Pricing and Welfare Implications of Payment Card Network Competition

Fumiko Hayashi[*]

December 14, 2006

Payments System Research, Federal Reserve Bank of Kansas City
Working Paper 06-03

Preliminary. Please do not cite or quote without permission.

Abstract

This paper examines how competition among payment card networks—three-party scheme networks and four-party scheme networks—affects pricing as well as the welfare of various parties. A competing network has an incentive to provide rewards to its card users. By providing more generous rewards than its rival networks, the network can increase its own card transactions because multihoming cardholders—who hold multiple networks' cards—choose to use its card instead of using its rivals'. Although a monopoly network does not have such an incentive, in a monopoly four-party scheme network, competition among card issuers likely makes issuers provide rewards. Due to rewards, the merchant fees under competition can be higher than the merchant fees set by a monopoly network, unless the majority of cardholders are multihoming. Generally, cardholding consumers are better off under network competition. In contrast, non-cardholding consumers are better off only when network competition reduces merchant fees lower than those under monopoly. The results suggest that policies that simply encourage network competition will likely increase cardholder rewards but will not necessarily lower merchant fees in the U.S. payment card market. Several empirical indicators may possibly tell which direction the U.S. payments system needs to go.

[*] Payments System Research, Federal Reserve Bank of Kansas City, fumiko.hayashi@kc.frb.org. The views expressed in this paper are those of the author and do not necessarily reflect those of the Federal Reserve Bank of Kansas City or the Federal Reserve System.

1. Introduction

Credit and debit card payments have been growing very rapidly. In the United States, merchants have been experiencing higher costs of accepting payment cards, while many cardholders enjoy receiving rewards for their use of payment cards. Since rewards are partially funded by merchant fees, more generous rewards are likely to imply higher merchant fees.

Unlike other countries, the U.S. government agencies do not regulate payment card fees; rather they encourage competition among payment card networks.[1] As of June 2006, at least 50 lawsuits against major payment card networks have been filed. Many of them accuse the card networks of abusing monopoly power. Despite legal and policy-based initiatives for more competition in the payment card market, we know little about how payment network competition affects the price structure or levels and welfare of the various parties.

This paper first investigates how competition between three-party scheme payment card networks affects two prices, merchant fees and cardholder fees, and examines whether competition improves the welfare of the respective parties—cardholders, non-cardholders, merchants, and networks—compared with the welfare under a monopoly network. A three-party scheme card network issues cards, performs the services of the merchant acquirer, and sets both cardholder fees and merchant fees. After analyzing three-party scheme network competition, this paper considers more realistic network competition in the United States—four-party scheme network competition. In a four-party scheme card network, the network does not set cardholder fees and merchant fee directly: rather it sets interchange fees—transfer payments between the

[1] In 2004, the Department of Justice won the court case which required MasterCard and Visa to eliminate their exclusion rules that had prohibited member banks from issuing American Express and Discover cards. In a different case, the Department of Justice required First Data to divest NYCE network, a PIN-based debit network, when First Data acquired Concord EFS, which at the time was the owner of Star network, another PIN-based debit network.

card issuer and the merchant acquirer—to influence cardholder fees and merchant fees. Cardholder fees and merchant fees are set by card issuers and merchant acquirers, respectively.

This paper extends the analysis in Hayashi (2006b), which sought the highest merchant fees that competing (three-party scheme) networks would charge, given cardholder bases and cardholder fees, to include networks' or card issuers' cardholder fee setting behavior. In the analysis of three-party scheme network competition, each network is assumed to determine its cardholder fee first, and then determine its industry-specific merchant fees, given the cardholder bases. This assumption implies that the merchants' card acceptance does not affect consumers' cardholding. In the United States, typically interchange fees (and thus merchant fees) vary by industry.[2] An industry-specific interchange fee, say a supermarket interchange fee, is less likely to be set by accounting for the effects of the supermarkets' card acceptance on consumer cardholding. This assumption also implies that cardholder fees do not affect current cardholder bases. Although changing the network's cardholder fee likely affects the network's cardholder base, such effects will appear rather slowly. Instead, it likely has an immediate effect on existing cardholder's transactions—cardholders who also hold other networks' cards will use that network's card exclusively.

To reflect the reality, some assumptions are altered in the analysis of four-party scheme network competition. A four-party scheme network is assumed to determine its industry-specific interchange fees. Although each merchant acquirer sets its merchant fees, since the major component of merchant fees in the United States is interchange fees and merchant fees do not vary by merchant acquirer, each merchant acquirer is assumed to set its merchant fees at the

[2] See Hayashi and Weiner (2006) p. 96 for the variation of interchange fees of major payment card networks in the United States.

same level of the network's interchange fees. In contrast, cardholder fees (or rewards) vary greatly by issuer. Therefore, each card issuer is assumed to freely set its cardholder fee.

Several models of payment card markets have been developed to analyze the effect of network competition on price structure and/or price level.[3] Some of the models, however, do not necessarily fit well with U.S. markets with respect to two important features. First, some models assume either that consumers hold at most one card, or that merchants accept at most one branded card, or both (Manenti and Somma (2002), Chakravorti and Roson (2006)). Many U.S. consumers hold more than one card and many U.S. merchants accept more than one branded card.[4, 5] Second, some models assume that merchants do not have a strategic motive to accept cards (Rochet and Tirole (2003), Chakravorti and Roson (2006)). However, U.S. industries are competitive and many merchants claim that they are afraid of losing customers by rejecting cards the customers prefer.[6] Rochet and Tirole (2002) and Guthrie and Wright (2003, 2006) satisfy these two important features—they assume that some cardholders and some merchants are *multihoming* and that merchants accept cards for strategic reasons. A main difference between them is that while consumer cardholding is exogenously given in Rochet and Tirole, it is endogenized in Guthrie and Wright. They found that if all cardholders hold at most one card and merchants accept cards for strategic reasons, network competition does not result in lower interchange fees (and thus merchant fees), and that if some cardholders hold more than one card, network competition may lower interchange fees.[7]

---

[3] See, for example, Hayashi and Weiner (2006) that surveyed literature on payment card network competition.
[4] According to the Bank for International Settlements (2004), the number of debit cards and credit cards issued in the United States in 2002 were 260.4 million and 709 million, respectively. The U.S. population in the same year was 288.2 million.
[5] See, for example, the 2004 National Retail Census of Credit Cards.
[6] See, for example, a recent merchant survey conducted by the Association for Financial Professionals.
[7] Guthrie and Wright (2006) also showed the cases where network competition may *raise* interchange fees.

The basic framework of the model in this paper is built upon the model of Rochet and Tirole (2002). As mentioned above, the assumption of exogenously given consumer cardholding likely fits better than the assumption of endogenously determined consumer cardholding. In my model, however, not only networks' but also card issuers' behavior is taken into consideration.

As a benchmark case, this paper numerically solves equilibrium prices under competition between three-party scheme networks. This approach allows us to find equilibrium merchant fees under various cardholder fees and other parameter values. Even this approach, however, does not make it easier to find equilibrium cardholder fees. Because a network's cardholder fee is assumed to be the same regardless of in which industry the transactions occur, equilibrium cardholder fees need to reflect each industry's characteristics, such as the number of customers, share of cardholding customers, and merchants' and card users' transactional benefits, for all industries. Therefore, I seek to find equilibrium cardholder fees, assuming the number of industries is relatively small. As an initial step, the number of industries is assumed to be one or, in other words, all of the industries are assumed to have exactly the same characteristics in this paper.

The results suggest that a competing three-party scheme network has an incentive to provide rewards to its card users (set a negative cardholder fee). By providing more generous rewards than its rival network, the network can increase its own card transactions because multihoming cardholders choose to use its card instead of using its rival's card. In contrast, card issuers of a four-party scheme network do not always have an incentive to provide rewards to their cardholders. A monopoly three-party scheme network, however, does not have such an incentive.[8] At what level competing three-party scheme networks will set their rewards depends

[8] If providing rewards is just a fund transfer from merchants to card users and does not cost anything to the monopoly network, the network is indifferent in providing rewards or not.

on several factors. The share of multihoming cardholders among the total cardholders is one of the critical factors: when the share is relatively small, the networks will provide rewards as generous as possible; as the share gets larger, the networks will provide less generous rewards because they cannot charge higher merchant fees to cover generous rewards. Thus, it is possible that equilibrium merchant fees under network competition are higher than the merchant fee set by a monopoly network if the share of multihoming cardholders among the total cardholders is small enough. The sum of competing networks' net fee income (merchant fee minus reward), however, cannot exceed the monopoly network's net fee income.

Competition between three-party scheme networks impacts the welfare of cardholders, non-cardholders, merchants, and networks differently. Cardholders are always better off under network competition because they receive rewards. Non-cardholders are worse off under network competition if equilibrium merchant fees are higher than the monopolistic merchant fee level, because a higher merchant fee leads to a higher retail price. Since the model assumes that the merchant's retail price setting is completely flexible, the merchant's profits are the same under competition and under monopoly.[9] The total networks' profit under competition is always lower than the monopoly network's profit.

The effects of competition in which a four-party scheme network is involved are not so straightforward. Whether a four-party scheme network competes against another four-party scheme network or a three-party scheme network, to what degree and in what way the card issuers are competing, and whether card issuers are members of multiple networks would influence equilibrium prices and thus welfare.

The rest of this paper is organized as follows. Section 2 develops the model of three-party scheme network competition. The results of competition between three-party scheme networks are presented in section 3. Section 4 considers several different forms of competition in which a four-party scheme network is involved, as extensions of the model. Section 5 provides concluding remarks.

2. The model—three-party scheme card network

The basic framework of the model is the same as Hayashi (2006b). In the model, only two payment instruments are available—cash and card. Card payments are provided by two competing three-party scheme networks: Network 1 and Network 2. Both networks' cards, Card 1 and Card 2, provide the same transactional benefits to the card users and the merchants who accept those cards; the transactional benefit to card users is to reduce their transactional costs associated with a cash transaction, t_c, to zero and the transactional benefit to merchants is to reduce their transactional costs associated with a cash transaction, t_m, to zero. These transactional costs associated with a cash transaction do not vary by each individual consumer or merchant but vary by industry.[10] A card transaction does not create other benefits for either merchants or card users.[11] Each network *i* charges a universal cardholder fee to the card user, f_i, and an industry-specific merchant fee to the merchant, m_i, per transaction.[12] For consumers, the true cost of purchasing a good or service is $p+t_c$ with cash and $p+f_i$ with Card *i*, where p is the retail price charged by the merchant. For merchants, the true cost of selling a good or service is $d+t_m$ with cash and $d+m_i$ with Card *i*, where d is the cost of selling one unit of goods or

[9] See Hayashi (2006a) for the other case.
[10] Rationale for this assumption, see Hayashi (2006a).
[11] A credit card may create benefits other than transactional benefits to both card users and merchants. However, the paper focuses on industries where a credit card's revolving function is less important. Those industries may include grocery stores, drug stores, gas stations, and quick service food restaurants.
[12] Obviously, m_i vary by industry.

services regardless of the payment methods used for the transaction. To simplify the analysis, d is assumed to be zero.

The model assumes that cardholder bases are exogenously given to the networks. This also implies that the merchants' card acceptance in a given industry does not affect their customers' cardholding behavior. Therefore, a fraction of customers, α_i, hold Card i in a given industry. Some consumers (a fraction of $\sigma \geq 0$) are assumed to hold both cards (multihoming). By definition, the total cardholding consumers in a given industry, α, must satisfy $\alpha = \alpha_1 + \alpha_2 - \sigma$, and the number of multihoming cardholders must be less than both the number of Card 1 holders and the number of Card 2 holders, i.e., $\sigma \leq \alpha_1, \alpha_2$.

Given the cardholder bases, each network sets industry-specific merchant fees and a universal cardholder fee. Each network determines its cardholder fee first, and then determines industry-specific merchant fees. Thus, when determining an industry-specific merchant fee for a given industry, the network treats cardholder fees of its own and of its rival's as given. A network is assumed to maximize its revenue from merchant fees.[13]

The paper focuses on markets where merchants are competing against each other so that those merchants have strategic motives to accept cards. We assume that aggregate consumer demand is price inelastic and two merchants, Merchant A and Merchant B, are competing according to the Hotelling model. Consumers (mass 1) are uniformly distributed on the interval of [0,1], which is independent of their cardholding. Merchant A is located at point 0, and Merchant B is located at point 1. For the consumer located at point x, where $0 \leq x \leq 1$, the

[13] Equilibrium merchant fees under this assumption are likely lower than equilibrium merchant fees under the assumptions of profit maximizing. This is true if the cost per card transaction is higher than the cardholder fee, which is likely.

transportation cost to Merchant A is tx, and the transportation cost to Merchant B is $t(1-x)$. Merchants are required to set the same retail price for both card users and cash users.[14]

A merchant decides its card acceptance behavior from four choices: accept none, accept Card 1 only, accept Card 2 only, or accept both. If a merchant accepts both Card 1 and Card 2, multihoming cardholders use the card that gives them the higher net benefit (i.e., they use the card with the lower (higher) cardholder fee (rebate)). If a merchant accepts both cards, and if both cards have the same cardholder fee (rebate), multihoming cardholders are assumed to randomly choose to use either card, thus half of them use Card 1 and half of them use Card 2.

The timing of the game is as follows:

(I) Given cardholder bases in each industry, each payment card network sets a universal cardholder fee.

(II) Given cardholder fees, each payment card network sets industry-specific merchant fees.

(III) Each merchant decides whether to accept cards (neither, Card 1 only, Card 2 only, or both) and determines its retail price.

(IV) A consumer decides from which merchant he or she makes purchases and which payment method he or she uses (if a cardholder).

Starting with stage (IV), a cardholder is willing to use her card if the cardholder fee she pays to the network, f_1 or f_2, does not exceed transactional costs associated with cash, t_c, since the merchant sets a unique retail price for all of its customers. If the merchant accepts both cards, and if the consumer holds both cards, then she will use the card with the lower cardholder fee.

Suppose $t_c > f_1, f_2$. At stage (III), the merchants decide whether to accept cards and determine the retail prices. Suppose that both cards have been accepted in the industry for a long

---

[14] This is due to the no surcharge rule imposed by card networks.

time. In such an industry, when a merchant decides its card acceptance behavior, it is likely that the merchant expects its rival will accept both cards.[15] Suppose that one of the merchants, say Merchant B, accepts both cards. Merchant A selects its card acceptance behavior from four choices: accepts both, accepts Card 1 only, accepts Card 2 only, or accepts neither. First, let us consider the case where Merchant A accepts both cards. Given Merchant B's retail price p_B, Merchant A's profit function is defined as:

(1) $$\pi_A(p_A) = \{(p_A - t_m)(1-\alpha) + (p_A - m_1)(\alpha_1 - \rho\sigma) + (p_A - m_2)(\alpha_2 - (1-\rho)\sigma)\}\frac{t + p_B - p_A}{2t},$$

where ρ depends on f_1 and f_2. When $f_1 = f_2$, $\rho = 0.5$; when $f_1 > f_2$, $\rho = 1$; and when $f_1 < f_2$, $\rho = 0$. Similarly, Merchant B's profit function is defined. Equilibrium retail prices are:

(2) $$p_A = p_B = t + (1-\alpha)t_m + (\alpha_1 - \rho\sigma)m_1 + (\alpha_2 - (1-\rho)\sigma)m_2.$$

Merchant A's profit is:

(3) $$\pi_A(A:\text{both}; B:\text{both}) = \frac{t}{2}.$$

Second let us consider the case where Merchant A accepts neither card. Merchant A's profit function is defined as:

(4) $$\pi_A(p_A) = (p_A - t_m)\{\frac{t + p_B - p_A}{2t} - (\alpha_1 - \rho\sigma)\frac{t_c - f_1}{2t} - (\alpha_2 - (1-\rho)\sigma)\frac{t_c - f_2}{2t}\},$$

and Merchant B's profit function is defined as:

(5) $$\begin{aligned}\pi_B(p_B) = &\{(p_B - t_m)(1-\alpha) + (p_B - m_1)(\alpha_1 - \rho\sigma) + (p_B - m_2)(\alpha_2 - (1-\rho)\sigma)\}\frac{t + p_A - p_B}{2t} \\ &+ (p_B - m_1)(\alpha_1 - \rho\sigma)\frac{t_c - f_1}{2t} + (p_B - m_2)(\alpha_2 - (1-\rho)\sigma)\frac{t_c - f_2}{2t}.\end{aligned}$$

Equilibrium retail prices are:

[15] See Hayashi (2006a) for detailed discussion.

(6) $p_A = t + (1 - \frac{\alpha}{3})t_m + \frac{\alpha_1 - \rho\sigma}{3}(m_1 - (t_c - f_1)) + \frac{\alpha_2 - (1-\rho)\sigma}{3}(m_2 - (t_c - f_2))$,

(7) $p_B = t + (1 - \frac{2\alpha}{3})t_m + \frac{\alpha_1 - \rho\sigma}{3}(2m_1 + (t_c - f_1)) + \frac{\alpha_2 - (1-\rho)\sigma}{3}(2m_2 + (t_c - f_2))$.

Merchant A's profit is:

(8) $\pi_A(A:\text{neither}; B:\text{both}) = \frac{1}{2t}\{t - \frac{\alpha_1 - \rho\sigma}{3}(m_1^m - m_1) - \frac{\alpha_2 - (1-\rho)\sigma}{3}(m_2^m - m_2)\}^2$,

where m_1^m ($= t_m + t_c - f_1$) and m_2^m ($= t_m + t_c - f_2$) are the merchant fees if each of the networks sets its merchant fee monopolistically. From equations 3 and 8, if Merchant B accepts both cards, Merchant A is better off by accepting both cards than by rejecting both cards, as long as each of the networks sets its merchant fee lower than the fee set by a monopoly network.

Lastly, let us consider the case where Merchant A accepts either Card 1 or Card 2. Merchant A's profit function by accepting only Card *i* (*i*=1 or 2) depends on f_i and f_j ($j \neq i$). If $f_i \le f_j$, Merchant A's profit function is defined as:

(9) $\pi_A(p_A) = \{(p_A - t_m)(1 - \alpha_i) + (p_A - m_i)\alpha_i\}\frac{t + p_B - p_A}{2t} - (p_A - t_m)(\alpha_j - \sigma)\frac{t_c - f_j}{2t}$;

and if $f_i > f_j$, Merchant A's profit function is:

(10)
$$\pi_A(p_A) = \{(p_A - t_m)(1 - \alpha_i) + (p_A - m_i)\alpha_i\}\frac{t + p_B - p_A}{2t} - (p_A - m_i)\sigma\frac{f_i - f_j}{2t} - (p_A - t_m)(\alpha_j - \sigma)\frac{t_c - f_j}{2t}.$$

Merchant B's profit function also depends on f_i and f_j. When $f_i < f_j$,

(11)
$$\pi_B(p_B) = \{(p_B - t_m)(1 - \alpha) + (p_B - m_i)\alpha_i + (p_B - m_j)(\alpha_j - \sigma)\}\frac{t + p_A - p_B}{2t} + (p_B - m_j)(\alpha_j - \sigma)\frac{t_c - f_j}{2t};$$

when $f_i = f_j$,

$$\pi_B(p_B) = \{(p_B - t_m)(1-\alpha) + (p_B - m_i)(\alpha_i - \frac{\sigma}{2}) + (p_B - m_j)(\alpha_j - \frac{\sigma}{2})\}\frac{t + p_A - p_B}{2t} \tag{12}$$
$$+ (p_B - m_j)(\alpha_j - \sigma)\frac{t_c - f_j}{2t};$$

and when $f_i > f_j$,

$$\pi_B(p_B) = \{(p_B - t_m)(1-\alpha) + (p_B - m_i)(\alpha_i - \sigma) + (p_B - m_j)\alpha_j\}\frac{t + p_A - p_B}{2t} \tag{13}$$
$$+ (p_B - m_j)(\alpha_j - \sigma)\frac{t_c - f_j}{2t}.$$

Equilibrium prices are given when $f_i < f_j$

(14) $p_A = t + (1 - \alpha_i - \frac{\alpha_j - \sigma}{3})t_m + \alpha_i m_i + \frac{\alpha_j - \sigma}{3} m_j - \frac{\alpha_j - \sigma}{3}(t_c - f_j)$,

(15) $p_B = t + (1 - \alpha_i - \frac{2(\alpha_j - \sigma)}{3})t_m + \alpha_i m_i + \frac{2(\alpha_j - \sigma)}{3} m_j + \frac{\alpha_j - \sigma}{3}(t_c - f_j)$;

when $f_i = f_j$,

(16) $p_A = t + (1 - \alpha_i - \frac{\alpha_j - \sigma}{3})t_m + (\alpha_i - \frac{\sigma}{6})m_i + \frac{2\alpha_j - \sigma}{6} m_j - \frac{\alpha_j - \sigma}{3}(t_c - f_j)$,

(17) $p_B = t + (1 - \alpha_i - \frac{2(\alpha_j - \sigma)}{3})t_m + (\alpha_i - \frac{\sigma}{3})m_i + \frac{2\alpha_j - \sigma}{3} m_j + \frac{\alpha_j - \sigma}{3}(t_c - f_j)$;

and when $f_i > f_j$,

(18) $p_A = t + (1 - \alpha_i - \frac{\alpha_j - \sigma}{3})t_m + (\alpha_i - \frac{\sigma}{3})m_i + \frac{\alpha_j}{3} m_j - \frac{\alpha_j - \sigma}{3}(t_c - f_j) - \frac{\sigma}{3}(f_i - f_j)$,

(19) $p_B = t + (1 - \alpha_i - \frac{2(\alpha_j - \sigma)}{3})t_m + (\alpha_i - \frac{2\sigma}{3})m_i + \frac{2\alpha_j}{3} m_j + \frac{\alpha_j - \sigma}{3}(t_c - f_j) + \frac{\sigma}{3}(f_i - f_j)$.

Merchant A's profit is therefore given when $f_i < f_j$,

(20) $\pi_A(A:\text{Card } i; B:\text{both}) = \frac{1}{2t}[\{t - \frac{\alpha_j - \sigma}{3}(m_j^m - m_j)\}^2 - \alpha_i(\alpha_j - \sigma)(t_c - f_j)(m_i - t_m)]$;

when $f_i = f_j$,

$$\pi_A(A:\text{Card } i; B:\text{both})$$

(21)
$$= \frac{1}{2t}[\{t - \frac{\alpha_j - \sigma}{3}(m_j^m - m_j) + \frac{\sigma}{6}(m_j - m_i)\}^2 - \alpha_i(\alpha_j - \sigma)(t_c - f_j)(m_i - t_m)];$$

and when $f_i > f_j$,

(22)
$$\pi_A(A:\text{Card } i; B:\text{both}) = \frac{1}{2t}[\{t - \frac{\alpha_j}{3}(m_j^m - m_j) + \frac{\sigma}{3}(m_i^m - m_i)\}^2$$
$$- \{\alpha_i(\alpha_j - \sigma)(t_c - f_j) - (1 - \alpha_i)\sigma(f_i - f_j)\}(m_i - t_m)].$$

Suppose both networks set their merchant fees lower than the monopoly fees (i.e., $m_1 \le m_1^m$ and $m_2 \le m_2^m$). Given that Merchant B accepts both cards, Merchant A accepts only one card if and only if:

(23) $\text{Max}\{\pi_A(A:\text{Card 1}; B:\text{both}), \pi_A(A:\text{Card 2}; B:\text{both})\} > \pi_A(A:\text{both}; B:\text{both}) = \frac{t}{2}$.

At stage (II), each network sets its merchant fee, given its rival network's merchant fee, and both networks' cardholder bases and cardholder fees. Given Network 2's merchant fee, m_2, Network 1 has two strategies: 1) "undercuts" and 2) prevents Network 2 from "undercutting."[16] Network 1's "undercut" is successful if one of the two merchants accepts Card 1 only. By undercutting, Network 1 may be able to increase its market share in terms of the number of transactions. Denote G_1 as the Network 1's reaction function when Network 1 undercuts given m_2, i.e., $\underline{m}_1 = G_1(m_2)$, and denote g_1 as the Network 1's reaction function when Network 1

[16] Actually, there is another strategy for Network 1: it can allow Network 2 to undercut at the merchant fee of m_2. However, this strategy is always inferior to the strategy that prevents Network 2 from undercutting.

prevents Network 2 from undercutting given m_2, i.e., $\overline{m}_1 = g_1(m_2)$. Similarly, Network 2 has two strategies. Denote G_2 and g_2 as Network 2's reaction functions.

Equilibrium merchant fees (m_1^*, m_2^*) are defined as follows: First, neither network can earn more by undercutting its rival network. This condition is described in equation 24 below.

(24) $E_i(m_i^*, m_j^*) \geq E_i(G_i(m_j^*), m_j^*)$,

where E_i is the earning function of Network *i* (*i*=1, 2). Second, given its rival's merchant fee, m_j^*, Network *i* (*i*=1 or 2 or both) may be able to earn more by setting a merchant fee, $g_i(m_j^*)$, that prevents its rival network from undercutting at m_j^*. However, if that is the case, its rival network should set its merchant fee at $G_j(g_i(m_j^*))$ to undercut and as a result Network *i*'s, earning should be lower than the equilibrium earning. This implies that if equation 25 holds:

(25) $E_i(g_i(m_j^*), m_j^*) \geq E_i(m_i^*, m_j^*)$,

then, equations 26 and 27 must hold.

(26) $E_j(G_j(g_i(m_j^*)), g_i(m_j^*)) \geq E_j(m_j^*, g_i(m_j^*))$,

(27) $E_i(g_i(m_j^*), G_j(g_i(m_j^*))) \leq E_i(m_i^*, m_j^*)$.

At stage (I), each network sets its cardholder fee, given its rival network's cardholder fee, and both networks' cardholder bases. Equilibrium cardholder fees (f_1^*, f_2^*) are defined as follows.

(28)
$$\begin{aligned} f_1^* &= \arg\max \pi_1(f_1, f_2^*) \\ &= \arg\max \sum_{n=1}^{N} D_n(\alpha_{1,n} - \rho\sigma_n)(m_{1,n}^* + f_1 - s), \end{aligned}$$

where D_n is the measure of consumers in industry *n*, $\alpha_{1,n}$ is a fraction of customers who hold Card 1 in industry *n*, ρ depends on f_1 and f_2^*, σ_n is a fraction of customers who hold both Cards 1 and 2 in industry *n*, $m_{1,n}^*$ is the equilibrium merchant fee set by Network 1 in industry *n*, and *s* depends on f_1. When $f_1 = f_2^*$, $\rho = 0.5$; when $f_1 > f_2^*$, $\rho = 1$; and when $f_1 < f_2^*$, $\rho = 0$. *s* is the resource cost of providing reward per transaction, therefore if Network 1 charges zero or a positive cardholder fee ($f_1 \geq 0$), then *s*=0, otherwise *s*>0.

3. Competition between two three-party scheme card networks

Due to the complexity of the model developed in the previous section, general analytical results cannot be easily obtained. This section, therefore, takes a numerical approach. Because a network's cardholder fee is assumed to be the same regardless of in which industry the transactions occur, equilibrium cardholder fees need to reflect each industry's characteristics, such as size of market (D_n), share of cardholding customers ($\alpha_{1,n}$, $\alpha_{2,n}$, and σ_n), merchants' and card users' transactional benefits ($t_{m,n}$ and $t_{c,n}$), and merchant's markup per transaction (t_n), for all industries. In order to deal with this complexity, I assume all industries have exactly the same characteristics.

3.1 Pricing under network competition—providing rewards to card users

As the simplest scenario, I assume that all of the industries have the same characteristics. I consider two cases; (i) two networks' cardholder bases are symmetric and (ii) two networks' cardholder bases are asymmetric.

The following variables are treated as parameters in the numerical examples.

α : share of cardholding customers in the total customer base,

σ / α : share of multihoming cardholders in the total cardholding customer base,

t_m : a merchant's transactional benefit relative to t, (merchant's markup per transaction),

t_c : a card user's transactional benefit relative to t,

c : ratio of Network 2's cardholder base to Network 1's cardholder base.

(i) Symmetric cardholder bases

When both networks' cardholder bases are the same ($\alpha_1 = \alpha_2$), equilibrium cardholder fees are symmetric and equilibrium merchant fees are symmetric. At equilibrium both merchants in any industries accept both cards. As long as singlehoming cardholders and multihoming cardholders coexist ($0<\sigma / \alpha<1$), competing networks set a negative cardholder fee, i.e., they provide rewards to card users. Here, I assume that the maximum reward is equal to 1 (which is equivalent to assuming that reward cannot exceed the merchant's markup per transaction).

For relatively large σ / α, there exist multiple equilibria: All equilibria are symmetric because neither network has an incentive to set a different cardholder fee from its rival network's in the range between the highest and lowest reward level. If a network, say Network 1, sets a lower cardholder fee (the higher reward level) than Network 2's, all multihoming cardholders are willing to use Network 1's cards. However, now, Network 2 may have a stronger incentive to undercut than when both networks set the same cardholder fee. Since Network 1 does not want to set its merchant fee to one that induces Network 2 to undercut, its merchant fee may become much lower than it would be otherwise.[17] If the increased transactions are big enough to compensate for the losses from lower cardholder fee and lower merchant fee, then Network 1 will set a lower cardholder fee than Network 2's cardholder fee, but otherwise it will not do so. Similarly, we can show that a network has an incentive to set a higher cardholder fee than its

[17] See Hayashi (2006b) section 3.3 for detailed discussions of equilibrium merchant fees.

rival's under some circumstances. Although all multihoming cardholders use its rival's cards, the network can set its merchant fee as high as the level where no merchants will reject its cards. If the higher merchant fee and higher cardholder fee can compensate for the loss of transactions, the network will set a higher cardholder fee than its rival's cardholder fee; if not, then the network will set a cardholder fee at the same level or lower than its rival's.

Chart 1 shows the equilibrium cardholder fee (shown as reward) and merchant fee, assuming that the resource cost of providing rewards per transaction, *s*, is negligible. For a given combination of α, t_m, and t_c, when the share of multihoming cardholders in the total cardholder base is small ($0<\sigma/\alpha<0.2$), both networks set the reward level as high as possible. When all cardholders are multihoming, ($\sigma/\alpha=1$), the equilibrium reward level and equilibrium merchant fee are both zero. When the share of multihoming cardholders is in the middle range ($0.3<\sigma/\alpha<1$), multiple equilibria likely exist. Although there are some bumps, as the share of multihoming cardholders increases, the equilibrium reward level gets lower.

By comparing panels 1, 2, and 3 in chart 1, one can see the effects of the merchant transactional benefit (t_m) and card user transactional benefit (t_c) on the equilibrium reward and merchant fee. While t_m has little influence on the range of σ/α where both networks provide rewards as generous as possible, t_c does affect the range: the higher the card user transactional benefit, the broader the range where both networks set a reward level as high as possible. For a relatively greater σ/α, both t_m and t_c influence the equilibrium reward and merchant fee. The higher the t_m or t_c, the higher the level of reward/merchant fee.

Let us compare the equilibrium cardholder fee (reward) and merchant fee with the fees set by a monopoly network. A monopoly network has no incentive to provide rewards because by doing so it cannot increase its profit. Rather, the network will lose profit because providing rewards requires an additional resource cost to the network, even if the cost is negligible. Therefore, the highest merchant fee the monopoly network charges is the sum of t_m and t_c. ($f^m = 0$ and $m^m = t_m + t_c$.) It may not be surprising that the cardholder rebate under competition is always more generous than the cardholder rebate provided by a monopoly network; however, it may be surprising that the merchant fee under competition is higher than the merchant fee under monopoly even when the share of multihoming cardholders in the total cardholder bases is around 0.5. In order to have an equilibrium merchant fee that is lower than the merchant fee set by a monopoly, the share of multihoming cardholders needs to be greater than 0.8.

(ii) Asymmetric cardholder bases

When two networks' cardholder bases are asymmetric ($\alpha_1 \neq \alpha_2$), the asymmetric equilibrium rebate is relatively rare, but the equilibrium merchant fees are likely asymmetric. In any industries, both merchants accept both cards at equilibrium. Without loss of generality, I assume that Network 1's cardholder base is greater than Network 2's (c<1). Because multihoming cardholders cannot exceed the smaller network's cardholder base, ($\sigma \leq \alpha_2$), the share of multihoming cardholders in the total cardholder base (σ / α) should be equal to or less than c.

Chart 2 shows the (weighted) average equilibrium reward and merchant fee, assuming that the resource cost of providing rewards per transaction, s, is negligible. When the difference in cardholder bases is relatively small (panel 1), as the share of multihoming cardholders increases, the equilibrium reward level gets lower. When the difference in cardholder bases is relatively large (panel 2), both networks may set the reward level as high as possible for the entire range of σ / α. For a relatively large share (σ / α>0.5), the average equilibrium reward under asymmetric cardholder bases is higher than the equilibrium reward under symmetric cardholder bases. The average equilibrium merchant fee under asymmetric cardholder bases, however, is not necessarily higher than the equilibrium merchant fee under symmetric cardholder bases. Due to the upper limit of σ / α created by asymmetric cardholder bases, it is possible that for the entire range of σ / α, the average equilibrium merchant fee under competition is higher than the merchant fee set by a monopoly network.

3.2 Welfare implications

How does network competition affect the welfare of various parties—cardholders, non-cardholders, merchants, and networks? When two networks' cardholder bases are symmetric, a competing network can charge a merchant fee at most as high as the sum of the merchant and card user transactional benefit ($t_m + t_c$) and rewards ($-f$). Therefore, the net revenue per transaction, which is the merchant fee minus reward, is at most as high as $t_m + t_c$. When two networks' cardholder bases are asymmetric, the network with larger cardholder bases will charge merchants a fee that is higher than $t_m + t_c - f$ in some cases. Nevertheless, the average equilibrium merchant fee minus the average equilibrium rewards is at most as high as $t_m + t_c$. A monopoly network, on the other hand, always earns $t_m + t_c$ per transaction. Since the total number of card transactions under competition and that under monopoly are the same, the sum of competing networks' net revenues is less than or equal to the monopoly network's net revenue. In addition, competing networks incur the cost of providing rewards, s per transaction, while the monopoly network does not. Thus, the networks' profit as a whole under competition is lower than that under monopoly.

Each merchant always earns the same profit, regardless of whether payment card networks are competing or not. When payment card networks are competing, both merchants in a given industry accept both cards at equilibrium. From equation 3, a merchant's profit is $t/2$. Previous studies showed that a merchant's profit under a monopoly network is also $t/2$.[18] The welfare of merchants is not affected by network competition.

Cardholders are always better off under network competition because of the reward, even if the retail price they pay may be higher. From equation 2, when networks compete, the retail price charged by a merchant is $p^c = t + t_m + \alpha(m^c - t_m)$, where m^c is either the equilibrium merchant fee when two networks' cardholder bases are symmetric or the average equilibrium merchant fees when cardholder bases are asymmetric. As discussed above, m^c is as high as $t_m + t_c - f^c$. As previous studies showed, when a monopoly network provides payment cards, the retail price charged by a merchant is $p^m = t + t_m + \alpha t_c$. Because of the rewards provided by competing networks ($f^c \leq 0$), a card user's transactional cost under competition, $p^c + f^c$, is always lower than that under monopoly, $p^m + f^m$.

The non-cardholders' surplus solely depends on the retail price charged by a merchant, and the retail price depends on the average merchant fee. As was seen in the previous subsection, the average merchant fee under competition is lower than that under monopoly only when the share of multihoming cardholders among the total cardholders is quite large (σ/α>0.8). Therefore, non-cardholders are worse off under competition when the share of multihoming cardholders is small. Especially when two networks' cardholder bases are quite different, non-cardholders are always worse off under competition.

[18] Rochet and Tirole (2002) and Hayashi (2006a).

The aggregate consumers' surplus depends on the aggregate transactional cost to consumers. The aggregate transactional cost to consumers under competition is $p^c + \alpha f^c + (1-\alpha)t_c$ and that under monopoly is $p^m + (1-\alpha)t_c$. Clearly, $p^c + \alpha f^c \leq p^m$. Thus, the aggregate consumers' surplus under competition is higher or at least the same as that under monopoly.

If the social welfare is measured by simply aggregating consumers', merchants' and networks' surplus, the social welfare is always lower under network competition than under monopoly because providing rewards is costly. When the majority of cardholders are multihoming, network competition will shift the surplus from networks to consumers, while when the majority of cardholders are singlehoming, network competition could enlarge the inequality between cardholders and non-cardholders.

4. Extensions

Sections 2 and 3 assumed networks are three-party schemes and thus they determine both cardholder fees and merchant fees. In the United States, however, most networks are four-party scheme networks.[19] This section considers the effects of competition in which a four-party scheme network is involved.

In contrast to a three-party scheme network, a four-party scheme network does not set its cardholder fees and merchant fees directly. Instead, it sets interchange fees—the transfer payments typically paid by merchant acquirers to card issuers—to influence the cardholder fees and merchant fees. Cardholder fees and merchant fees are set by individual card issuers and merchant acquirers, respectively.

[19] American Express and Discover used to be representatives of three-party scheme networks, but after the court ruling in 2004, several larger banks started issuing American Express cards. Discover signature debit cards are now issued by several banks.

Although each merchant acquirer sets its merchant fees, the major component of merchant fees is interchange fees and merchant fees do not vary by merchant acquirer very much. Therefore, I assume each merchant acquirer sets its industry-specific merchant fees at the level of the network's industry-specific interchange fees. Cardholder fees (or rewards), on the other hand, vary greatly by issuer. I assume each card issuer freely sets its cardholder fee (or reward). A four-party scheme network's objective is likely to maximize its members' joint profit. In order to achieve this objective, the network sets its interchange fees by anticipating each card issuer's cardholder fee (or at least the average cardholder fee).

Outcomes of network competition in which a four-party scheme network is involved depend on various factors. In addition to the factors discussed in the previous sections, whether a four-party scheme network competes against another four-party scheme network or a three-party scheme network, to what degree and in what way the card issuers are competing, and whether card issuers join both networks when two four-party scheme networks are competing against each other would influence equilibrium prices and welfare.

4.1 Competition between a four-party and a three-party scheme card network

If the four-party scheme network can determine its cardholder fees and impose the cardholder fees on each card issuer, then equilibrium cardholder fees (rewards) and merchant fees obtained in section 3 also are equilibrium prices under competition between the four-party scheme network and a three-party scheme network. However, in the four-party scheme network card issuers do not necessarily choose the cardholder fees that the network would set.

As assumed for networks, let us assume that cardholder bases are given to card issuers (i.e., cardholder fees do not affect each card issuer's cardholder base). First, let us consider situations where the card issuing market is the least competitive. Suppose the four-party scheme network has two card issuers.[20] Suppose also cardholders hold at most one card from the *same* brand. This means, multihoming cardholders hold one card of the three-party scheme network and one card of the four-party scheme network; and singlehoming cardholders hold at most one card—either one card of the three-party scheme network or one card of the four-party scheme network. Consider two extreme cases: in one case, all cardholders of one card issuer (say Issuer A) are singlehoming, while all cardholders of the other card issuer (say Issuer B) are multihoming; and in the other case, the two card issuers have identical cardholder bases (i.e., the share of multihoming cardholders in one card issuer's cardholder base equals that in the other card issuer's cardholder base).

In the first case, Issuer A has no incentive to provide rewards to its cardholders, while Issuer B sets its rewards (at least) at the level of the three-party scheme network's cardholder rewards. As a result, the average cardholder rewards in the four-party scheme network is lower than the cardholder rewards in the three-party scheme network. Because a network's merchant fees reflect the average cardholder rewards in the network (especially when the share of multihoming cardholders is small), the merchant fees in the four-party scheme are likely lower than the merchant fees in the three-party scheme network.

In the second case, equilibrium cardholder rewards and merchant fees will depend on the share of multihoming cardholders in the total cardholder bases. When the share of multihoming cardholders is large, equilibrium cardholder rewards and merchant fees are likely the same as equilibrium cardholder rewards and merchant fees, respectively, under competition between two three-party scheme networks. In order not to lose transactions by multihoming cardholders, two card issuers in the four-party scheme network will set their cardholder rewards at the level of the

[20] If there is only one card issuer in the four-party scheme network, the network acts as if it is a three-party scheme network.

rival three-party scheme network's cardholder rewards when the share of multihoming cardholders is large. In contrast, when the share of multihoming cardholders is small enough, a card issuer has an incentive to set lower cardholder rewards than the other card issuer's cardholder rewards. By doing so, the card issuer may lose transactions of multihoming cardholders, but per-transaction profit becomes higher because the four-party scheme network sets its interchange fees by accounting for the average cardholder rewards. As a result, equilibrium cardholder rewards and merchant fees are likely lower under competition between a four-party scheme and a three-party scheme network.

Now, let us consider situations where the card issuing market is more competitive. In two ways, the card issuing market becomes more competitive. One, the number of card issuers increases, and two, more cardholders hold more than one card from the same brand. These two likely lead cardholder rewards in the opposite direction.

If more card issuers belong to the four-party scheme network, each card issuer is more likely to have an incentive to set lower cardholder rewards than the network average. It is likely that card issuers become more heterogeneous as more card issuers belong to the network. Some issuers may have relatively smaller shares of multihoming cardholders compared to the other card issuers. Then, those issuers likely set lower cardholder rewards. Even if all card issuers are homogeneous (i.e., all card issuers have the same share of multihoming cardholders), each card issuer is more likely to set lower cardholder rewards. A card issuer's lowering of cardholder rewards has little effect on the network's interchange fees, because each card issuer's share in the network is now small. Therefore, the increase in per-transaction profit by lowering rewards will be more likely to offset the loss of transactions by multihoming cardholders.

In contrast, if more cardholders hold more than one card from the four-party scheme network, then card issuers will be less likely to reduce their cardholder rewards; rather they may have an incentive to set higher cardholder rewards than their rival card issuers. Consider a case where two card issuers—Issuer A and Issuer B—belong to the four-party scheme network, and some cardholders hold two four-party scheme network cards, one is issued by Issuer A and one is issued by Issuer B. If some of these cardholders do not hold a three-party scheme network card, they are "singlehoming" cardholders from the networks' perspective, but are "multihoming" cardholders from the card issuers' perspective. In this case, if a card issuer, say Issuer A, sets its cardholder rewards lower than Issuer B, then Issuer A will lose transactions by its customers who also hold a card issued by Issuer B. Obviously, some of these cardholders are singlehoming from the networks' perspective. Although Issuer A can increase per-transaction profit by reducing its cardholder rewards, the loss from losing transactions by the customers who hold two four-party scheme network's cards (multihoming cardholders from the card issuers' perspective) may exceed the gain from the increased per-transaction profit.

Equilibrium cardholder rewards and merchant fees under competition between a four-party scheme network and a three-party scheme network greatly depend on whether the card issuing market is competitive, and if so, in what way the card issuers are competing. If the share of multihoming cardholders from the *card issuers*' perspective is relatively small, at equilibrium the average cardholder rewards in the four-party scheme network is likely lower than the equilibrium cardholder rewards under competition between two three-party scheme networks. As more card issuers belong to the network, this will be more likely to happen. If, on the other hand, the share of multihoming cardholders from the *card issuers'* perspective is relatively large, card issuers will be less likely to set their cardholder rewards lower. It is possible that, at equilibrium, the average cardholder rewards in the four-party scheme network can be greater than the equilibrium cardholder rewards under competition between two three-party scheme networks. Equilibrium merchant fees, however, are not necessarily higher under the competition between a four-party scheme network and a three-party scheme network. Especially when the share of multihoming cardholders from the *networks*' perspective is large, merchants are more likely to reject the network's cards with the higher merchant fees, and therefore the four-party scheme network cannot set its merchant fees higher than a certain level.

4.2 Competition between two four-party scheme card networks

Under competition between two four-party scheme networks, it is possible that some card issuers belong to both of the networks. If every card issuer is a member of at most one network, the analysis in the previous subsection is applicable. This subsection, therefore, focuses on cases where some card issuers are members of both of the networks.[21]

When each card issuer belongs to only one network or the other, multihoming cardholders from the *networks'* perspective are also multihoming cardholders from the *card issuers'* perspective. In contrast, when some card issuers belong to both networks, some multihoming cardholders from the *networks'* perspective can be singlehoming cardholders from the *card issuers'* perspective. For example, a cardholder holds two cards (say one MasterCard card and one Visa card), that are issued by the same issuer, and he does not hold any other cards. Regardless of which card he uses, his transactions always bring interchange fee revenue to a single card issuer. Therefore, this person is a singlehoming from the issuers' perspective.

Card issuers always have an incentive to provide rewards to their customers when card issuers compete for their customers' transactions (i.e., some of their customers are multihoming from the issuers' perspective), either under competition between a four-party scheme and a three-party scheme network or under competition between two four-party scheme networks. Unlike under competition between a four-party scheme versus a three-party scheme network, card issuers may also provide rewards to its customers even when they do not compete for their customers' transactions under competition between two four-party scheme networks. Suppose a card issuer's customers are all singlehoming cardholders from the card issuers' perspective, and some of them hold both networks' cards. Suppose also a network's interchange fees are higher than the other network's. In this case, the card issuer will provide rewards to its customers if they use a card with the higher interchange fees. The cardholders will use a card with (greater) rewards, and as a result, the card issuer can earn greater per-transaction profit. Because a four-party scheme network's objective is to maximize its members' joint profit within the network, the network will try to set higher interchange fees than its rival network. By setting higher interchange fees, the network will likely increase its transaction volume and thus members' joint profit.

While three-party scheme networks compete for their customers' transactions directly, four-party scheme networks cannot do so. If no card issuer belongs to multiple networks, four-party scheme networks can have little effect over their card issuers' cardholder rewards setting decisions. Cardholder rewards are almost solely determined by competitive parameters in the card issuing market. If, instead, some card issuers belong to multiple networks, then four-party scheme networks can affect their card issuers' rewards setting by using interchange fees. Four-party scheme networks compete for card issuers by offering higher interchange fees. Higher interchange fees provide card issuers an incentive to entice their customers to use a card with the

[21] This assumption is realistic. The majority of the largest credit card issuers in the United States issue both Visa and MasterCard in 2006 (*Nilson Report* No.849). Some of them also issue American Express.

higher interchange fees. Then, card issuers react to the higher interchange fees, by providing (greater) rewards to their customers if they use a card with the higher interchange fees. In this way, interchange fees can be strategically used by four-party scheme networks to affect their cardholder rewards.

5. Conclusion

This paper examined the effects of network competition on pricing and the welfare of various parties. A competing network has an incentive to provide rewards to its card users. By providing more generous rewards than its rival networks, the network can increase its own card transactions because cardholders who hold multiple networks' cards choose to use its card instead of using its rivals'. A three-party scheme network can directly control its cardholder rewards, while a four-party scheme network can indirectly control its rewards through interchange fees only when its card issuers belong to its rival networks. In contrast, a monopoly network does not have an incentive to provide rewards. However, this does not imply that no rewards are provided in the monopoly network. If the monopoly network is a four-party scheme network, and if its card issuers compete for transactions of their customers who hold more than one card, then issuers likely provide rewards to their customers. Thus, cardholder rewards depend not only on competition among networks but also on competition among card issuers.

Due to rewards, it is possible that equilibrium merchant fees under network competition are higher than the merchant fee set by a monopoly network. It is only when the share of multihoming cardholders—cardholders who hold multiple networks' cards—among the total cardholders is large enough that merchants can reject cards with higher merchant fees, and thus equilibrium merchant fees under network competition are lower than those under monopoly network.

Compared with the case under a monopoly three-party scheme network, network competition will always make cardholders better off. Even under a monopoly network, as competition among card issuers for their customers' transactions becomes more intense, cardholders likely become better off. In contrast, non-cardholders likely become worse off under network competition and under card issuer competition. Non-cardholders are better off only when network competition reduces the merchant fees below the merchant fee set by a monopoly network.

The results obtained in this paper suggest that policies that simply encourage network competition will likely increase cardholder rewards, but will not necessarily lower merchant fees. In the United States, general-purpose credit cards are provided by four networks and debit cards are provided by more than ten networks. Although these payment card networks are competing vigorously, one network's cardholder base is significantly larger.[22] Therefore, the share of multihoming cardholders (from the networks' perspective) among the total cardholders is not likely large enough to reduce merchant fees. Furthermore, greater cardholder rewards resulted from network competition and competition among card issuers will likely make cardholders act as if they were 'singlehoming' even when they actually hold multiple cards. Several studies have reported that consumers who hold multiple cards use their most preferred cards exclusively and that their card preferences are tied with rewards programs.[23]

---

[22] In the U.S. credit card market, Visa has the largest market share in terms of the number of cards, followed by MasterCard, Discover, and American Express. According to a consumer survey, MasterCard's cardholder base is about 80 percent of Visa's cardholder base and 45 percent of consumers who hold either Visa or MasterCard hold both Visa and MasterCard. Almost all consumers who hold either Discover or American Express hold Visa and/or MasterCard. However, Discover and American Express have cardholder bases that are approximately 20 percent of the bankcard (Visa and MasterCard) cardholder base. In the debit card market, Visa signature debit has the largest market share in terms of the number of cards, followed by Star (PIN debit). Star's cardholder base is about 70 percent of Visa's signature debit cardholder base.

[23] See, for example, consumer surveys conducted by Edgar, Dunn & Company (2004, 2006) or by TNS Financial Services (2006).

Greater cardholder rewards may not necessarily harm society from an efficiency point of view. As long as cardholder rewards entice cardholders to use more efficient payment instruments, cardholder rewards can improve social welfare (after subtracting the costs of offering rewards programs). Rewards may further improve social welfare if they help non-cardholders to move from less efficient payment instruments, such as cash and checks, to more efficient payment instruments, such as cards or other electronic payments.

In reality, however, cardholder rewards may not always improve social welfare. For example, some credit card networks recently introduced new rewards credit cards that have higher interchange fees than traditional credit cards. Consumers who started to use new rewards credit cards likely have used traditional credit cards before. It may be unlikely that new rewards credit cards are more efficient than traditional cards. As another example, credit card rewards typically are greater than debit card rewards and signature debit rewards usually are greater than PIN debit rewards. Although there is not enough empirical evidence to judge which type of cards is more efficient than the others, it is possible that greater rewards may not be aligned with efficiency.[24] Lastly, not-holding cards may not be a consumer's own choice. If so, rewards may hardly induce non-cardholders to hold and use cards. Typically, non-cardholders are low-income consumers. Some of them may not qualify for having credit cards. Although debit cards become more available to unbanked and underbanked consumers, still many debit cards are tied with bank accounts. It may be too costly for some of low-income consumers to open and keep a bank account.

Higher merchant fees may likely harm society from an equity point of view. In the case where all consumers use cards, higher merchant fees are just redistributing surpluses among parties that are involved in card payments. If higher merchant fees are tied with greater rewards, then all consumers, first, pay higher retail prices and then receive what they paid extra as rewards. In the real world, however, because some consumers are non-cardholders and typical merchants cannot (or do not) differentiate retail prices according to payment instruments used by consumers, higher merchant fees may raise retail prices paid by both cardholders and non-cardholders. Even without cardholder rewards, merchant fees can be at the level where resulting retail prices are higher than the retail prices that would be set when all consumers use cash. Under such circumstances, providing cardholder rewards further raises merchant fees, and as a result, it further deteriorates non-cardholders' welfare. As mentioned above, not-holding cards may not be a consumer's own choice. Such consumers not only are unable to enjoy the benefits that card payments would bring to them but also are partially paying for cardholder rewards.

There are several key empirical indicators that policymakers can use to evaluate the current situation. The first indicator is whether average cardholders would use cards without receiving rewards. If they would, then rewards do not play any roles when cardholders decide whether to use cards (or electronic payments) or to use cash (or paper-based payments). The second indicator is whether merchants would reduce their retail prices if all of their customers used paper-based payments. If they would, then the merchant fees (and interchange fees) raise retail prices higher than the retail prices that would be set when all transactions are made with less efficient payment instruments. If both variables are positive, then current merchant fees may likely be too high. However, if rewards have induced enough non-cardholders to become cardholders, lowering merchant fees may have adverse effects on social welfare. Therefore, the third indicator policymakers should know is the likelihood of non-cardholders becoming

[24] Efficiency of cards likely depends on transaction characteristics, such as value of transactions and physical environment. Nevertheless, cardholders who receive rewards on both credit and debit cards tend to use credit cards

cardholders and if the likelihood is high, how much rewards contribute to this likelihood. If the first two indicators are positive and the third indicator is negative, then reducing merchant fees may improve social welfare. When reducing merchant fees improves social welfare, how much merchant fees need to be reduced becomes a policy question. One possible policy would be restricting components of interchange fees (merchant fees in the case of three-party scheme networks) so that they do not include the portion that funds cardholder rewards.[25, 26] This does not imply cardholder rewards need to be zero; rather it implies cardholder rewards should not be subsidized by non-cardholders when they are already burdened with higher retail prices. This policy may decrease some networks' or issuers' transaction volume; however, it may have little influence on overall card transaction volume. Although more detailed empirical information is necessary for policymakers to reach a socially optimal solution, these three indicators may possibly tell which direction the U.S. payments system needs to go.

more often than debit cards at any types of stores. (See Ching and Hayashi (2006)).

[25] According to a recent study by Diamond Management & Technology Consultants, rewards account for 44% of interchange costs.

[26] A similar policy has been adopted in Australia and is under consideration in the UK.

References

Bank for International Settlements. 2004. *Statistics on Payment and Settlement Systems in Selected Countries*. Basle, Switzerland: BIS.

Chakravorti, Sujit, and Roberto Roson. 2006. "Platform Competition in Two-Sided Markets: The Case of Payment Networks," *Review of Network Economics*, 5(1), pp. 118-142.

Ching, Andrew, and Fumiko Hayashi. 2006. "Payment Card Rewards Programs and Consumer Payment Choice," Federal Reserve Bank of Kansas City Payments System Research Working Paper 06-02.

Guthrie, Graeme, and Julian Wright. 2003. "Competing Payment Schemes," National University of Singapore Department of Economics Working Paper No. 0311.

Guthrie, Graeme, and Julian Wright. 2006. "Competing Payment Schemes," *Journal of Industrial Economics*, forthcoming.

Hayashi, Fumiko. 2006a. "A Puzzle of Card Payment Pricing: Why Are Merchants Still Accepting Card Payments?" *Review of Network Economics*, 5 (1), pp. 144-174.

Hayashi, Fumiko. 2006b. "Network Competition and Merchant Discount Fees," Federal Reserve Bank of Kansas City Payments System Research Working Paper 05-04.

Hayashi, Fumiko and Stuart E. Weiner. 2006. "Interchange Fees in Australia, the UK, and the United States: Matching Theory and Practice," Federal Reserve Bank of Kansas City *Economic Review*, Third Quarter, pp. 75-112.

Manenti, Fabio M., and Ernesto Somma. 2002. "Plastic Clashes: Competition among Closed and Open Systems in the Credit Card Industry," mimeo.

Rochet, Jean-Charles, and Jean Tirole. 2002. "Cooperation among Competitors: Some Economics of Payment Card Associations," *Rand Journal of Economics*, 33 (4), pp. 549-570.

Rochet, Jean-Charles, and Jean Tirole. 2003. "Platform Competition in Two-Sided Markets," *Journal of European Economic Association*, 1 (4), pp. 990-1029.

Chart 1: Equilibrium reward level and merchant fee (α=0.75): Symmetric cardholder bases

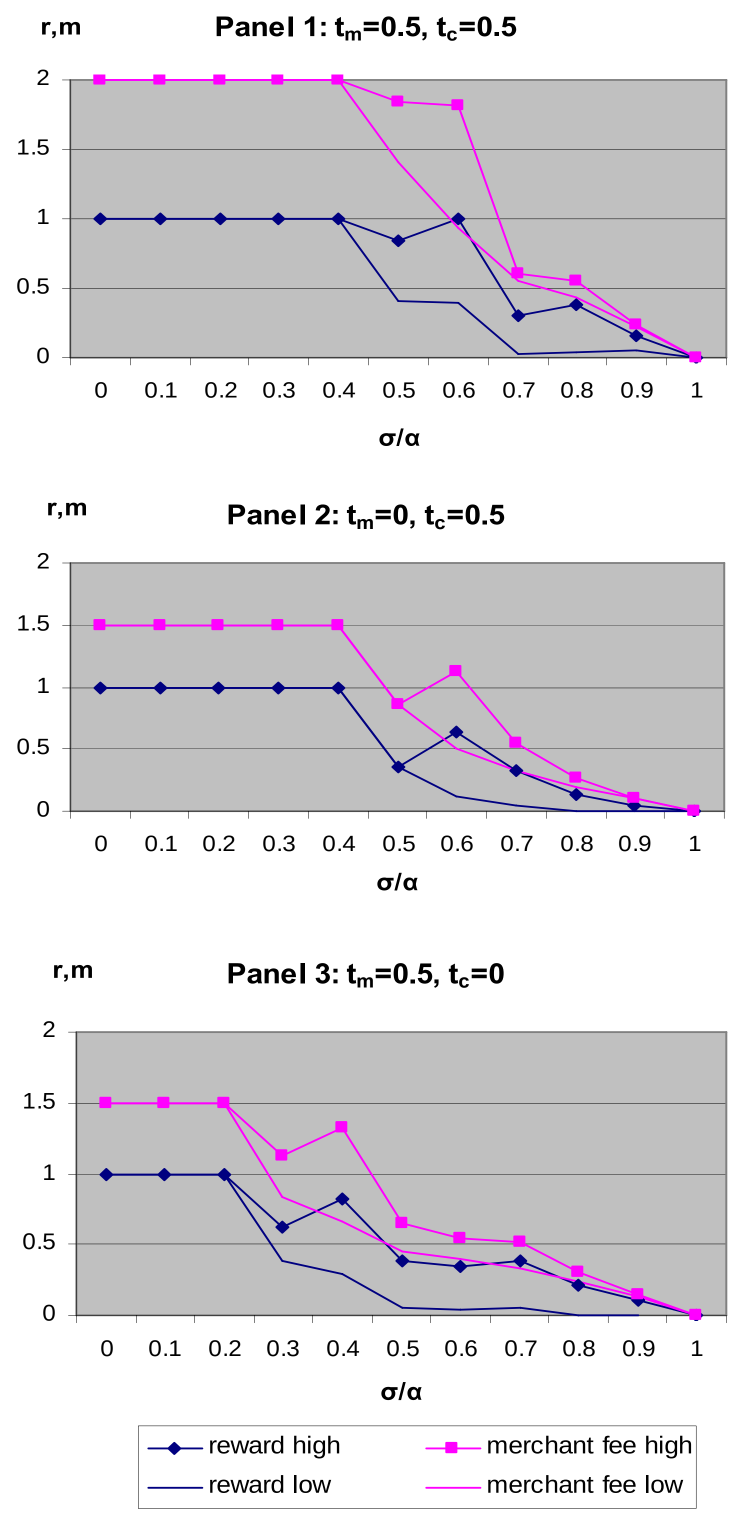

Chart 2: Average equilibrium reward level and merchant fee (α=0.75, t_m=0.5, t_c=0.5): Asymmetric cardholder bases