly longer to handle than credit card transactions, cash users may impose an externality on card users by slowing them down at the point of payment. This externality would offset, at least partly, the transfer from cash users to card users. However, the available data on the time it takes to handle a transaction by payment method do not provide strong support for this view.[34] It is possible that cash congestion effects may be relevant for highway toll booths, as discussed in Amromin, Jankowski, and Porter (2007). But electronic toll transponders that serve as a faster alternative to cash are not credit cards, and the proportion of toll payments in total consumption is relatively small.

8. Conclusion

We proposed an accounting methodology to calculate two types of implicit monetary transfers occurring in a simplified representation of the U.S. payments market: 1) the transfer between cash buyers and credit card buyers; and 2) the transfer between low-income and high-income households. Both of these transfers are estimated to be economically significant and robust to potential changes in the assumptions underlying the accounting methodology.

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[34]According to a 2000 study by the Food Marketing Institute, titled "It All Adds Up: An Activity Based Cost Study of Retail Payments," a credit card transaction takes longer to handle than a cash transaction: 49 seconds compared to 29 seconds. However, a 2006 study by MasterCard International titled "MasterCard PayPass: The Simpler Way to Pay," finds that the average cash transaction is slower than the average credit card transaction if no signature is required: 34 seconds compared to 27 seconds.

Extending our model and analysis with better data and more realistic features of the credit card market surely would provide more refined quantitative estimates of the these transfers. However, we are confident that the qualitative existence of these two transfers is robust to changes in the model and data.

Appendix A.   A model of consumer payment choice

To be able to understand households' choice of means of payment, this appendix constructs a calibration-ready analytical model of how consumers select their payment instruments.

There are N_L low-income buyers and N_H high-income buyers. Income levels are denoted by I_L and I_H, respectively. Each income group, $i = H, L$ is composed of a continuum of buyers indexed on the unit square by $(b_i^c, b_i^b) \in [\beta_i^c - 1, \beta_i^c] \times [\beta_i^b - 1, \beta_i^b]$. The index b_i^c measures benefits from *convenience* use of credit cards. The index b_i^b measures benefits from *borrowing* on credit cards. Note that in general $\beta_i^b(r)$ should be a function of interest rate r. Figure 5 displays the density of buyers belonging to income group i. In view of Figure 5, households
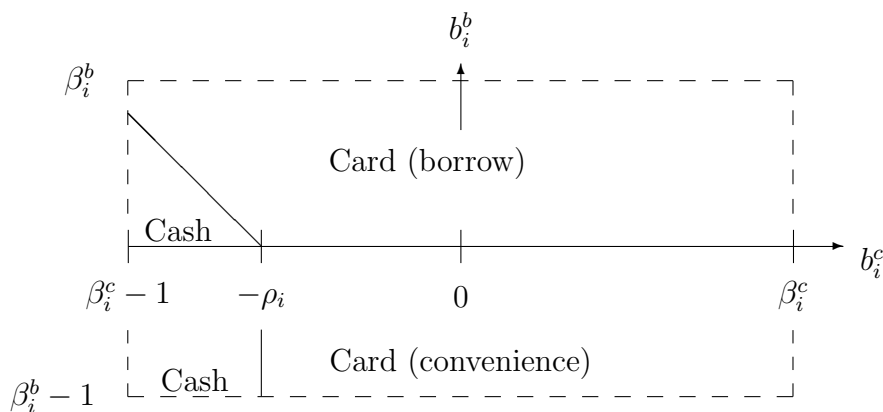

Figure 5: Distribution of buyers on the unit square according to increased benefits from paying with cash, cards (convenience), and card (borrowing). *Note*: Figure is not drawn to scale as the proportion of cash users turns out to be much higher.

indexed by a high b_i^c like the convenience of paying with credit cards. In addition, high values of b_i^b indicate that the household benefits from borrowing at the given card interest rate r.

But these "benefits" may take negative values revealing preference for cash (low values of b_i^c) and/or desire to avoid borrowing (low values of b_i^b).

All households pay a single good priced p regardless of the means of payment (NSR). Let ρ_L and ρ_H denote *effective* reward rates (such as cash-back) on credit card transactions to households belonging to low- and high-income households. Therefore, the effective price paid by buyers belonging to income group $i = H, L$ is

$$p^{\text{buyer}} = \begin{cases} p(1 - \rho_i) & \text{paying with a card} \\ p & \text{paying cash.} \end{cases} \tag{7}$$

Thus, assuming that buyers spend their entire budget, low-income buyers perform I_L/p^{buyer} transactions, whereas high-income buyers perform I_H/p^{buyer} transactions. Let $0 < \alpha \le 1$. We define the utility function of an income group i buyer who is indexed by (b_i^c, b_i^b) by

$$U_{(b_i^c, b_i^b)} = \begin{cases} \left(\dfrac{I_i}{p}\right)^{\alpha} & \text{paying cash,} \\[2ex] \left[(1 + b_i^c)\dfrac{I_i}{p(1 - \rho_i)}\right]^{\alpha} & \text{paying with a card (convenience)} \\[2ex] \left[(1 + b_i^c + b_i^b)\dfrac{I_i}{p(1 - \rho_i)}\right]^{\alpha} & \text{paying with a card (borrow).} \end{cases} \tag{8}$$

Equation (8) implies that a buyer's utility is increasing with the number of transactions (income divided by price). In addition, utility increases by b_i^c (decreases, if negative) as a result of the convenience of paying with a credit card. It also increases by b_i^b (decreases, if negative) if the buyer borrows on a credit card.

The utility function (8) implies all households indexed by $b_i^b \ge 0$ prefer borrowing and convenience over just the convenience use of credit cards. Next, borrowing and convenience use of cards is preferred over cash if $b_i^b \ge -b_i^c - \rho_i$. Convenience use of cards is preferred over cash for households indexed by $b_i^c > -\rho_i$. Clearly, the number of convenience users increases with the card reward rate ρ_i. These inequalities define the boundaries among the three payment choices and are displayed in Figure 5.

The remainder of this section computes the number of card and cash payers as well as the number of transactions made with each payment instrument. Recall that superscripts

"h" (for cas**h**) denote cash payers, whereas superscripts "c" (for **c**onvenience), and "b" (for **b**orrowers) denote card payers. In view of Figure 5, the numbers of households paying cash (total and per income group $i = H, L$) are

$$n^h = n_L^h + n_H^h, \quad \text{where} \quad n_i^h = N_i \left\{ \frac{[-\rho_i - (\beta_i^c - 1)]^2}{2} + [-\rho_i - (\beta_i^c - 1)](1 - \beta_i^b) \right\}. \quad (9)$$

Similarly, for card convenience users,

$$n^c = n_L^c + n_H^c, \quad \text{where} \quad n_i^c = N_i(1 - \beta_i^b)(\beta_i^c + \rho_i). \quad (10)$$

Finally, for the numbers of revolving households (total and per income group) are

$$n^b = n_L^b + n_H^b, \quad \text{where} \quad n_i^b = N_i \left\{ \beta_i^b - \frac{[-\rho_i - (\beta_i^c - 1)]^2}{2} \right\}. \quad (11)$$

The total number of cash and card transactions made by each income group $i = L, H$, denoted by , t_i^h, and $t_i^c + t_i^b$ in the model, multiplied by the price p, equals spending. Thus,

$$S_i^h = pt_i^h = n_i^h I_i \quad \text{and} \quad S_i^c + S_i^b = p(t_i^c + t_i^b) = (n_i^c + n_i^b)\frac{I_i}{1 - \rho_i}. \quad (12)$$

Appendix B. Proving that Our Household Definition Does not Affect Transfers Across Income Groups

Suppose that we did have data on spending by payment instrument at the household level. For example, imagine low-income household A that spends S_A^h using cash and S_A^c on a credit card that she then pays off. In that case her transfers would be the sum of

$$
\begin{aligned}
x_A^h &= \pi_A^h - \left\{ \left[\lambda_L S_A^h M_1 + (1 - \lambda_L) S_A^h M_2 \right] - \epsilon S_A^h \right\} \\
x_A^c &= \pi_A^c + \kappa S_A^c + \rho_L S_A^c + \frac{\bar{r}}{12} S_A^c - \left[\lambda_L S_A^c M_1 + (1 - \lambda_L) S_A^c M_2 \right].
\end{aligned}
$$

Summing up, the total transfer received (paid, if negative) by household A is

$$x_A = x_A^h + x_A^c = \pi_A + \kappa S_A^c + \rho_L S_A^c + \frac{\bar{r}}{12} S_A^c + \epsilon S_A^h - \left[\lambda_L (S_A^h + S_A^c) M_1 + (1 - \lambda_L)(S_A^h + S_A^c) M_2 \right].$$

Similarly the transfers received of a household B who pays with cash and borrows on a credit card is

$$x_B = \pi_B + \kappa S_B^b + \rho_L S_B^c + \frac{\bar{r}}{12} S_B^c + \epsilon S_B^h - \left[\lambda_L (S_B^h + S_B^c) M_1 + (1 - \lambda_L)(S_B^h + S_B^c) M_2 \right] - (r_L^b - \bar{r}) S_B^b.$$

To compute the transfers between the low- and high-income groups, we would need to sum these transfers up within income groups. Let $\sum_L$ denote a sum of all low-income households. Then the total transfer received (paid, if negative) by the low-income group is

$$\begin{aligned}
X_L &= \sum_L \pi_i + (\kappa + \rho_L) \sum_{i \in L} (S_i^c + S_i^b) + \frac{\bar{r}}{12} \sum_L (S_i^c + S_i^b) + \epsilon \sum_{i \in L} S_i^h \\
&\quad - \left[\lambda_L M_1 \sum_L (S_i^h + S_i^c + S_i^b) + (1 - \lambda_L) M_2 \sum_L (S_i^h + S_i^c + S_i^b) \right] - (r_L^b - \bar{r}) S_i^b,
\end{aligned}$$

which is exactly how we defined transfers in equation (6). The sum of high-income households can be configured in the same way. This proves that our computations of transfers between the low- and the high-income groups is invariant with our characterization of households as only cash, card convenience, or only card revolving only.

Appendix C.   Pass-through and Market Power: An independence result

Since the NSR does not allow merchants to price discriminate between cash and card users, merchant k's profit-maximization problem is typically formulated as

$$\Pi^k = \underbrace{p_k q_k(p_k)}_{\text{sales revenue}} - \underbrace{c q_k(p_k)}_{\text{cost of goods sold}} - \underbrace{M_k p_k q_k(p_k)}_{\text{cost of payment services}},$$

which shows that the the proportional costs of payment services (1) essentially act as a sales tax. The solution to this problem is

$$p_k = \left(\frac{1}{1 - M_k} \right) \left(\frac{1}{1 + \eta_k} \right) c \qquad \eta_k = \frac{\partial q}{\partial p} \frac{p}{q} < 0.$$

This result shows that merchants will shift exactly 100 percent of the payment costs on to their customers (100 percent pass-through), regardless of how much market power they

have. While the final price does depend on the market power η, it only does so in the "usual" sense that merchants mark up their prices over marginal costs, c. Conditional on the monopolistically competitive price ($c/(1+\eta)$), merchants do not markup up their price by more (or less) than what is required to cover the expected cost of a payment. In other words, some market power is a necessary (but not sufficient) condition for generating a pass-through that is different from 100 percent. In order to model pass-through one would have to build a more detailed model of the retail industry, which is beyond the scope of our paper. Given the evidence in other countries we think that this an important avenue for future research.

References

Amromin, G., C. Jankowski, and R. Porter. 2007. "Transforming payment choices by doubling fees on the Illinois Tollway." *Economic Perspectives* 31 (2).

Armstrong, M. 2006. "Competition in two-sided markets." *RAND Journal of Economics* 37 (3):668–691.

Bergman, M., G. Guibourg, and B. Segendorf. 2007. "The costs of paying—Private and social costs of cash and card payments." Bank of Sweden Working Paper No. 212 .

Berkovich, E. 2009. "Trickle-Up Wealth Transfer: Cross-subsidization in the payment card market." The Hispanic Institute Working Paper .

Bertaut, C. and M. Haliassos. 2006. "Credit cards: Facts and theories." In *The economics of consumer credit*, edited by G. Bertola, R. Disney, and C. Grant. Cambridge, MA: MIT Press.

Bolt, N. Jonker, W. and C. van Renselaar. 2009. "Incentives at the counter: An empirical analysis of surcharging card payments and payment behavior in the Netherlands." *Journal of Banking and Finance* 34 (8):1738–1744.

Bolt, W. and S. Chakravorti. 2008. "Economics of payment cards: A status report." *Economic Perspectives* 32 (4):15–27.

Bradford, T. and F. Hayashi. 2008. "Developments in interchange fees in the U.S. and Abroad." *Federal Reserve Bank of Kansas City Payment System Research Briefing* :37–63.

Brito, D. and P. Hartley. 1995. "Consumer rationality and credit cards." *Journal of Political Economy* 103 (2):400–433.

Carlton, D. and A. Frankel. 1995. "The antitrust economics of payment card networks." *Antitrust Law Journal* 63 (2):643–668.

———. 2005. "Transaction costs, externalities, and two-sided payment markets." *Columbia Business Law Review* :617–642.

Carroll, C.D. 1997. "Buffer-stock saving and the life cycle/permanent income hypothesis." *Quarterly Journal of Economics* 112 (1):1–55.

Chakravorti, S. and W. Emmons. 2003. "Who pays for credit cards?" *Journal of Consumer affairs* 37 (2):208–231.

Chakravorti, S. and A. Shah. 2003. "Underlying incentives in credit card networks." *Antitrust Bulletin* 48 (1):53–76.

Chatterjee, S., D. Corbae, M. Nakajima, and J.V. Rios-Rull. 2007. "A quantitative theory of unsecured consumer credit with risk of default." *Econometrica* 75 (6):1525–1589.

Cohen-Cole, E. Forthcoming. "Credit card redlining." *Review of Economics & Statistics* .

Evans, D. and R. Schmalensee. 2005. "The economics of interchange fees and their regulation: An overview." In *Interchange Fees in Credit and Debit Card Industries: What Role for Public Authorities?* Kansas City: Federal Reserve Bank of Kansas City.

Frankel, A. 1998. "Monopoly and competition in the supply and exchange of money." *Antitrust Law Journal* 66:313–361.

Frankel, A. and A. Shampine. 2006. "The economic effects of interchange fees." *Antitrust Law Journal* 73:627–673.

Gans, J. and S. King. 2003. "The neutrality of interchange fees in payment systems." *Topics in Economic Analysis and Policy* 3 (1):1069–1069.

Garcia-Swartz, D., R. Hahn, and A. Layne-Farrar. 2006. "The move toward a cashless society: Calculating the costs and benefits." *Review of Network Economics* 5 (2):199–228.

Gresvik, O. and H. Haare. 2009. "Costs in the Norwegian payment system." Norges Bank Staff memo .

Gross, D. and N. Souleles. 2002. "Do liquidity constraints and interest rates matter for consumer behavior? Evidence from credit card data." *Quarterly Journal of Economics* 117 (1):149–185.

Harris, E. and J. Sabelhaus. 2000. "Consumer expenditure survey family level extracts." `www.nber.org/data/ces_cbo.html`, National Bureau of Economic Research.

Hayashi, F. 2008. "The economics of interchange fees and payment card fee structure: What is the optimal balance between merchant fee and payment card rewards?" Economic Research, Federal Reserve Bank of Kansas City Working Paper :08–06.

———. 2009. "Do U.S. consumers really benefit from payment card rewards?" *Federal Reserve Bank of Kansas City Economic Review* :37–63.

Humphrey, D., A. Kaloudis, and G. Øwre. 2004. "The future of cash: Falling legal use and implications for government policy." *Journal of International Financial Markets, Institutions and Money* 14 (3):221–233.

Humphrey, D., L. Pulley, J. Vesala, and R. Avery. 1996. "Cash, paper, and electronic payments: a cross-country analysis." *Journal of Money, Credit & Banking* 28 (4):914–939.

Humphrey, D., M. Willesson, G. Bergendahl, and T. Lindblom. 2006. "Benefits from a changing payment technology in European banking." *Journal of Banking & Finance* 30 (6):1631–1652.

Katz, M. 2001. "Reform of credit card schemes in Australia II: Commissioned report." *Reserve Bank of Australia Public Document.* August .

Klee, E. 2006. "Families' use of payment instruments during a decade of change in the U.S. payment system." Federal Reserve Board, Finance and Economics Discussion Paper 2006-01 .

McAndrews, J. and Z. Wang. 2008. "The economics of two-sided payment card markets: Pricing, adoption and usage." Federal Reserve Bank of Kansas City, Research Working Paper :08–12.

Mester, L. 2003. "Changes in the use of electronic means of payment: 1995-2001." *Business Review* (Q3):18–28.

Murphy, M. and M. Ott. 1977. "Retail credit, credit cards and price discrimination." *Southern Economic Journal* 43 (3):1303–1312.

Prager, R., M. Manuszak, E. Kiser, and R. Borzekowski. 2009. "Interchange fees and payment card networks: Economics, industry developments, and policy issues." Finance and Economics Discussion Series .

Rochet, J. 2003. "the Theory of Interchange Fees: A synthesis of recent contributions." *Review of Network Economics* 2 (2):97–124.

Rochet, J. and J. Tirole. 2006. "Two-sided markets: A progress report." *RAND Journal of Economics* 37 (3):645–667.

Rochet, J. and J. Wright. 2010. "Credit card interchange fees." *Journal of Banking & Finance* 34:1788–1797.

Roson, R. 2005. "Two-sided markets: A tentative survey." *Review of Network Economics* 4 (2):142–160.

Rysman, M. 2009. "The economics of two-sided markets." *Journal of Economic Perspectives* 23 (3):125–143.

Schuh, S. and J. Stavins. 2010. "Why are (some) consumers (finally) writing fewer checks? The role of payment characteristics." *Journal of Banking and Finance* 34 (8):1745–1758.

Schwartz, M. and D. Vincent. 2006. "The no surcharge rule and card user rebates: Vertical control by a payment network." *Review of Network Economics* 5 (1):72–102.

Semeraro, Steven. 2009. "The Reverse-Robin-Hood-Cross-Subsidy Hypothesis: Do Credit Card Systems Effectively Tax the Poor and Reward the Rich?" *Rutgers Law Journal* 40 (2).

Shy, O. and Z. Wang. 2011. "Why do card networks charge proportional fees?" *American Economic Review* 101 (Forthcoming in June).

Stavins, J. 2001. "Effect of consumer characteristics on the use of payment instruments." *New England Economic Review* 3 (2001):19–30.

Sullivan, R. 2010. "The changing nature of US card payment fraud: industry and public policy options." *Economic Review* :101–133.

Verdier, M. 2011. "Interchange fees in payment card systems: A survey of the literature." *Journal of Economic Surveys* 25 (2):273–297.

Wang, Z. 2010. "Market structure and payment card pricing: What drives the interchange?" *International Journal of Industrial Organization* 28 (1):86–98.

Weyl, Eric G. and Michal Fabinger. 2009. "Pass-Through as an Economic Tool." *SSRN eLibrary* .

Wright, J. 2003. "Optimal card payment systems." *European Economic Review* 47 (4):587–612.

Zinman, J. 2009a. "Debit or credit?" *Journal of Banking and Finance* 33 (2):358–366.

———. 2009b. "Where is the missing credit card debt? Clues and implications." *Review of Income and Wealth* 55 (2):249–265.