Why Do Merchants Accept Credit Cards?

Sujit Chakravorti Ted To*

September 1999

Abstract

In this article, we investigate why merchants accept credit cards for payment despite the relatively high cost of processing these types of transactions. A two-period model is constructed to determine under what conditions a credit card equilibrium would exist. The results of the model indicate that when the cost of funds is not too high and when the merchant's profit margin is sufficiently high, a credit card equilibrium exists. Consumers and the card issuer are strictly better off from credit card transactions. Merchants as a whole are worse off even though each merchant maximizes its expected profits. If merchants have bargaining power, they can capture some of the card-issuer's rents.

Key Words: Credit Cards, Merchant Discount, Payment Systems

*Chakravorti: Federal Reserve Bank of Chicago, 230 S. LaSalle Street, Chicago, IL 60604, USA. E-mail: Sujit.Chakravorti@chi.frb.org. To: Centre for the Study of Globalisation and Regionalisation, University of Warwick, Coventry CV4 7AL, UK. E-mail: T.To@warwick.ac.uk. We benefitted from comments received from participants at the 1999 MidWest Macroeconomics conference held at the University of Pittsburgh and the Electronic Payments Symposium held at the University of Michigan. The views expressed are those of the authors and should not be attributed to the Federal Reserve Bank of Chicago or the Federal Reserve System.

Systems used to transfer monetary value between consumers and merchants continue to evolve. Many financial analysts have predicted that electronic bits of information representing monetary value or payment instructions to transfer monetary value will replace the exchange of paper among consumers and merchants in the United States. However, both merchants and consumers must benefit from electronic payments for this migration to occur. In general, merchants prefer to accept payment instruments that can be easily, safely, and inexpensively converted into good funds while consumers prefer to use instruments that are safe, convenient, and widely accepted.

Today, credit cards offer merchants an electronic alternative to paper-based products. Credit cards are the third most popular payment instrument in the United States behind cash and checks. In 1997, there were 16.89 billion credit card transactions accounting for $1.07 trillion in the United States (Nilson Report, 1998). Bank of America issued the first general-purpose credit card in 1958.[1] Although the BankAmericard was initially paper-based, with the adoption of computer networks to authorize and clear payments along with automated processing at the point of sale, the credit card transaction eventually became an electronic one for merchants. However, in most cases, consumers continue to use checks to pay their credit card bills. Today, the BankAmericard which has since changed its name to Visa is accepted worldwide. In addition to Visa, MasterCard, Discover/Novus, and American Express also issue general-purpose credit cards.

Consumers benefit from the extension of credit when using their credit cards either short-term—between the time when purchases are made and when the bill is due—or long-term. Merchants benefit from receiving good funds usually within forty-eight hours and making sales to liquidity-constrained individuals without directly incurring credit risk. In addition, to being a credit instrument, these cards have also become popular payment instruments as evidenced by the large percentage of convenience users—those that do not carry monthly balances. Both consumers and merchants pay for these services either directly in the form of fees or indirectly in the form of higher prices.

Recently, merchants have voiced their disapproval over the pricing policies and certain rules of the credit card associations. Currently, there are two antitrust cases pending against Visa and

[1] The general-purpose charge card was issued by Diners Club in 1949. Unlike with credit cards, charge card consumers needed to pay their charges in full every month.

MasterCard. The U.S. Department of Justice case charges the two associations with colluding. The Justice Department claims that these anticompetitive practices result in higher prices than those that would exist in competitive markets. The other case filed by a group of retailers led by Wal-Mart charges the two credit card associations with imposing illegal tying arrangements that force merchants accepting one of the credit card association's payment products to accept all of their products. Antitrust cases are neither new to the credit card industry nor easily resolved—primarily because of the complexity of the credit card industry.

In order to better understand credit card transactions, we investigate the costs and benefits for each participant involved. We assume the following two commonly observed practices in our model. First, merchants rarely price discriminate between credit and cash purchases. Second, interest is levied on cardholders only if they fail to pay their balance each month. Our model provides insights into the following interrelated questions: i) why credit cards are more expensive for merchants, ii) given their cost, why do merchants accept them and iii) what do card issuers gain from offering credit cards?

A two-period model with three types of agents—consumers, merchants, and a credit-card issuer—is constructed to study a series of bilateral interactions that make up a credit card transaction. Consumers are better off with credit cards because they either benefit from access to credit which allows them to consume before their income arrives or to earn revenue in the form of float.[2] Each merchant chooses to accept credit cards based on their two-period profit maximization problem. By accepting credit cards, merchants increase their first period sales and profits. However, when all merchants accept credit cards, each merchant's two-period profit is below what they would have earned if no merchants accepted credit cards. Because individual merchants cannot affect second period sales, they chose to increase first period sales although as a group they would be better off if they all declined credit cards to begin with. By allowing merchants to have bargaining power, merchants can reduce the amount of the transfer given to the card-issuer. The credit-card issuer must weigh the risk of payment default based on the cardholders uncertain second-period income

[2]In our model, we assume prices are fixed and merchants do not increase prices to recover the additional costs associated with credit card transactions. Such an assumption may be realistic if merchants are able to increase overall profits by accepting credit cards without increasing their prices. Chakravorti and Emmons (1998) construct a model where they consider price changes resulting from costs associated with credit cards in a competitive goods market.

and their ability to extract sufficient transfers from merchants that accept credit cards.

The remainder of the article is organized as follows. In the next section, we briefly review the existing literature on credit cards in the context of the interrelated bilateral transactions. In Section 2, we present our model. We solve for the credit card equilibrium in Section 3 and conclude in Section 4.

1 Credit Card Transactions

Credit card transactions can be viewed as a set of interrelated bilateral transactions and usually involve at least five participants—the consumer, the consumer's financial institution, the merchant, the merchant's financial institution, and the credit-card network. In Figure 1, we have diagrammed the interactions among participants in a credit card transaction. After establishing a credit line with her financial institution, the consumer uses her credit card to make a purchase from a merchant. The merchant usually uses a network to authorize the credit card transaction. To convert the credit card receipt into good funds, the merchant sends the credit card receipt usually electronically to its financial institution. Upon receiving funds from the consumer's financial institution, the merchant's financial institution credits the merchant's account usually within forty-eight hours. However, the consumer's financial institution may only receive funds from the consumer more than twenty days later depending on when the charge was made in the payment cycle. The consumer may also choose to pay her charges in installments.

As mentioned above, credit card transactions are the most expensive to process. However, participants do not share equally in the credit card's cost. In Figure 2, we diagram the payments made among the participants. When choosing among credit-card issuers, consumers determine which issuer best fits their needs. Consumers usually do not pay per-transaction fees to their financial institutions, but receive benefits most notably an interest-free short-term loan if they paid the preceding and following month's bill in full. In addition, issuers may entice consumers to use their credit cards by offering enhancements such as frequent-use awards. However, Chakravorti and Emmons (1998) suggest that those consumers that revolve their balances may bear some or all of the cost associated with credit card transactions. Furthermore, if the revolvers are profitable to

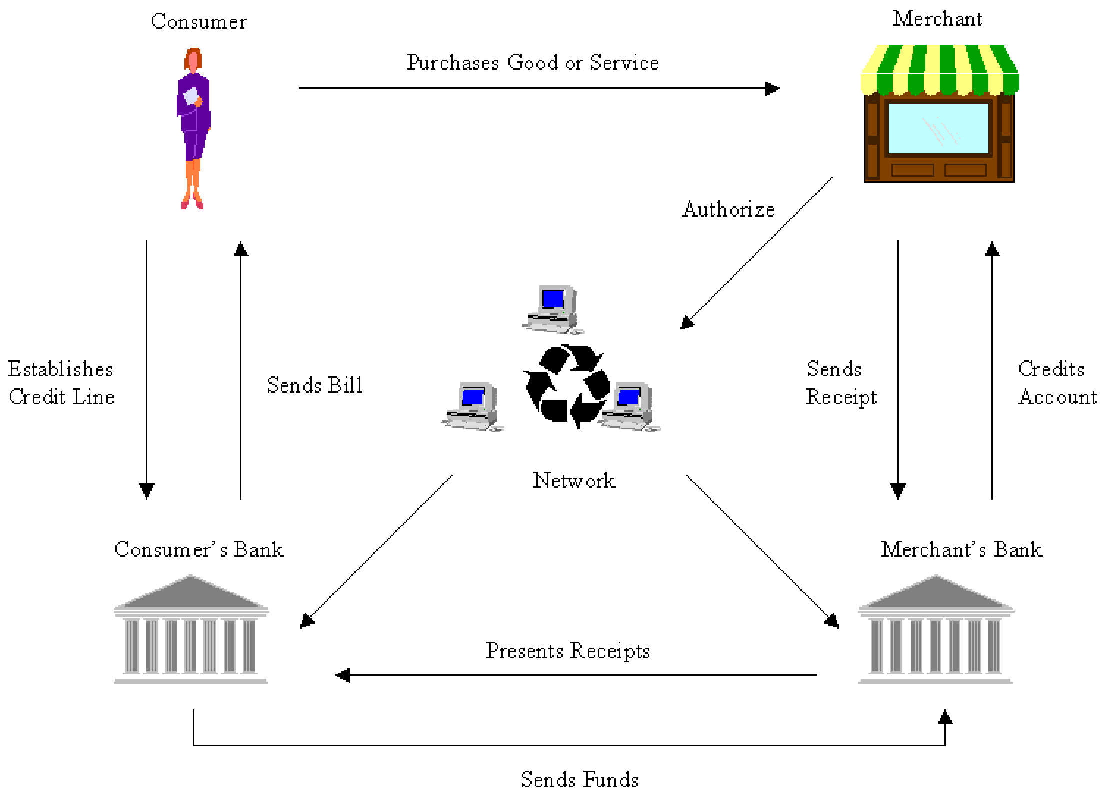

Figure 1: A Credit Card Transaction

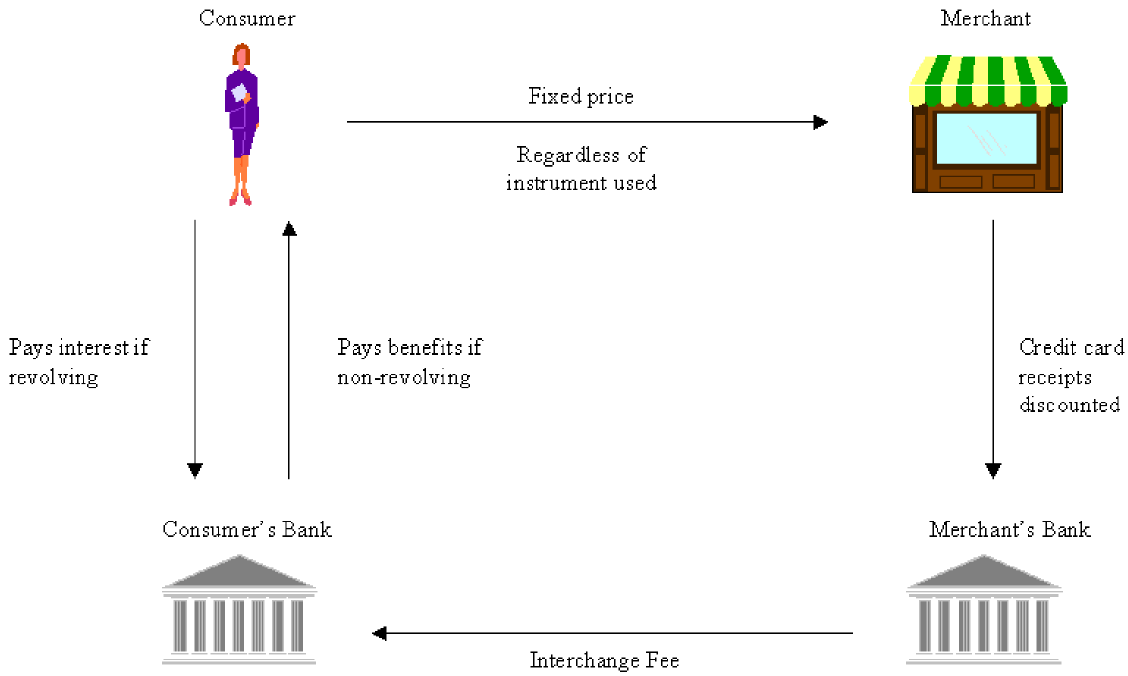

Figure 2: Transaction Costs

card issuers, they may be willing to subsidize the payment component, because some convenience users may become revolvers in the future.

Why consumers use credit cards to make purchases has received substantial attention in the academic literature (see Ausubel 1991, Brito and Hartley 1995, Calem and Mester 1995, and Whitesell 1992). Illiquid consumers benefit from credit cards because they are able to consume before their incomes arrive. Liquid consumers benefit from using credit cards because credit issuers essentially grant them interest-free short-term credit along with possible frequent-use awards, and other enhancements. Therefore, some observers suggest that liquid consumers should always use their credit cards when possible to make payment and pay off their monthly balances when due (Chakravorti, 1997).

The relationship between the consumer and the merchant may be the most puzzling because seldom do we observe merchants charging more for credit card purchases. For various reasons, merchants refrain from charging more to their credit card customers. Such reasons include agreements between merchants and their financial institutions that may prohibit surcharging for credit card transactions, consumer resistance to differentiated pricing, and historical pricing conventions. However, Chakravorti and Emmons (1998) suggest that in competitive goods and credit markets welfare would improve if merchants charged illiquid consumers higher prices for using their credit cards.

How merchants benefit from accepting credit cards has received far less attention in the academic literature. According to the Food Marketing Institute (1998), credit cards on average cost supermarkets $1.07 per transaction compared to 8¢ for cash and 58¢ for checks. Even though credit cards are expensive to accept, 83 percent of retailers felt that accepting credit cards increased sales and 58 percent thought their profits would increase by accepting credit cards (Ernst and Young, 1996). Humphrey and Berger (1990) calculated that the total cost of credit cards to be 88¢ compared to 79¢ for checks, 4¢ for cash, 47¢ for point-of-sale debit card transactions. Chakravorti and Emmons (1998) argue that even though credit cards are expensive to use, they may improve market efficiency under certain conditions.

Since the introduction of credit cards, merchants have negotiated with their financial institutions about the level of their merchant discounts. Initially, large merchants were unwilling to pay these fees to third-party credit-card issuers. Today, the merchant discount is much lower than the six-percent fee initially charged by Bank of America. Merchants weigh the cost of the merchant discount against the potential of increased profits resulting from increased sales and a guarantee of good funds.

Financial institutions establish pricing policies that affect the usage and acceptance of credit cards. Some pricing policies such as fees charged to consumers and merchants are set by the individual financial institution. Other fees such as interchange fees are set by the credit card associations along with other rules. Some of these rules and pricing policies set by these associations have recently been challenged in the courts.

2 The Model

In the model we lay out, the five participants described in Section 1—the consumer, the consumer's financial institution, the merchant, the merchant's financial institution, and the credit-card network—have been condensed to just three participants. The consumer's financial institution, the merchant's financial institution, and the credit-card network are assumed to be a single agent, the credit issuer, to ensure tractability of the model. Such a simplification may not be unrealistic given the history of the credit card industry. Because of interstate branching restrictions at the time credit cards began, to expand their networks nationally, card-issuers entered into licensing agreements with other banks.

Assume that there are two types of goods $j = 1, 2$ which are indivisible and have exogenously given prices p^j where $p^2 > p^1$. Because keeping prices fixed is more restrictive for merchants, if credit card equilibria exist under such conditions, they would also exist if prices were allowed to change as long as consumers still benefitted. Furthermore, even if merchants could set prices, it is well known that in general cost increases (in this case credit card processing costs) are not wholly passed on to consumers.

These goods are sold by two types of merchants—type-2 merchants can only sell type-2 goods which have unit cost c^2 and type-1 merchants can only sell type-1 goods which have unit cost c^1. There is a continuum of type-2 goods, say $[0, 1]$, each of which has a monopolistic seller who earns rents, $p^2 - c^2 > 0$. Since 'high-end' merchants earn rents, credit cards can be of value if they increase sales. The particular type-2 good that such a consumer wishes to consume is uniformly determined. Type-1 goods are competitively sold so that $p^1 - c^1 = 0$. This ensures that 'low-end' merchants earn no rents and therefore can gain nothing from accepting credit cards.[3] As is typically true in actual practice, assume that merchants do not price discriminate between credit card and cash purchasers. In each period, each consumer desires a type-1 good with probability γ and a type-2 good with probability $1 - \gamma$. This captures the notion that consumer spending may be stochastic and that some expenditures may be unanticipated.

Assume there is a continuum of consumers. Each consumer has income ω_t in periods $t = 1, 2$.

[3] In fact, we only need to assume that $p^1 - c^1$ is not too large.

For each consumer, ω_t is independently distributed via continuous cumulative distribution function F and associated probability density function f and has support $\Omega = [\underline{\omega}, \bar{\omega}]$. Consumers have discount factor β. In each period that a consumer consumes a unit of good j, she gets utility u^j where $u^2 > u^1$. Any money not spent in the first period earns return $R > 1$. R will also be the credit issuer's cost of funds and the interest rate earned on merchants' first period profits.

Assume that a monopolistic credit-card issuer offers a credit card to all consumers with credit limit $L(\omega)$. That is, if a consumer has a first period income of ω_1, the amount of credit issued to her by the financial institution is $L(\omega_1)$. Since the economy only lasts for two periods, credit is only offered in the first period. Merchants must decide whether or not to accept credit cards as payment for first period purchases. The credit-card issuer imposes a per-sale transaction fee, $\rho \geq 0$, for each credit card purchase. The card issuer and pays the merchant the sum of the sales receipts minus the amount corresponding to the merchant discount. The credit-card issuer then collects debts owed (or however much is collectable) at the beginning of the second period. It is important to note consumers pay no interest on credit card purchases. This assumption is based on the observation that credit card purchases have a 'grace period' during which no interest accumulates. There would be interest due only if part of the consumer's debt were carried over into a third period. For reasons of tractability, this possibility is excluded and the economy lasts for only 2 periods. The agreements between the card issuer and consumers and between the card issuer and the merchants is assumed to be costlessly enforceable.[4]

Since low-quality merchants will never accept credit cards which carry a positive merchant discount, without loss of generality, the credit-card issuer can choose credit limits among functions of the following form: $L(\omega) = 0$ if $\omega_1 \notin \hat{\Omega}$ and $L(\omega) = p^2$ if $\omega_1 \in \hat{\Omega}$ where $\hat{\Omega} \subset \Omega$. That is, we can limit L to take only the values 0 and p^2 since a credit card is useful only if it allows one to purchase good 2—credit limits below p^2 or beyond p^2 are of no use. Since lower income consumers will have a higher risk of default, it must be the case that the optimal $L(\omega)$ will have $\hat{\Omega} = [\hat{\omega}, \bar{\omega}]$ for some $\hat{\omega} \in \Omega$. Thus, the credit-card issuer can simply choose $\hat{\omega}$ to maximize revenues while minimizing defaults. Given that we examine credit limit functions which take values of 0 on $[\underline{\omega}, \hat{\omega})$ and p^2 on

[4] Initially, credit card fraud was a major problem (see Evans and Schmalensee (1993), Mandell (1990), and Nocera (1994)). Credit-card issuers still must invest adequate resources to contain fraud.

$[\hat{\omega}, \bar{\omega}]$, we will call $\hat{\omega}$ the *income requirement*, below which consumers are not offered credit cards.

As pointed out earlier, if $\rho > 0$, low-quality merchants will not accept credit cards since they would earn negative profits by doing so. On the other hand, type-2 merchants might gain customers by accepting credit cards since some consumers are liquidity constrained and they earn rents from the sale of type-2 goods. Since the mix of customers matched to each merchant is the same, each merchant faces an identical profit maximization problem. Thus, in equilibrium all high-quality merchants will either accept credit cards or none will accept them.[5]

Date	Agent	Actions
$t = 0$	Credit Issuer	Choose $\hat{\omega}$ and ρ
	Merchants	Accept/Not Accept Credit Cards
$t = 1$	Nature	Determine ω_1 and $j = 1, 2$
		for each consumer
	Consumers	Buy/Not Buy
		If Buy, Use/Not Use Credit
$t = 2$	Nature	Determine ω_2 and $j = 1, 2$
		for each consumer
	Credit Issuer	Collect Debts
	Consumers	Make Cash Purchases

The structure of the model is illustrated in the table. At time 0, the credit-card issuer chooses the transaction fee, ρ, and the minimum income, $\hat{\omega}$, for consumers to qualify for a credit card. The merchants then decide whether or not to accept credit. At the beginning of periods 1 and 2, consumer incomes and desired consumptions are randomly determined. Any outstanding debts are then collected. Lastly, each consumer decides whether to purchase her desired consumption good and then if she has access to credit, how she should pay for it.

An alternative interpretation of the model just described is one with features similar to models of search and money (Kiyotaki and Wright, 1989, 1993, for example). That is, type-1 merchants sell a 'low quality' product and type-2 merchants sell a 'high quality' product and with probability γ consumers are matched to a type-1 merchant and with probability $1-\gamma$ they are matched to a type-2 merchant. Search frictions give rise to positive rents. Each of these interpretations have advantages

[5]To see why, suppose that only some fraction of type-2 merchants accept credit cards. It must therefore be the case that type-2 merchants are indifferent between accepting credit cards and not. However, the credit-card issuer now has an incentive to slightly lower the transaction fee in which case all merchants strictly prefer to accept credit cards.

and disadvantages and thus perhaps the ideal interpretation may be some convex combination of the two where both search frictions and market power play some role.

3 Equilibrium

3.1 Consumers

Starting with the second period, a consumer will always purchase the good she desires if she can afford it. Since it is the last period, all transactions are made in cash. If the consumer had purchased good j with credit in the first period then she can afford to buy good k in the second period if $R\omega_1 + \omega_2 \geq p^j + p^k$ for $j, k = 1, 2$. That is, she earns a return R on her first period endowment, ω_1. Her total money balances in the second period must be used to pay off her debt from the first period p^j. If $R\omega_1 + \omega_2 < p^j$ then she defaults and the sum $R\omega_1 + \omega_2$ is seized by the credit-card issuer. If after meeting her first-period debt obligation, sufficient funds remain to purchase good k, she consumes in the second period as well. Before the realization of her second period income, the probability that she can afford to buy good k is $\Pr(\omega_2 \geq p^j + p^k - R\omega_1)$. Similarly, given that she bought good j with cash in the first period, the probability that she can afford good k in the second period is $\Pr(\omega_2 \geq p^k - R(\omega_1 - p^j))$. Finally, if she did not buy at all in the first period, the probability that she can afford good k is $\Pr(\omega_2 \geq p^k - R\omega_1)$. Given some target second period wealth level, x, the probability that ω_2 is at least x can be written in terms of the cumulative distribution function as $\Pr(\omega_2 \geq x) = 1 - F(x)$.

We can now calculate a consumer's first period discounted expected utility from purchasing with her credit card and from purchasing with money. If a consumer wishes to consume a type-2 good and buys on credit she gets discounted expected utility of:

$$U^{2c}(\omega_1) = u^2 + \beta\{\gamma \Pr[\omega_2 \geq p^2 + p^1 - R\omega_1]u^1 + (1-\gamma)\Pr[\omega_2 \geq 2p^2 - R\omega_1]u^2\}. \quad (1)$$

She gets u^2 for consuming the type-2 good in the first period and will consume in the second period if she can afford to. Second period consumption is discounted by β. With probability γ she wishes to consume a unit of some type-1 good in the second period and will be able to afford to buy it (getting utility u^1) with probability $\Pr[R\omega_1 + \omega_2 \geq p^2 + p^1]$. Similarly, she wishes to consume a type-2 good with probability $1-\gamma$ and will be able to afford it with probability $\Pr[R\omega_1 + \omega_2 \geq 2p^2]$.

If a consumer buys good 2 with cash, she gets discounted expected utility of:

$$U^{2m}(\omega_1) = u^2 + \beta\{\gamma \Pr[\omega_2 \geq p^1 - R(\omega_1 - p^2)]u^1 + (1-\gamma)\Pr[\omega_2 \geq p^2 - R(\omega_1 - p^2)]u^2\}. \quad (2)$$

If a consumer buys good 1 with cash, she gets discounted expected utility of:

$$U^{1m}(\omega_1) = u^1 + \beta\{\gamma \Pr[\omega_2 \geq p^1 - R(\omega_1 - p^1)]u^1 + (1-\gamma)\Pr[\omega_2 \geq p^2 - R(\omega_1 - p^1)]u^2\} \quad (3)$$

Finally, if a consumer does not buy at all in the first period, she gets:

$$U^0(\omega_1) = \beta\{\gamma \Pr[\omega_2 \geq p^1 - R\omega_1]u^1 + (1-\gamma)\Pr[\omega_2 \geq p^2 - R\omega_1]u^2\}. \quad (4)$$

Define $\Omega^* = \{\omega_1 \in \Omega \mid \omega_1 \geq p^1, U^{1m}(\omega_1) \geq U^0(\omega_1)\}$. We can now characterize the consumer's choices, given that merchants either accept or do not accept credit and the income requirement $\hat{\omega}$ chosen by the credit issuer.

Proposition 1 *In the first period, given some $\hat{\omega}$, a consumer with first period income*

i) $\omega_1 \in \Omega^*$ who wishes to purchase a type-1 good buys one unit with cash,

ii) $\omega_1 \geq p^2$ who wishes to purchase a type-2 good, and is precluded from purchasing with a credit card (either $\omega_1 < \hat{\omega}$ or the merchant does not accept credit cards), buys a unit with cash and

iii) $\omega_1 \geq \hat{\omega}$ who wishes to purchase a type-2 good whose merchant accepts credit cards buys a unit of good 2 with her credit card.

Proof:

i) Follows from the definition of Ω^*.

ii) Compare a consumer's utility from paying for good 2 with cash versus not buying good 2 at all. Since if she doesn't buy good 2 in the first period, she can always afford to buy it in the second, it follows that:

$$\begin{aligned} U^{2m}(\omega_1) &= u^2 + \beta\{\gamma u^1 + (1-\gamma)\Pr[\omega_2 \geq p^2 - R(\omega_1 - p^2)]u^2\} \\ &> \beta\{\gamma u^1 + (1-\gamma)u^2\} = U^0(\omega_1). \end{aligned} \quad (5)$$

Since the consumer cannot purchase good 2 using a credit card, but can afford to pay with cash, she buys good 2 with cash.

iii) There are two possible cases that need to be considered. First, suppose that $\omega_1 \geq p^2$. It is easy to see that since $\Pr[\omega_2 \geq 2p^2 - R\omega_1] > \Pr[\omega_2 \geq p^2 - R(\omega_1 - p^2)]$ that:

$$\begin{aligned} U^{2c}(\omega_1) &= u^2 + \beta\{\gamma u^1 + (1-\gamma)\Pr[\omega_2 \geq 2p^2 - R\omega_1]u^2\} \\ &> u^2 + \beta\{\gamma u^1 + (1-\gamma)\Pr[\omega_2 \geq p^2 - R(\omega_1 - p^2)]u^2\} = U^{2m}(\omega_1). \end{aligned} \quad (6)$$

Thus, even though she can afford to buy good 2 with cash, she prefers to pay with her credit card in order to take advantage of the interest free grace period or float.

Now suppose that $\omega_1 < p^2$. Notice that U^0 is bounded above by u^2. It therefore follows that:

$$\begin{aligned} U^{2c}(\omega_1) &= u^2 + \beta\{\gamma \Pr[\omega_2 \geq p^2 + p^1 - R\omega_1]u^1 + (1-\gamma)\Pr[\omega_2 \geq 2p^2 - R\omega_1]u^2\} \\ &> \beta\{\gamma u^1 + (1-\gamma)\Pr[\omega_2 \geq p^2 - R\omega_1]u^2\} = U^0(\omega_1). \end{aligned} \quad (7)$$

Thus, a consumer with $\omega_1 \geq \hat{\omega}$ who is matched to a type-2 merchant who accepts credit cards buys good 2 using her credit card. ■

Given that some type-2 merchants accept credit cards, a consumer wishing to buy a unit of a type-2 good who cannot pay with credit but has sufficient cash will purchase a unit of consumption with cash. A similar consumer who can pay with credit will purchase on credit.

Finally, those consumers who wish to consume a type-1 good do so whenever $U^{1m}(\omega_1) \geq U^0(\omega_1)$. Unfortunately, without imposing some conditions on the model parameters, it is not possible to get a 'clean' characterization of the equilibrium behavior of these consumers. One possible restriction is:

$$\frac{\gamma u^1}{(1-\gamma)u^2} > \frac{f(p^2 - R\omega_1) - f(p^2 - R(\omega_1 - p^1))}{f(p^1 - R(\omega_1 - p^1))}. \quad (8)$$

In this case, Ω^* is easily characterized. To see this, note that (8) implies that $\partial U^{1m}/\partial\omega_1 > \partial U^0/\partial\omega_1$. This implies that consumers with higher first period incomes are more likely to prefer to purchase 1 immediately so that $\Omega^* = [\max\{\omega^*, p^1\}, \bar{\omega}]$ where ω^* solves $U^{1m} = U^0$. This condition requires that f is not declining too quickly. Notice that if f is nondecreasing (for example, the uniform distribution) then $f(p^2 - R\omega_1) \leq f(p^2 - R(\omega_1 - p^1))$ and (8) is satisfied. An alternative condition which is independent of the distribution and which also yields a simple characterization is $\underline{\omega} \geq p^1$ and $u^1 \geq \beta(1-\gamma)u^2$. In this case, all consumers can afford to purchase and prefer to purchase immediately. Since the behavior of consumers matched to a type-1 merchant is not crucial to the remaining analysis, for simplicity we assume that conditions are such that $\Omega^* = [\omega^*, \bar{\omega}]$ for some $\omega^* \geq p^1$, noting that we can impose restrictions under which this is true.

3.2 Merchants

We are primarily interested in and will derive conditions for the existence of equilibria in which type-2 merchants accept credit cards. Since prices and costs are exogenously specified, and accepting credit cards is costly, merchants will be willing to accept credit cards only if they increase sales volume. In a credit card equilibrium, it must be that $\hat{\omega} < p^2$ since otherwise type-2 merchants who accepted credit cards would not increase their sales and would also be required to pay fee ρ on all credit card sales.

Merchants are assumed to take p^j and c^j as given and therefore their only role is in deciding whether or not to accept credit cards as a form of payment. As already discussed, type-1 merchants will not accept credit cards since $p^1 = c^1$ so that increased sales do not imply increased profits. In order to make their decision, type-2 merchants need to be able to properly forecast the current and future demand for their product. First period demand is based on the distribution of first period income, $F(\omega_1)$, and the credit limit offered by the credit-card issuer, $L(\omega_1)$. Second period demand depends on the distribution of total wealth, net of cash purchases or credit repayments, at the beginning of the second period. This in turn depends on the equilibrium and as a result, the credit limit function L. Let the distribution of second period net total income be given by the cumulative distribution function, $H(x;\hat{\omega})$).[6]

Provided that $p^2 \geq \hat{\omega}$, each type-2 merchant's discounted expected profits from accepting credit cards will be proportional to:

$$\pi^c = [1 - F(\hat{\omega})](p^2 - c^2 - \rho) + \frac{1}{R}[1 - H(p^2;\hat{\omega})](p^2 - c^2). \tag{9}$$

The same merchant's discounted expected profits from not accepting credit cards will be proportional to:

$$\pi^{nc} = [1 - F(p^2)](p^2 - c^2) + \frac{1}{R}[1 - H(p^2;\hat{\omega})](p^2 - c^2). \tag{10}$$

A type-2 merchant will accept credit cards when $\pi^c \geq \pi^{nc}$ and will not accept them when $\pi^c < \pi^{nc}$. As long as ρ is sufficiently small, if $\hat{\omega} < p^2$ then it is to the advantage of the merchant to accept credit cards. By accepting credit, a type-2 merchant sells an additional $F(\hat{\omega}) - F(p^2)$ units of good 2—all credit sales come at the additional unit cost of ρ. Notice that since individual merchants are massless, a single merchant's decision of whether or not to accept credit has no effect on second period sales.

3.3 The Credit-Card Issuer

The credit-card issuer maximizes profits through choice of ρ and $\hat{\omega}$. The question then is, under what conditions will the card issuer choose ρ and $\hat{\omega}$ such that type-2 merchants are willing to accept credit as a form of payment. To solve the card issuer's problem, she needs to be able to forecast the gross income, $x = R\omega_1 + \omega_2$, of consumers to whom they extend credit, $\omega_1 \geq \hat{\omega}$. The distribution of x conditional on the realization of ω_1 is $G(x \mid \omega_1) = \Pr[R\omega_1 + \omega_2 \leq x] = F(x - R\omega_1)$. Conditional on $\omega_1 \geq \hat{\omega}$ for some $\hat{\omega} < \bar{\omega}$, the distribution of x is:

$$G(x \mid \omega_1 \geq \tilde{\omega}) = \int_{\tilde{\omega}}^{\bar{\omega}} F(x - R\omega_1)\frac{f(\omega_1)}{1 - F(\tilde{\omega})} d\omega_1. \tag{11}$$

[6]It is straightforward to derive H, however, as we will see, its actual distribution is irrelevant to the merchant's decision.

When all type-2 merchants accept credit, the card issuer's profits can be written as:

$$\Pi = (1-\gamma)[1-F(\hat{\omega})]\Bigg\{ -(p^2-\rho) + \frac{1}{R}\left[p^2(1-G(p^2 \mid \omega_1 \geq \hat{\omega})) + \int\limits_{\min\{R\hat{\omega}+\underline{\omega},p^2\}}^{p^2} xg(x \mid \omega_1 \geq \hat{\omega})dx \right]\Bigg\}, \quad (12)$$

where $G(\cdot \mid \omega_1 \geq \hat{\omega})$ is given by (11) and $g(\cdot \mid \omega_1 \geq \hat{\omega})$ is the associated conditional probability density function. The first term is the amount lent to consumers for first period credit purchases, less the sales fee charged to merchants. The terms within the brackets are repayments from the consumers who do not default and those from consumers who do. Notice that as long as F is continuous, Π is continuous. Since $(\rho, \hat{\omega})$ must belong to the compact set $[0, p^2 - c^2] \times [\underline{\omega}, \bar{\omega}]$, Π has a global maximum so that there exists at least one equilibrium. We now investigate some of the properties of these equilibria.

Notice that ρ's purpose is to extract rents from the merchants and has no effect on the gross rents available. It is therefore straightforward to derive the optimal ρ by setting $\pi^c = \pi^{nc}$ and solving. When $\hat{\omega} > p^2$, no additional sales are generated by the acceptance of credit cards and $\rho = 0$. When $\hat{\omega} \leq p^2$, this is given by:

$$\rho(\hat{\omega}) = \frac{F(p^2) - F(\hat{\omega})}{1 - F(\hat{\omega})}(p^2 - c^2). \quad (13)$$

In other words, ρ is a fraction of the additional first period revenues generated by the acceptance of credit cards. Differentiating $\rho(\hat{\omega})$ with respect to $\hat{\omega}$ yields:

$$\frac{\partial \rho}{\partial \hat{\omega}} = -\frac{f(\hat{\omega})(1 - F(p^2))}{(1 - F(\hat{\omega}))^2}(p^2 - c^2). \quad (14)$$

That is, the fee that the credit-card issuer can charge merchants falls if credit is more restrictive. In a broader sense, the ability to increase merchant fees is directly related to the number of consumers that have access to credit cards. Credit cards in our model display characteristics of a network good because as the number of cardholders increases the value of accepting them also increases.

The variable $\hat{\omega}$ determines the magnitude of available rents. Note first that if $(1+R)\underline{\omega} \geq p^2$ then even the poorest consumers can afford to repay p^2 and there would be no defaults. As a result, if the bank issues any credit, it issues it to everyone (i.e., $\hat{\omega} = \underline{\omega}$). On the other hand, if $(1+R)\underline{\omega} < p^2$ and $\hat{\omega} < p^2$ then depending on $\hat{\omega}$, some consumers may default. We investigate this more interesting, case. In particular, if $\hat{\omega}$ is such that $R\hat{\omega}+\underline{\omega} < p^2$, a positive measure of consumers default with certainty.

To determine whether or not banks are willing to extend credit to consumers, take the first order condition for the card issuer's profit maximization problem with respect to $\hat{\omega}$. Since optimal ρ is given by (13) for any $\hat{\omega}$, we can first substitute (13) into (12) before taking the first order condition. The first derivative is given by:

$$
\begin{aligned}
\frac{\partial \Pi}{\partial \hat{\omega}} &= (1-\gamma) f(\hat{\omega}) \left\{ (p^2 - \rho) - \frac{1}{R} \left[p^2 (1 - G(p^2 \mid \omega_1 \geq \hat{\omega})) + \int_{\min\{R\hat{\omega}+\underline{\omega}, p^2\}}^{p^2} x g(x \mid \omega_1 \geq \hat{\omega}) dx \right] \right\} \\
&+ (1-\gamma) f(\hat{\omega}) \left\{ -\frac{1-F(p^2)}{1-F(\hat{\omega})}(p^2 - c^2) + \frac{1}{R} \left[p^2 \int_{\hat{\omega}}^{\bar{\omega}} [F(p^2 - R\hat{\omega}) - F(p^2 - R\omega_1)] \frac{f(\omega_1)}{1-F(\hat{\omega})} d\omega_1 \right. \right. \\
&\left. \left. + \int_{\min\{R\hat{\omega}+\underline{\omega}, p^2\}}^{p^2} x \int_{\hat{\omega}}^{\bar{\omega}} [f(x - R\omega_1) - f(x - R\hat{\omega})] \frac{f(\omega_1)}{1-F(\hat{\omega})} d\omega_1 dx \right] \right\} \\
&- (1-\gamma)(1-F(\hat{\omega}))(R\hat{\omega}+\underline{\omega}) \int_{\hat{\omega}}^{\bar{\omega}} f(R(\hat{\omega}-\omega_1)+\underline{\omega}) \frac{f(\omega_1)}{1-F(\hat{\omega})} d\omega_1, \quad (15)
\end{aligned}
$$

where $\hat{\omega}$ must lie in $[\underline{\omega}, \bar{\omega}]$.

Proposition 2 *If R and c^2 are not too large then in every equilibrium, the credit-card issuer extends credit (i.e., the $\hat{\omega} \in [\underline{\omega}, p^2)$), almost all type-2 merchants accept credit and some consumers default.*

Proof: To evaluate the first order condition we need to evaluate it for $\hat{\omega}$ where 1) $R\hat{\omega}+\underline{\omega} \geq p^2$ and 2) $R\hat{\omega}+\underline{\omega} < p^2$. First, notice that the bounds of integration of the last term in (15) are $\hat{\omega}$ and $\bar{\omega}$. This implies that $R(\hat{\omega}-\omega_1) \leq 0$ so this last term is always zero.

Consider $\hat{\omega}$ such that $R\hat{\omega}+\underline{\omega} \geq p^2$. In this case there will be no defaults—the minimum income required to qualify for a credit card, including the return it earns, and the minimum income in the second period is sufficient to fully repay p^2. In this case, the second term of the second line of (15) is zero because $\underline{\omega} \geq p^2 - R\hat{\omega} \geq p^2 - R\omega_1$ so that $F(p^2 - R\hat{\omega}) = F(p^2 - R\omega_1) = 0$. Since $R\hat{\omega} + \underline{\omega} \geq p^2$ (by supposition), $\min\{R\hat{\omega} + \underline{\omega}, p^2\} = p^2$ so the integral in the first line and the term in the third line are also zero. Furthermore, $R\hat{\omega} + \underline{\omega} \geq p^2$ implies that $G(p^2 \mid \omega_1 \geq \hat{\omega}) = 0$ so that after substituting for ρ, (15) simplifies to:

$$\frac{\partial \Pi}{\partial \hat{\omega}} = -(1-\gamma) f(\hat{\omega}) \left\{ \frac{1 - R + RF(p^2) - F(\hat{\omega})}{(1 - F(\hat{\omega}))R} p^2 - \frac{F(p^2) - F(\hat{\omega})}{1 - F(\hat{\omega})} c^2 + \frac{1 - F(p^2)}{1 - F(\hat{\omega})} (p^2 - c^2) \right\}. \tag{16}$$

If $R = 1$ or $c^2 = 0$, this is strictly negative so that as long as R and c^2 are not too large, an equilibrium must have $\hat{\omega} < p^2$ so that there is credit.

Now, notice that at $R\hat{\omega} + \underline{\omega} = p^2 - \varepsilon$, for ε sufficiently small this derivative is still negative (i.e., the second term in the second line and the third line of (15) may be positive but can be made arbitrarily close to zero when $R\hat{\omega} + \underline{\omega}$ is sufficiently close to p^2). Since (15) is strictly negative for $\hat{\omega} \in [(p^2 - \underline{\omega} - \varepsilon)/R, \bar{\omega}]$, any maximum must satisfy $R\hat{\omega} + \underline{\omega} < p^2$. Thus, in every equilibrium, a positive measure of the consumers who purchased on credit, $F(p^2) - F(R\hat{\omega} + \underline{\omega})$, default.

Finally, the analysis so far has assumed that all type-2 merchants accept credit cards. Suppose that this were not the case and that in equilibrium some proportion ζ accept credit cards while some proportion $1 - \zeta$ do not accept credit cards. In this case, the credit-issuer's profits would be given by $\zeta\Pi$ where Π is as given in (12) and optimal $\hat{\omega}$ is still characterized by (15). However, if the credit-issuer lowered ρ by ε, then all type-2 merchants would strictly prefer to accept credit. Since we can take ε to be small, the credit-issuer can discontinuously increase her profits by lowering ρ and in equilibrium the set of type-2 merchants who do not accept credit is of measure zero. As a result, in equilibrium almost all type-2 merchants accept credit. ■

That is, as long as there are sufficient rents available and the cost of funds is not too large, in every equilibrium of this model the credit-issuer offers credit, type-2 merchants accept credit cards, and consumers use credit cards to make purchases when possible. The credit-issuer chooses the income requirement, $\hat{\omega}$, above which consumers can purchase on credit, such that a non-zero mass of consumers will be unable to pay off their first period debt and default. If the objective function is concave, then the equilibrium is unique.

It is interesting to note that type-2 merchants as a group earn lower profits when they accept credit cards. To see this, observe that on average, net total incomes must be reduced as a result of additional first period sales of good 2. This implies that second period sales must fall. But all of the rents generated by the additional sales from a merchant's acceptance of credit cards are extracted by the credit-card issuer through the per unit transaction fee ρ. In other words, first period profits, net of the transaction fee, are exactly the same as if she had not accepted credit cards. Since second period profits fall, discounted expected profits are lower for type-2 merchants. This effect comes about because, merchants are caught in a Prisoner's Dilemma type of situation. As a group, merchants realize group acceptance of credit reduces second period profits and that first period rents generated by the acceptance of credit cards will be fully extracted—they therefore recognize that they would be better off not accepting credit. Individually, however, a merchant's decision of whether or not to accept credit cards has no effect on net total consumer incomes and the credit-card issuer can choose ρ such that all type-2 merchants find it in their best interest to accept credit cards.[7] Thus, type-2 merchants accept credit despite the fact that they are made worse off. This adverse affect on merchants who accept credit cards may be the very reason for the recent antitrust litigation and the survey evidence suggesting that 83 percent of retailers believe credit cards increase sales but only 58 percent believe that they increase profits (Ernst and Young, 1996).

Credit card acceptance by type-2 merchants could also have an adverse effect on type-1 merchant profits. Suppose that a type-1 merchant's profit margin is $p^1 - c^1 = \varepsilon > 0$ for ε small.[8] A type-1 merchant's second period profits are reduced, just as the type-2 merchant's second period profits, and first period profits are independent and do not depend on the existence of credit. That is, not only do type-2 merchants as a group impose an externality on each other through their choice to

[7]Even with a finite set of merchants, they do not bear the full second period cost of accepting credit. A credit sale today reduces future wealth but current customers will in all likelihood buy from another merchant.

[8]As long as ε is sufficiently small, type-1 merchants have no incentive to accept credit and our other results therefore go through.

accept credit but they may impose the same externality on type-1 merchants.

The result that type-1 merchants can be made worse off in a credit equilibrium would appear to be fairly robust—they get none of the benefits but must pay some of the costs (lower future sales). However, one might think that allowing for rent sharing between type-2 merchants and the credit issuer might allow type-2 merchants to be better off. In particular, suppose that ρ is now given by:

$$\rho(\hat{\omega}) = \xi \frac{F(p^2) - F(\hat{\omega})}{1 - F(\hat{\omega})}(p^2 - c^2), \tag{17}$$

where $0 < \xi < 1$. Under a generalized Nash bargain, ξ is interpreted as the card-issuer's 'bargaining power' and is her share of the rents generated through the acceptance of credit cards. In this case, merchants are able to retain some of the rents generated by accepting credit cards. However, by yielding some of the rents to the merchants, the credit issuer will be more restrictive with credit (i.e., $\hat{\omega}$ rises).[9] Once rent sharing is allowed, a credit card equilibrium becomes more difficult to sustain (i.e., it shifts the feasible (R, c^2) frontier downwards). Alternatively, card-issuers could collect rents from consumers in the form of fees and interest revenue for longer-term loans. Assuming some bargaining process determines ρ, card-issuers may be willing to forgo earning rents from merchants if sufficient rents could be earned from consumers. Chakravorti and Emmons (1998) focus on the rents that could be extracted from liquidity-constrained consumers that highly discount future consumption.

4 Conclusion

In this article, we construct a model to investigate why merchants accept credit cards even though they are expensive to process. Given the two institutional features of credit cards—consumers rarely pay more when using their credit cards and are granted interest-free short-term credit—we have shown that a credit card equilibrium can exist. For such an equilibrium to exist, the cost of funds must be relatively low and the merchant's profit margin sufficiently high. In our model, consumers and the card issuer are strictly better off. But merchants are worse off even though

[9] This can be seen by substituting (17) into (15) and applying the proof of 2.

their two-period profit-maximizing decisions support the credit card equilibrium. In other words, merchants are willing to accept credit cards because they increase first period profits. However, this is offset by lower second period sales. A fixed payment made to merchants (perhaps in the form of volume discounts) could yield equilibria where type-2 merchants are also better off.

Further research into bilateral relationships among participants would increase our understanding of which participants pay for credit card transactions and why. One extension of the model that may help capture another feature of the credit card market and potentially increase rents to the card issuer is to allow consumers to borrow for another period but at a non-zero interest rate. This interest rate would be higher than the interest rate in the model to mimic the credit card market where there is a considerable gap between the supply of funds for credit-card issuers and the interest rate that they charge their customers. If additional rents could be earned by the extension of long-term credit, the merchant's profit margin may not need to be as large to support a credit card equilibrium.

Finally, we feel that as an explanation for why merchants accept credit cards, our model performs quite well. That is, credit increases sales because both purchases and incomes vary over time and with credit cards, 'credit worthy,' liquidity-constrained consumers are able to purchase—all else equal, merchants prefer to make a sale today rather than tomorrow. However, there are many other elements not captured in our model which influence the welfare of various agents. We present a simplified model of the credit card market to tractably focus attention on why merchants accept credit cards. To properly assess the welfare effects of credit card acceptance, one would need a general equilibrium setting which can capture other important elements of the credit card industry.

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