Must-Take Cards and the Tourist Test

Jean-Charles Rochet and Jean Tirole*

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De Nederlandsche Bank NV
P.O. Box 98
1000 AB AMSTERDAM
The Netherlands
Abstract

Antitrust authorities often argue that merchants cannot reasonably turn down payment cards and therefore are forced to accept unacceptably high merchant discounts. The paper attempts to shed light on this “must-take cards” view from two angles.

First, the paper gives some operational content to the notion of “must-take card” through the “tourist test” (would the merchant want to refuse a card payment when a non-repeat customer with enough cash in her pocket is about to pay at the cash register?) and analyzes its relevance as an indicator of excessive interchange fees.

Second, it identifies four key sources of potential social biases in the payment card associations’ determination of interchange fees: internalization by merchants of a fraction of cardholder surplus, issuers’ per-transaction markup, merchant heterogeneity, and extent of cardholder multi-homing. It compares the industry and social optima both in the short term (fixed number of issuers) and the long term (in which issuer offerings and entry respond to profitability).

Keywords: Card payment systems, interchange fee, internalization, multi-homing, tourist test.


1 Introduction

In payment cards systems such as Visa or MasterCard, the interchange fee (IF) paid by the merchant’s bank to the cardholder’s bank allocates the total cost of the payment service between the two users, cardholder and merchant. In several regions of the world, courts of justice, competition authorities, and banking regulators have asserted that these IFs are set at unacceptably high levels. Merchants, the argument goes, accept to pay the resulting high merchant discount because they are concerned that turning down cards would impair their ability to attract customers; that is, cards are “must-take cards” (Vickers 2005).\(^1\)

This paper offers a model of the payment card industry that is sufficiently rich to account for the complex effects of IFs on volumes of card payments, banks’ profits, consumer welfare, retailers’ profits and retail prices, yet simple enough to assess their regulation.

First, the paper gives some operational content to the notion of “must-take card” through the “tourist test”: would the merchant want to refuse a card payment when a non-repeat customer with enough cash in her pocket is about to pay at the cash register? The merchant discount passes the tourist test if and only if accepting the card does not increase the merchant’s operating costs. The paper analyzes its relevance as an indicator of excessive interchange fees.

Second, it identifies four key sources of potential social biases in the payment card associations’ determination of interchange fees: internalization by merchants of a fraction of cardholder surplus, issuers’ per-transaction markup, merchant heterogeneity, and extent of cardholder multi-homing. It compares the industry and social optima both in the short term (fixed number of issuers) and the long term (in which issuer offerings and entry respond to profitability).

The paper is organized as follows: Section 2 assesses the impact of the pricing of payment cards services on card acceptance decisions by merchants, card usage decisions

\(^1\)In the UK, the Office of Fair Trading, following a multi-year investigation of MasterCard’s credit card IFs, ruled that the multilateral setting of these IFs was anti-competitive. Similarly, under the pressure of the European Commission, Visa International agreed in 2002 to reduce its cross-border interchange fees on credit and debit transactions within the European Union. In Australia, after the publication of an extensive study of debit and credit card schemes in 2000, the Reserve Bank of Australia mandated a sizeable reduction of credit-card IFs, and is considering doing the same (or perhaps even mandating a zero IF) for debit transactions. Other countries where similar decisions have been made (or are seriously considered) by courts of justice, competition authorities or banking regulators include Israel, Spain, Portugal, Belgium, and the Netherlands. The regulation of IFs may operate less directly, as was the case in the 2003 WalMart settlement in which MasterCard and Visa agreed to pay $3 billion to merchants and to stop tying their credit and off-line debit card (the merchants in particular complained that the implicit IF on off-line debit was too high).
by consumers and efficiency. It also introduces the tourist test. Section 3 investigates whether the interchange fees maximizing short-term welfare and total user surplus (the latter equal to the former minus banks’ profits), respectively, meet the tourist test, in a benchmark model where banks’ margins are constant. Section 4 allows these margins to vary with the interchange fee. Section 5 performs the same exercise in the long term, in which issuer entry and offerings respond to industry profitability (and so welfare and total user surplus coincide). Section 6 shows that retailer heterogeneity makes the tourist test more likely to produce false positives. Section 7 compares privately and socially optimal interchange fees, first in the case of a monopoly platform, then when several platforms compete. Section 8 concludes.

Relation to the literature. The paper borrows form and extends a number of contributions in the literatures on card payments and two-sided markets. It elaborates on previous theoretical analyses (surveyed in Rochet (2003)) of the impact of IFs, in particular Rochet and Tirole (2002), Schmalensee (2002), and Wright (2003a, 2003b, 2004). In particular, the idea that merchants may accept cost-increasing means of payment is drawn from our earlier paper on card payments. Our analysis of merchant heterogeneity builds on the contributions of Schmalensee (2002) and Wright (2004). Wright built on Schmalensee and showed how the privately and socially optimal IFs depend on the elasticities on the two sides (merchants, cardholders). He argued that there is no systematic bias between the IF chosen by the association and the socially optimal IF. We also borrow from Wright the modelling of cardholder demand, which is a bit simpler than our initial modelling: Wright assumed that cardholders’ convenience benefit is drawn at the moment of purchase while we presumed that cardholders differ systematically in the benefit that they derive from card payments. While ex post (Wright) and ex ante (Rochet-Tirole) heterogeneity deliver broadly convergent results, ex ante heterogeneity makes merchants’ card acceptance decisions strategic complements rather than independent.

Finally, there is also a sizeable, less formal literature (surveyed in Schmalensee (2003)) on the potential anticompetitive effects of IFs, in particular Carlton and Frankel (1995), Evans and Schmalensee (1995), Frankel (1998), Chang and Evans (2000) and Balto (2000).

While these contributions have substantially influenced this paper, none emphasizes the distinctions between the relevant measures of welfare (social welfare, total user surplus, consumer surplus) and their horizon (short vs. long term) and relates them to the tourist test, as we do. The best of our knowledge, we are also not aware of any analysis of the role of issuer, acquirer and merchant margins (Section 4) and of entry into credit card services.
(Section 5), and of any derivation of the link between the average merchant benefit and efficient IFs (Section 6).

2 The model

2.1 Must-take cards

Consumers buy one unit of a retail good each and must decide which store to patronize. Once in the store they must further select a payment method, provided that the retailer indeed offers a choice among payment means. The benchmark model has a single card payment system. We assume “price coherence”; that is, the retailers either find it too costly or are not allowed to charge different prices for transactions settled by card and by cash. Whenever a transaction between a consumer (buyer) and a retailer (seller) is settled by card, the buyer pays transaction fee $p_B$ and the seller pays merchant discount $p_S$. There are no annual fees and all consumers have a card.

The consumer’s convenience benefit of using a card is a random variable drawn from cumulative distribution function $H$:

$$H(b_B) = \Pr(\tilde{b}_B \leq b_B),$$  \hspace{1cm} (1)

and density $h(b_B) = H'(b_B)$. The distribution has a monotone hazard rate: $\frac{h(b_B)}{1 - H(b_B)}$ is increasing. Because the net benefit of paying by card is equal to the difference $\tilde{b}_B - p_B$, a card payment is optimal for the consumer whenever $\tilde{b}_B \geq p_B$. The proportion of card payments at a store that takes cards is denoted $D_B(p_B)$:

$$D_B(p_B) = \Pr(\tilde{b}_B \geq p_B) = 1 - H(p_B).$$ \hspace{1cm} (2)

$v_B(p_B)$ denotes the average net cardholder benefit per card payment:

$$v_B(p_B) \equiv E[b_B - p_B|b_B \geq p_B]$$

$$= \frac{\int_{p_B}^{\infty} (b_B - p_B) \, dH(b_B)}{\int_{p_B}^{\infty} dH(b_B)} > 0.$$

\footnote{We allow $p_B$ to be negative, in which case the cardholder receives a payment from his bank, in the form of interest-free period, cash back bonuses or air miles awarded to the buyer every time he uses his card.}
From the monotone hazard rate property, \( v_B \) is a decreasing function\(^3\) of \( p_B \).

The merchant’s convenience benefit, \( b_S \), is assumed to be homogeneous in a first step.

We make the following assumption on retailers’ card acceptance policies:

**Assumption 1:** A retailer accepts the card if and only if:

\[
p_S \leq b_S + s(\alpha, p_B),
\]

where \( s(\alpha, p_B) \) represents the increase in the quality of service associated with the option to pay by card, as perceived by customers, and \( \alpha \) is a parameter that characterizes the consumers’ awareness of the retailer’s card acceptance policy.

The function \( s(\cdot, \cdot) \) is increasing in \( \alpha \) and decreasing in \( p_B \), and satisfies:\(^4\) \( s(0, p_B) \equiv 0 \), \( s(1, p_B) \equiv v_B(p_B) \), and \( \frac{\partial^2 s}{\partial \alpha \partial p_B} < 0 \).

Appendix 1 shows that Assumption 1 is satisfied in the (unique equilibrium of the) classic Hotelling-Lerner-Salop model of retailing, where the parameter \( \alpha \) is interpreted as the probability that consumers are aware of a retailer’s card acceptance policy and \( s \) is linear in \( \alpha \) (\( s = \alpha v_B(p_B) \)).

To understand formula (3), note that when consumers are unaware of the retailer’s card acceptance policy (\( \alpha = 0 \), and thus \( s = 0 \)), accepting the card does not help the retailer attract customers. And so the retailer accepts the card if and only if this reduces his operating cost: \( p_S \leq b_S \). When consumers know that the card is accepted (\( \alpha = 1 \)), they expect to enjoy extra surplus \( v_B(p_B) \) per card payment (recall that they do not know their convenience benefit before going to the store), and so the retailer can increase the retail price by the amount \( v_B(p_B) D_B(p_B) \) while keeping sales constant. This price increase must exceed the operating cost increase in order for the retailer to accept the card.

Formula (3) reflects the idea that in general (that is, if \( \alpha > 0 \) and thus \( s(\alpha, p_B) > 0 \)), retailers internalize some of the cardholders’ usage surplus and are therefore willing to accept cards even if their net cost of card transactions is positive (i.e., \( p_S > b_S \)). They are willing to incur a cost \( p_S - b_S \) (provided that it is not too large) per card transaction, in order to offer a better quality of service to their customers (who value the option of

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\(^3\)This is a consequence of a well-known property of log-concave distribution functions (see Prékopa 1973).

\(^4\)The assumption that \( s \) is decreasing in \( p_B \) is actually redundant: it is a consequence of \( s(0, p_B) \equiv 0 \) and \( \frac{\partial^2 s}{\partial \alpha \partial p_B} < 0 \). We state it only for the reader’s convenience.
paying by card). The parameter $\alpha$ measures the extent to which card acceptance makes their store more attractive to the consumer.

This internalization of consumer surplus is unrelated to competition among retailers. Indeed, formula (3) also applies to a retail monopolist and has much broader generality than the Hotelling-Lerner-Salop competition model would lead us to believe.\(^5\) Card acceptance increases both the retailers’ cost (if $p_S > b_S$) and quality of service for the consumer. Provided that consumers attach the same value to the increase in the quality of service, regardless of their willingness to pay for the good sold by the retailer,\(^6\) the retailer’s card acceptance decision depends only on the sum of the merchant net convenience benefit and the perceived quality increase brought about by card acceptance.

Retail prices are not a good measure of consumer surplus because they do not account for transaction costs. The relevant measure of “consumer surplus” $\phi$, which we call total user surplus:

$$
\phi \equiv (b_S - p_S) D_B (p_B) + \int_{p_B}^{\infty} (b_B - p_B) dH (b_B)
$$

$$
\equiv \int_{p_B}^{\infty} (b_B + b_S - p_B - p_S) dH (b_B),
$$

represents the expectation of the total surplus (total benefit $b_B + b_S$ minus total price $p_B + p_S$) derived from card payments by the two categories of users.

### 2.2 The tourist test

Retailers often complain that they are “forced” to accept card transactions that increase their net costs. To understand this “must-take card” argument, one must distinguish between ex post and ex ante considerations. Once the customer has decided to buy from the retailer, it is in the latter’s interest to “steer” the former to pay by cash or check.

\(^5\)Consider for example a retail monopolist. By accepting the card he can obtain profit $\pi_A = \max_p (p - \gamma - C) [\alpha D(p - u) + (1 - \alpha) D(p)]$ where $p$ is the retail price, $\gamma$ the cost of the good sold by the retailer, $C = (p_S - b_S) D_B (p_B)$ the expected net transaction cost of card payments, $D(\cdot)$ the demand for the retail good and $u = \int_{p_B}^{\infty} (b_B - p_B) dH (b_B)$. This profit is clearly decreasing in $C$, and increasing in $\alpha$ and $u$. Thus it is greater than the profit obtained when rejecting cards, $\pi_R = \max_p (p - \gamma) D(p)$, whenever $C$ is smaller than some function $\psi (\alpha, p_B)$. This condition is equivalent to $p_S < b_S + \psi (\alpha, p_B)$, where $s(\alpha, p_B) = \frac{\psi (\alpha, p_B)}{D_B (p_B)}$.

\(^6\)Recall that all consumers’ convenience benefit $b_B$ is drawn from the same distribution and that consumers do not know their individual benefit until they go to the store.
instead of by card whenever \( p_S > b_S \). But from an ex ante point of view, the retailer must also take into account the increase in store attractiveness brought about by the option of paying by card. Because retailers ex ante can always turn down cards, the “must-take card” argument refers to the ex post perspective.

Let us accordingly introduce the “tourist test”: suppose the buyer in question is a tourist, who will never patronize the store again in the future and shows up at the cash register with ostensibly enough cash to pay the wares. The merchant discount passes the tourist test if the retailer is willing to allow this consumer to pay by card, or equivalently if accepting the card does not increase the retailer’s operating costs: \( p_S \leq b_S \).

**Definition:** The merchant discount \( p_S \) passes the tourist test if and only if accepting the card does not increase the retailer’s net operating cost: \( p_S \leq b_S \).

The attraction of the tourist test resides in the fact that the merchant pays no more than his convenience benefit from card payments. Capping the merchant discount at the merchant’s convenience benefit prevents card payment systems from exploiting the internalization effect to force merchants to accept card payments that they do not want. Perhaps more importantly from an economic point of view, the absence of overpayment by the merchant suggests that the cardholder is not over-incentivized to use the card.

Whether the cap implied by the tourist test is reasonable, though, depends on whether cardholders are provided with the proper social incentive: The social optimum is reached only when the cardholders make the efficient decision with regards to the choice of payment method. As is usual, a “first-best rule” usually may no longer be adequate when the rest of the economy is already distorted. Potential existing distortions are:

(i) **cardholders’ incentives are already distorted:** If merchants’ fee equals their convenience benefit, the cardholder pays more than the net social cost of the card transaction (equal to the total cost of card payments, \( c_B + c_S \), minus the merchant’s benefit, \( b_S \)) whenever issuers (or acquirers for that matter) levy markups above cost. This suggests that cardholders may underconsume card payments if the merchant discount passes the tourist test.

(ii) **merchants are heterogenous:** When merchants differ in their convenience benefit \( b_S \), inframarginal merchants derive more benefit from card payments than marginal ones. The tourist test can be applied to each merchant (or at least to merchants who end up accepting the card), but cardholders, whose usage fee does not depend much on the merchant’s identity, cannot be induced to exactly internalize the welfare of each merchant.
We now model the payment card industry and investigate the impact of interchange fees on prices \( p_B \) and \( p_S \), and ultimately on consumer surplus. Recall that, in a payment card association, the interchange fee (IF) \( a \) represents the amount paid\(^7\) by the seller’s bank (the acquirer) to the buyer’s bank (the issuer) for each card transaction. It reallocates the total cost\(^8\) \( c = c_B + c_S \) of processing the transaction between the two banks. The acquirers’ net marginal cost becomes \( c_S + a \) and the issuers’ becomes \( c_I \equiv c_B - a \). We simplify the analysis by assuming that acquirers are perfectly competitive (we later note how acquirer margins affect this analysis):

\[
p_S = c_S + a. \tag{4}\]

By contrast, issuers may have (ex post) market power. The benchmark model assumes that issuers’ margin \( m \) is constant:\(^9\)

\[
p_B = c_I + m = c_B - a + m. \]

The interchange fee \( a \) passes the tourist test if and only if:

\[
a \leq a^T \equiv b_S - c_S \iff p_B \geq p_B^T = c - b_S + m. \tag{5}\]

With an inelastic final demand, total user surplus is equal to:

\[
\phi (p_B) \equiv \int_{p_B}^\infty (b_B + b_S - p_B - p_S) \, dH (b_B) = \int_{p_B}^\infty (b_B + b_S - c - m) \, dH (b_B) .
\]

Social welfare is equal (up to a constant) to the sum of total user surplus and banks’ profit \( \pi_B = mD_B (p_B) \):

\[
W \equiv \phi + \pi_B = \int_{p_B}^\infty (b_B + b_S - c) \, dH (b_B) .
\]

Social welfare is a single-peaked function of \( p_B \), and reaches its maximum at

\[
p_B^W \equiv c - b_S. \tag{6}\]

\(^7\)Nothing prevents, both in our model and in reality, \( a \) from being negative, i.e., the IF from flowing from the issuer to the acquirer.

\(^8\)As in the rest of the paper, indices \( B \) refer to the buyer side, and indices \( S \) refer to the seller side. Thus \( c_B \) represents the marginal cost of the issuer (the buyer’s bank) and \( c_S \) that of the acquirer (the seller’s bank).

\(^9\)In Section 4, we allow this margin to vary with \( a \).
The price $p_W^B$ makes the consumer perfectly internalize the externality associated with the decision of paying by card. Indeed, the social cost of a card payment includes both the marginal cost $c_B$ of the buyer’s bank and externality exerted on the seller’s side $c_S - b_S$.

The maximum interchange fee that passes the tourist test, $a^T$, thus corresponds to the socially optimal IF when banks are perfectly competitive ($m = 0$), as was first pointed out by Baxter (1983). The merchant discount corresponding to this upper bound $a^T$ (namely $p_S^T = c_S + a^T = b_S$) makes the retailer ex-post indifferent as to the buyer’s choice of payment instrument (Farrell 2006).

When issuers have market power ($m > 0$), the socially optimal interchange fee does not pass the tourist test:

\[ a^W = c_B - p_W^B + m = b_S - c_S + m > a^T. \]

By contrast, total user surplus $\phi$ is maximized\(^{10}\) for a larger value $p_B^{TUS}$:

\[ p_B^{TUS} = c - b_S + m. \]  

(7) $p_B^{TUS}$ exceeds $p_B^W$ because user surplus does not include the issuers’ profit. Since issuers’ profit $mD_B(p_B)$ decreases with $p_B$, a higher $p_B$ (and thus a lower interchange fee) implies a lower expected profit for issuers and thus, around the social welfare optimum, a higher expected total user surplus.

The corresponding interchange fee $a^{TUS}$ is given by:

\[ a^{TUS} = c_B - p_B^{TUS} + m = b_S - c_S = a^T. \]  

(8) The behavior of functions $W$ and $\phi$ is represented in Figure 1.

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\(^{10}\)Assumption 1 implies a lower bound on cardholder fees: a retailer accepts the card only if $p_S \leq b_S + s(\alpha, p_B)$. Thus $p_B = c + m - p_S$ must be equal at least to $p_B^m$, defined implicitly by $c + m - p_B^m = b_S + s(\alpha, p_B^m)$. Since total user surplus $\phi$ and social welfare $W$ are quasi-concave, whether this constraint binds or not does not modify the comparison between $p_B^{TUS}$, that maximizes $\phi$, and $p_B^W$, that maximizes $W$. 

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Figure 1: Total user surplus $\phi$, and social welfare $W$. The vertical difference between these functions represents the expected profit of issuers. It decreases with $p_B$. This explains why $p_{TB}^{TUS}$, which maximizes $\phi$, is to the right of $p_{WB}^W$, which maximizes $W$.

Proposition 1. When issuers’ margin is constant:

i) the interchange fee $a^W$ that maximizes social welfare offsets issuers’ margin and thus is higher than the tourist test threshold $a^T$:

$$a^W = a^T + m.$$

ii) the interchange fee $a^{TUS}$ that maximizes total user surplus is equal to $a^T$.

Thus in the benchmark model, the tourist test is a perfect test of interchange fees that are excessive from the point of view of total user surplus, but it is too restrictive from the point of view of social welfare.

The result $a^{TUS} = a^T$, hence that the tourist test allows an exact detection of interchange fees that exceed the level that maximizes total user surplus ($p_S > b_S \iff a > a^T = a^{TUS}$) relies on three strong assumptions:

- issuers’ margin is constant,
- the number of issuers is given,
- merchants are homogeneous.

We will relax each of these assumptions. Section 4 looks at variable issuers’ margins. Section 5 considers the possibility of entry (or exit) of issuers. Section 6 allows for heterogenous merchants.
Remark (acquirer margins): The analysis can be generalized to allow for acquirers’ markups $m_S(p_S)$. The total margin $m$ then equals the sum of acquirers’ margin $m_S$ and issuers’ margin $m_B$. With constant markups ($m_B$ and $m_S$ invariant), the wedge between the welfare-optimal IF, which remains equal to $a^W = b_S - c_S + m_B$, and the $TUS$-maximizing IF, $a^{TUS} = b_S - (c_S + m_S)$, increases. Intuitively, the buyer internalizes his own cost, including $m_B$, and so in the $TUS$ optimum, the internalization of the seller’s surplus accounts for the acquiring cost, $c_S + m_S$. Note that $a^T = b_S - c_S - m_S$ still coincides with $a^{TUS}$. Thus Proposition 1 extends to a constant acquirer margin.

4 Variable issuers’ margin

We now allow issuers’ margin to vary with their net cost $c_I = c_B - a$. We model issuer competition in reduced form, denoting by $p_B(c_I)$ and $\pi_B(c_I)$ the issuers’ price and profit as functions of $c_I$. We assume that $p_B$ increases and $\pi_B$ decreases with $c_I$.\(^\text{11}\) Issuers’ margin $m$ is a function of $p_B$:\(^\text{12}\)

$$m(p_B(c_I)) = p_B(c_I) - c_I. \tag{9}$$

There is cost absorption if $p'_B < 1$ (equivalently $m' < 0$) and cost amplification if $p'_B > 1$ (equivalently $m' > 0$). The benchmark case of Section 3 assumed cost passthrough ($p'_B = 1$, that is $m' = 0$).

For convenience, we take $p_B$ (instead of $a$) as the variable of interest. By assumption, $p_B$ is increasing in $c_I = c_B - a$, which implies that $p_B$ is decreasing in $a$. We can thus reason on $p_B$, keeping in mind that an increase in the IF results in a decrease in $p_B$.

The total profit of the members of the association (that is of the issuers, since acquirers make no profit in our model) is thus:

$$\pi_B = m(p_B) D_B(p_B). \tag{10}$$

We assume that $\pi_B$ is decreasing in $p_B$: Provided that merchants are kept on board, issuers prefer higher IFs.

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\(^{11}\)Revealed preference implies that these conditions are always satisfied for a monopoly issuer.

\(^{12}\)This is more general than Rochet and Tirole (2003) where we assumed $p_B = f(c_I)$ with $0 \leq f' < 1$. $m(\cdot)$ is derived from $f(\cdot)$ by a simple change of variable: $m[f(c_I)] = f(c_I) - c_I$. Here we maintain the assumption that $f' \geq 0$ ($p_B$ increases with $c_I$), but we do not require $f' < 1$. The assumption that $f' < 1$ implies that $m' < 0$ (cost absorption). The case $f' = 1$ corresponds to that of a constant margin. We also consider here the case where $f' > 1$ (e.g. Cournot oligopoly with isoelastic demand). In this cost amplification case $m$ increases with $p_B$. Note however that $m' = \frac{f'' - 1}{f'} < 1$. 

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The interchange fee $a$ passes the tourist test if and only if

$$a \leq a^T \equiv b_S - c_S \quad \iff \quad p_B \geq p_B^T = c - b_S + m (p_B^T).$$

$p_B^T$ is uniquely defined since $m' < 1$ (see footnote 12). Similarly the socially optimal interchange fee:

$$a^W = c_B - p_B^W + m (p_B^W),$$

where $p_B^W = c - b_S$. Thus

$$a^W = b_S - c_S + m (p_B^W) > a^T.$$

Finally, total user surplus

$$\phi (p_B) = \int_{p_B}^{\infty} [b_B + b_S - c - m (p_B)] dH (b_B) \quad (11)$$

is maximized for a larger value $p_B^{TUS}$, that satisfies the first-order condition:

$$\phi' (p_B) = [p_B + b_S - c - m] D_B' - m' D_B = 0.$$

Thus

$$p_B^{TUS} = c - b_S + m + \frac{m' D_B}{D_B'}.\quad (12)$$

The corresponding interchange fee $a^{TUS}$ is given by:

$$a^{TUS} = c_B - p_B^{TUS} + m (p_B^{TUS}) = b_S - c_S - \frac{m' D_B}{D_B'} (p_B^{TUS}) = a^T - \frac{m' D_B}{D_B'} (p_B^{TUS}).$$

**Proposition 2.** The interchange fee $a^{TUS}$ that maximizes total user surplus is higher than $a^T$ in the cost amplification case ($m' > 0$) and lower than $a^T$ in the cost absorption case ($m' < 0$). In both cases, the socially optimal interchange fee $a^W$ exceeds $a^T$.

**Remark (acquirer margins):** As in the case of constant margins, the analysis can be extended to allow for acquirer margins. The welfare optimal IF remains $a^W = b_S - c_S + m_B (p_B)$. By contrast, the formula of the $TUS$ optimum is altered.\(^{13}\)

\cite{footnote:acquirer_margins}

\(^{13}\)Letting $m_S (p_S) = m_S (c_S + a) = m_S (c + m_B (p_B) - p_B)$ denote the acquirers’ markup, then at the $TUS$ optimum,

$$p_B + b_S - (c + m_B + m_S) = \frac{D_B}{D_B'} [m_B' - m_S (1 - m_B')].$$
Table 1 shows when the tourist test is likely to deliver false positives or negatives.

<table>
<thead>
<tr>
<th>Interchange fee</th>
<th>( a^{W} )</th>
<th>( a^{T} )</th>
<th>( a^{\text{TUS}} )</th>
</tr>
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<tbody>
<tr>
<td>\text{Tourist test}</td>
<td>\text{PASSES}</td>
<td>\text{FAILS}</td>
<td></td>
</tr>
<tr>
<td>\text{Social welfare}</td>
<td>IF too low</td>
<td>IF too high</td>
<td></td>
</tr>
<tr>
<td>\text{Total user surplus}</td>
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<td></td>
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\[ \text{Cost absorption case} \]

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\[ \text{Cost amplification case} \]

**Table 1**: Different thresholds for the interchange fee.

5 **Entry: revisiting the notion of total user surplus**

The previous section analyzed the interchange fees associated with two benchmarks, corresponding to the maximization of social welfare and to that of consumer surplus (\( TUS \)). Focusing on the narrow notion of consumer surplus is legitimate for a short-term analysis as long as the welfare of shareholders is weighted much less heavily than that of consumers. In the medium and long term, though, issuers respond to increased profitability by offering a wider variety of products or by reducing prices.

To illustrate the impact of entry, this section computes the “long-term total user surplus” first in the context of an homogeneous issuing industry in which issuers do not compete perfectly (so entry reduces price but does not increase variety), then in a context of monopolistic competition among differentiated issuers. While these environments are special, they in a sense are polar cases. The homogeneous-good case confers limited benefits on the entry mechanism: While entry benefits consumers through lower prices, the incentive to enter comes in large part from business stealing. Indeed, Mankiw and Whinston (1986) show that in an homogeneous-good, free-entry industry, the equilibrium number of firms under free entry exceeds the efficient number minus 1. The monopolistic competition environment by contrast rules out any business stealing by assuming contestable niches, and thereby focuses on pure product creation. Thus the former (latter) environment is rather unfavorable (favorable) to a social accounting of the benefits from entry.
5.1 Homogeneous issuing industry

Let \( c_I \equiv c_B - a = c - p_S \) denote the issuers’ marginal cost, and \( N \) the number of issuers. The fixed cost of being in the issuing industry is \( F > 0 \).

Adapting our previous notation to account for the number \( N \) of issuers, we denote by \( p_B = p_B(c_I, N) \) and \( m = m(p_B, N) \) the equilibrium price and margin\(^{14}\) for a fixed number \( N \) of issuers. We assume that \( \frac{\partial m}{\partial N} < 0 \) (more issuers imply smaller margins). The number of issuers is now endogenous, and given by the unique solution \( N = N(p_B) \) to the zero-profit equation:

\[
m(p_B, N) D_B(p_B) = NF.
\]

(12)

Note that, from our assumption that issuers’ profit \( m(p_B, N) D(p_B) \) decreases with \( p_B \), the number of issuers \( N(p_B) \) also decreases with \( p_B \).

The long-term total user surplus (also equal to social welfare since issuers in the long term make no supra-normal profit) is equal to the sum of cardholder and merchant surpluses:

\[
TUS^{LT} = \int_{p_B}^{\infty} [b_B + b_S - c - m(p_B, N(p_B))] dH(b_B).
\]

The only difference with short-term total user surplus \( \phi \) (see formula (11)) is that the margin \( m(p_B) \) depends on \( p_B \) also through the number \( N \) of issuers. \( TUS^{LT} \) is maximized for

\[
p^*_B = c - b_S + m + \frac{D_B}{D'_B} \left[ \frac{\partial m}{\partial p_B} + \frac{\partial m}{\partial N} N' \right]. \tag{13}
\]

Comparing with \( p^{TUS}_B \), that maximizes short-term total user surplus \( \phi \), we see that \( p^*_B \) contains an additional term \( \frac{D_B}{D'_B} \frac{\partial m}{\partial N} N' \), corresponding to the impact of \( p_B \) on the number of issuers, and thus indirectly on the level of issuers’ margin. This additional term is negative since \( D'_B, \frac{\partial m}{\partial N} \) and \( N' \) are all negative. Thus

\[
p^*_B < p^{TUS}_B.
\]

The intuition for this result is that a lower net issuer cost \( c_I = c_B - a \) (and thus a lower cardholder fee \( p_B \)) increases entry and competition in the issuing market, and thereby reduces issuers’ margin.

\(^{14}\)For convenience, \( m \) is expressed as a function of \( p_B \) and \( N \). This is legitimate since, for \( N \) given, \( p_B \) and \( c_I \) are in a one-to-one relation with each other.
Note also that \( p_B^* > p_B^T = c - b_S + m(p_B^T) \) if and only if there is long-term cost absorption:
\[
\left[ \frac{\partial m}{\partial p_B} + \frac{\partial m}{\partial N} N' \right] < 0.
\]
Long-term cost absorption is less likely to prevail than short-term cost absorption \( \left( \frac{\partial m}{\partial p_B} < 0 \right) \), as the second term is positive.

To compare \( p_B^* \) and \( p_B^W = c - b_S \) (that maximizes short-term welfare), differentiate the zero-profit condition that defines \( N(p_B) \):
\[
m(p_B, N(p_B)) D(p_B) = N(p_B) F,
\]
yielding:
\[
\left( \frac{\partial m}{\partial p_B} + \frac{\partial m}{\partial N} N' \right) D_B + mD'_B = N' F. \tag{14}
\]
By using formula (13) defining \( p_B^* \), we get:
\[
p_B^* - p_B^W = \frac{1}{D_B'} \left[ mD'_B + D_B \left( \frac{\partial m}{\partial p_B} + \frac{\partial m}{\partial N} N' \right) \right].
\]
where the right-hand side is computed at \( p_B^* \). Thus
\[
p_B^* - p_B^W = \frac{N'}{D_B'} F > 0.
\]

We can now state our results in terms of the associated interchange fees \( a^*, a^{TUS} \) and \( a^W \).

**Proposition 3.** For an homogeneous issuing industry with free entry, the long-term total-user surplus maximizing interchange fee \( a^* \) lies in between \( a^{TUS} \), that maximizes short-term total-user-surplus, and \( a^W \), the short-term first best:
\[
a^{TUS} < a^* < a^W.
\]

\( a^* \) passes the tourist test \( (a^* \leq a^T) \) if there is long-term cost absorption \( (m(p_B, N(p_B)) \) decreasing) and fails it in case of long-term cost amplification \( (m(p_B, N(p_B)) \) increasing).

**Cournot example**: Consider Cournot competition with linear demand: \( D_B(p_B) = 1 - p_B \). The industry is viable if the monopoly profit \( \left( \frac{1 - c_I}{2} \right)^2 \) exceeds entry cost \( F \). In this case the short-term equilibrium price and the short-term margin are:
\[
p_B(c_I, N) = \frac{1 + N c_I}{1 + N} \text{ and } m(p_B, N) = p_B - c_I = p_B - \frac{(1 + N)p_B - 1}{N} = \frac{1 - p_B}{N}. \tag{15}
\]
Thus there is short-term cost absorption \( \left( \frac{\partial m}{\partial p_B} < 0 \right) \), implying, by formula (8):

\[
a^{TUS} = a^T - \left( \frac{\partial m}{\partial p_B} \cdot D_B \right) \left( p_B^{TUS} \right) < a^T.
\]

By contrast, there is long-term cost passthrough. Indeed, the zero-profit condition,

\[
m(p_B, N) (1 - p_B) = NF,
\]

yields:

\[
m(p_B, N(p_B)) = \sqrt{F},
\]

which is independent of \( p_B \). Thus long-term total user surplus is maximized for \( a^* = a^T = b_S - c_S < a^W = b_S - c_S + \sqrt{F} \).

### 5.2 Pure product variety

To illustrate the product-diversity argument, we build a stylized example that does not embody any business stealing effect. Consider a continuum of niche markets for cards, indexed by the fixed cost of entry \( F \). All markets are identical but for the fixed cost of entry. Let \( K(F) \) denote the cumulative distribution function of \( F \).

Each market is contestable (is an “auction market”). In equilibrium of a contestable market, there is a single firm, and this firm makes no profit; the markup \( m(c_I, F) \) is the smallest solution of:

\[
mD_B (c_I + m) = F. \tag{16}
\]

As \( \frac{d}{dm}(mD_B(c_I + m)) > 0 \) in the relevant range, the contestable market example exhibits long-term cost amplification\( ^{15} \left( \frac{\partial m}{\partial c_I} > 0 \right) \).

Let \( F^*(c_I) \), a decreasing function, be defined by:

\[
\max_m \{mD_B(c_I + m)\} = F^*(c_I).
\]

\( ^{15} \)Total differentiation of (16) gives indeed:

\[
\frac{d}{dm} (mD_B(c_I + m)) \frac{\partial m}{\partial c_I} + mD_B'(c_I + m) = 0.
\]

The result follows from \( D_B' < 0 \).
It corresponds to the maximum fixed cost that an issuer can sustain. \(K[F^*(c_I)]\) represents the mass of active issuers.

Note that

\[ b_S - p_S = b_S - c_S - a = a^T - a. \]

Then

\[
TUS^{LT} = \int_0^{F^*(c_I)} \left[ v_B (c_I + m (c_I, F)) + (b_S - p_S) \right] D_B (c_I + m (c_I, F)) dK(F)
\]

\[
= \int_0^{F^*(c_I)} \left[ v_B (c_I + m (c_I, F)) + (c_I - c_I^T) \right] D_B (c_I + m (c_I, F)) dK(F),
\]

where \(c_I = c_B - a\) and \(c_I^T \equiv c_B - a^T\).

Using

\[
v_B D_B = \int_{c_I + m (c_I, F)}^\infty [b_B - (c_I + m (c_I, F))] dH (b_B),
\]

we see that

\[
TUS^{LT} = \int_0^{F^*(c_I)} \int_{c_I + m (c_I, F)}^\infty [b_B - m (c_I, F) - c_I^T] dH (b_B) dK(F).
\]

Then at \(c_I = c_I^T\):

\[
\frac{dTUS^{LT}}{dc_I} = \frac{dF^*}{dc_I} v_B D_B k (F^*) - \int_0^{F^*(c_I)} D_B \frac{\partial m}{\partial c_I} dK(F) < 0
\]

(\(F^* \equiv F^*(c_I)\)). Thus long-term total user surplus increases when \(c_I\) is reduced below \(c_I^T\) (i.e. \(a^*\) increased over \(a^T\)).

**Proposition 4.** The total-user-surplus maximizing interchange fee in the pure-product-variety model always exceeds the level given by the tourist test: \(a^* > a^T\).

### 6 Heterogenous retailers

To bring our benchmark model more in line with reality, we introduce unobservable heterogeneity in the retailers’ convenience benefit \(b_S\) (heterogenous degrees of internalization \(\alpha\) are examined in Appendix 5). Following Schmalensee (2002), we assume that sellers’ convenience benefit is drawn from a continuous distribution with c.d.f. \(G\):

\[
G (b_S) = \Pr \left( \tilde{b}_S \leq b_S \right).
\]
Following Wright (2004), we assume that the retail sector consists in a continuum of subsectors, each corresponding to a value of \( b_S \). Merchants know their individual \( b_S \) before accepting cards. The buyers’ distribution of convenience benefits, \( H(b_B) \), is independent of the market in which they buy. Consumers buy one good in each of these markets and patronize the store that offers the best combination of retail price, transportation cost and quality of service (determined here by the retailer’s decision of whether to accept cards). For given prices for card services (\( p_B \) and \( p_S \)), the retailer’s equilibrium behavior is characterized by the same conditions as in Assumption 1, but now this behavior is conditional on the realization of \( b_S \): A retailer in “subsector” \( b_S \) accepts card payments if and only if:

\[
\hat{b} = b_S \geq \check{b} \equiv p_S - s(\alpha, p_B).
\] (17)

The volume of card transactions is easily computed:

\[
V = D_B(p_B) D_S(\hat{b}_S),
\] (18)

where \( D_S(\hat{b}_S) = 1 - G(\hat{b}_S) \) represents the “demand” for card transactions by retailers.\(^{16}\)

Social welfare is maximized when two symmetric “Samuelson conditions” are satisfied:

\[
p^*_{B} = c - E\left[ b_S | b_S \geq \hat{b}_S \right],
\]

and

\[
\hat{b} = c - E\left[ b_B | b_B \geq p^*_{B} \right].
\]

These Samuelson conditions imply a “balanced externality condition”: expected surpluses per card payment are equal for buyers and sellers. Indeed recall that the buyers’ expected surplus equals

\[
v_B(p^*_{B}) = E\left[ b_B - p^*_{B} | b_B \geq p^*_{B} \right].
\]

Taking the difference between the two conditions above gives:

\[
v_B(p^*_{B}) = v_S(\hat{b}_S) = E\left[ b_S - \hat{b}_S | b_S \geq \hat{b}_S \right],
\]

where \( v_S(\hat{b}_S) \) denotes the average retailer surplus per card payment.

\(^{16}\)A similar multiplicative formula for the volume of card transactions (with \( \alpha = 0 \) and thus \( \hat{b}_S = p_S \)) was first proposed by Schmalensee (2002) and later used in a more general context by Rochet and Tirole (2003).
When merchants fully internalize cardholder surplus ($\alpha = 1$ and so the second Samuelson condition is met\footnote{This condition is $\hat{b}_S = c - E(b_B|b_B \geq p_B^*) = c - p_B - v_B(p_B^*)$. When $\alpha = 1$ and $p_B + p_S = c$, this condition coincides with the definition of $\hat{b}_S$ (condition (17)), given that $s(1,p_B) = v_B(p_B)$.}) and $m = 0$ (perfect competition among issuers), this social optimum can be implemented by setting the interchange fee at:

$$a^* = c_B - p_B^* = E \left[ b_S | b_S \geq \hat{b}_S \right] - c_S.$$  

The corresponding merchant discount is

$$p_S = E \left[ b_S | b_S \geq \hat{b}_S \right].$$

In this case the average merchant (among those who accept cards) is ex post indifferent about the means of payment chosen by the consumer. This implies that unless all retailers are identical, some would want to reject cards ex post. Efficiency cannot require that the tourist test be met by all participating merchants because cardholders must internalize the welfare of the average merchant and not of the marginal one, who, recall, values card payments less than the average merchant. Capping merchant discounts at the convenience benefit of the most reluctant merchants provides the cardholder with an incentive for underconsumption of card payments.

**Proposition 5.** Assume that merchants differ in the net convenience benefit that they derive from card transactions, that they fully internalize cardholder surplus ($\alpha = 1$), and that issuers’ margin is nil (perfect competition). Then the social optimum is characterized by the “balanced externality condition” $v_S = v_B$ and can be implemented by selecting a merchant discount equal to the average convenience benefit among the merchants who accept cards.

Appendix 2 computes the interchange fees that maximize welfare and total user surplus when the issuers’ markup $m$ is constant. We here content ourselves with the expressions and intuitions. The socially optimal prices ($p_B^W, p_S^W$) are characterized by:

$$\frac{D_B'}{D_B} [v_S + [m - s]] = \frac{D_S'}{D_S} \left[ 1 + \frac{\partial s}{\partial p_B} [v_B + [m - s]] \right],$$

where $D_B = D_B(p_B^W)$, $v_B = v_B(p_B^W)$ and $v_S = v_S(\hat{b}_S^W)$.

The “optimal balancing” condition $\frac{D_B'}{D_B} v_S = \frac{D_S'}{D_S} v_B$ obtained in Rochet-Tirole (2003) must be amended to reflect internalization and market power. For an association, a
decrease in price on one side must be offset by an equal increase of price on the other side. Losing, say, one seller implies a waste of surplus \( v_B \) on the buyer side, and conversely. This explains the basic optimal balancing formula. To understand how internalization and market power modify this formula, note first that an increase in \( p_S \) has two effects on seller demand as it leads to an equal\(^{18} \) decrease in \( p_B \) and thus in a perceived increase in quality of service \( \frac{\partial s}{\partial p_B} \). Thus everything is as if the net price increase on the seller side were \( 1 + \frac{\partial s}{\partial p_B} < 1 \), or, put differently, as if the elasticity on the seller side had been scaled down by this factor. Second, the surpluses \( v_j \) on side \( j \in \{B, S\} \) created by increased demand on side \( i \) become \( v_j + [m - s] \); the correction is equal to the markup \( m \) (the issuers’ “surplus”) minus the fraction of the buyers’ surplus already internalized by the sellers. [The difference \( m - s \) will play an important role in Section 7 as well.]

The buyer price \( p_{BS}^{TUS} \) that maximizes total user surplus satisfies a formula similar to (19), except that it does not account for the issuers’ margin \( m \):

\[
\frac{D'_B}{D_B} [v_S - s] = \frac{D'_S}{D_S} \left[ 1 + \frac{\partial s}{\partial p_B} \right] [v_B - s].
\]

(20)

Note that for \( m = 0 \) and \( \alpha = 1 \), condition (19) (or (20)) yields the balanced externality condition, \( v_B = v_S \), of Proposition 5.

### 7 The privately optimal interchange fee

We now compute the IF that maximizes the issuers’ profit, first when merchant benefits are homogeneous (Sections 7.1 and 7.2) and then when they are heterogenous (Section 7.3).

#### 7.1 Monopoly platform

When \( b_S \) is the same for all merchants and there is no platform competition, the card association sets the IF at the maximum value that retailers accept, because issuers’ profit \( m(p_B)D_B(p_B) \) decreases with \( p_B \).

The price \( p_B^m \) chosen by the monopoly association is given implicitly by:

\[
p_S = b_S + s (\alpha, p_B).
\]

\(^{18}\)This is because this section assumes constant issuers’ margin.
Because \( p_S = c - p_B + m(p_B) \) from formulas (4) and (9), we can rewrite this as:

\[
b_S - c + p_B - m(p_B) + s(\alpha, p_B) = 0. \tag{21}
\]

Using formula (21), the issuers’ optimal buyer price can be rewritten as:

\[
p_B^m = c - b_S + m(p_B^m) - s(\alpha, p_B^m). \tag{22}
\]

Comparing (22) with formula (7) we see that \( p_B^m \) may be bigger or smaller than \( p_W^m = c - b_S \), depending on issuer market power and on the value of \( \alpha \). The interchange fee chosen by the association is thus:

\[
a^m = c_B - p_B^m + m(p_B^m) = b_S - c_S + s(\alpha, p_B^m). \tag{23}
\]

**Proposition 6.**

i) A monopoly association selects the maximum interchange fee \( a^m \) that is accepted by retailers.

ii) When \( m(p_W^m) < s(\alpha, p_W^m) \) (a condition that is more likely to be satisfied when issuers’ margin is small, merchant internalization is substantial and the net average cardholder benefit is large), \( a^m \) is larger than the socially optimal IF.

iii) When \( m(p_W^m) \geq s(\alpha, p_W^m) \), the interchange fee \( a^m \) chosen by the association coincides with the (second best) socially optimal IF.

**Proof of Proposition 6**

Part i) has already been noted. To establish parts ii) and iii), let us recall that social welfare is equal (up to a constant) to the sum of total user surplus and banks’ profit:

\[
W = \phi + mD_B = \int_{p_B}^{\infty} (b_B + b_S - c) \, dH(b_B),
\]

which is maximum for \( p_B = p_W^m \). Since \( W \) is quasi-concave in \( p_B \), the socially optimal buyer price is equal to \( p_W^m \) when this is compatible with merchant acceptance, i.e., when \( b_S - p_W^m + s(\alpha, p_W^m) > 0 \), and to \( p_B^m \) otherwise. Now

\[
p_W^m = c + m - p_W^m = m + b_S,
\]

and thus

\[
b_S - p_W^m + s(\alpha, p_W^m) = s(\alpha, p_W^m) - m(p_W^m).
\]

When this quantity is positive, the socially optimal buyer price is \( p_B^m > p_W^m \). When it is negative, the socially optimal buyer price coincides with \( p_B \), which establishes ii) and iii).

\[\blacksquare\]
Proposition 6 extends an earlier result of Rochet and Tirole (2002) to the case of an arbitrary internalization coefficient\(^{19}\) \(\alpha\). It shows that when there is a single association, when acquiring is perfectly competitive and when there is no unobservable heterogeneity among retailers, the association sets the highest possible IF \(a^m\) that retailers accept. \(a^m\) is always larger than the level \(a^{TUS}\) that maximizes total user surplus (and thus consumer surplus). However it is not necessarily larger than the socially optimal IF. If issuers’ margin is large, or if retailers’ acceptance of cards has a limited impact on their competitive position (for example if \(\alpha\) is close to zero and/or the average benefit \(v_B\) of cardholders per card payment is small) the interchange fee that maximizes social welfare is too large to be acceptable by retailers. The (second best) socially optimal IF then coincides with the privately optimal one.

### 7.2 Platform competition

We now extend our analysis to the competition between two card associations (indexed by \(k = 1, 2\)) in the context of the Hotelling-Lerner-Salop model of retailing: \(s(\alpha, p_B) = \alpha v_B(p_B)\). Retailers and consumers are located uniformly on a circle, and \(\alpha\) represents the probability that consumers are aware of a retailer’s card acceptance policy (see Appendices 1 and 3 for details).

For simplicity we assume that the two cards are perfect substitutes for both buyers and sellers: However the two associations may set different IFs \(a_1\) and \(a_2\), in which case user prices (denoted \(p^k_S\) and \(p^k_B\), \(k = 1, 2\)) also differ. Assume (without loss of generality) that \(a_1 \leq a_2\) so that \(p^1_S \geq p^2_S\). With perfectly competitive acquirers, we have also:

\[
p^1_S = c_S + a_1 \leq p^2_S = c_S + a_2. \tag{24}
\]

Since cards are perfect substitutes and card 2 is more expensive, retailers would be inclined to accept only card 1 but, like in Section 2, they must take into account the impact of their acceptance decisions on consumers’ patronage. We can characterize retailers’ acceptance decisions by looking at the behavior of function \(\phi_\alpha\):

\[
\phi_\alpha(p_B) \equiv [b_B - p_S + \alpha v_B(p_B)] D_B(p_B) = (b_S - p_S) D_B(p_B) + \alpha \int_{p_B}^{\infty} (b_B - p_B) dH(b_B).
\]

This behavior is represented in Figure 2 below.

---

\(^{19}\)We also relax the assumption of “cost absorption” by issuers (see footnote 12).
The function $\phi_\alpha$, which we call weighted total user surplus, coincides with total user surplus when $\alpha = 1$. As shown in Appendix 1, the optimal acceptance decision of a retailer is to accept the set of cards that maximizes the expected value of $\phi_\alpha$ among consumers.

Note that when retailers accept both cards, then a consumer who holds both cards (we call such a consumer a multi-homer) uses only card 2 (since $p^2_B \leq p^1_B$). Also, it is a dominated strategy for the associations to choose $p^2_B$ in the decreasing part of $\phi_\alpha$. Thus we can assume without loss of generality that $\phi_\alpha (p^1_B) \geq \phi_\alpha (p^2_B)$. In turn, this implies that it is a dominated strategy for merchants to accept only card 2. If they only accept only one card, it will be card 1.

A complete analysis of platform competition lies outside the scope of this paper. We content ourselves with the analysis of two polar cases: Subsection 7.2.1 looks at the case of complete multi-homing, and Subsection 7.2.2 studies complete single-homing. Appendix 3 analyzes the retailers’ acceptance decisions under partial multi-homing.

### 7.2.1 Complete multi-homing

We stick to the convention that $a_1 \leq a_2$ and therefore $p^1_B \geq p^2_B$. Now, if all consumers have both cards, retailers accept both cards if and only if\(^{20}\)

$$\phi_\alpha (p^2_B) \geq \max \left( 0, \phi_\alpha (p^1_B) \right).$$

Since issuers’ profit in network 2 is a decreasing function of $p^2_B$, network 2 wants to choose $p^2_B$ as small as possible, but it is constrained by the condition $\phi_\alpha (p^2_B) \geq \phi_\alpha (p^1_B)$. By symmetry the competition between networks results in (equal) prices, set to maximize $\phi_\alpha (p^2_B).^{21}$

**Proposition 7.** In the case of complete multi-homing (all consumers have the two cards), both associations set the same interchange fee, $a^{MH}$, corresponding to the cardholder price $p^{MH}_B$ that maximizes weighted total user surplus\(^{22}\) $\phi_\alpha$.

Furthermore

$$a^{MH} \leq a^{TUS} \text{ with strict inequality unless } \alpha = 1$$

---

\(^{20}\)This condition is a particular case of the general condition (37) obtained in Proposition 11, Appendix 3. It corresponds to a proportion of multi-homers $\beta_1$ equal to 1.

\(^{21}\)This is the two-sided version of Bertrand’s undercutting argument.

\(^{22}\)Specifically,

$$a^{MH} = b_S - c_S - \frac{D_B}{D'_B} (p^{MH}_B) \left[ m'(p^{MH}_B) - (1 - \alpha) \right]$$

where $p^{MH}_B \equiv \arg \max \phi_\alpha (p_B)$. The merchant discount is then given by $p^{MH}_S = c - p^{MH}_B + m(p^{MH}_B)$. 

---

23
and

\[ a^{MH} \leq a^T \text{ if and only if } m' \leq 1 - \alpha. \]

Thus the interchange fee set by competing networks is too low with respect to the value that maximizes total user surplus unless merchants fully internalize cardholder surplus. Furthermore, the interchange fee passes the tourist test provided that either there is cost absorption or passthrough by issuers \((m' \leq 0)\) or merchants internalize only a small fraction of cardholder surplus \((\alpha \text{ small, given that } m' < 1)\).

We now examine the polar case of complete single-homing.

### 7.2.2 Complete single-homing

If all consumers have a single card, card \(i\) is accepted if and only if \(\phi_\alpha(p^i_B) \geq 0\). This implies that, as with a single network, card associations select the highest IF \(a^{SH}\) that retailers accept. The outcome of network competition is the same as the monopoly outcome characterized in Proposition 6:

- The price \(p_B^{SH}\) paid by cardholders is characterized implicitly by \(\phi_\alpha(p_B^{SH}) = 0\), which gives:

  \[ p_B^{SH} = c - B + m(p_B^{SH}) - \alpha v_B(p_B^{SH}) = p_B^m. \]

- As illustrated by Figure 2, this price is lower than the value \(p_B^{TUS}\) that maximizes consumer surplus (or equivalently total user surplus) when issuers’ margin decreases with \(p_B\) (cost absorption case) but the reverse may hold when issuers’ margin increases with \(p_B\) (cost amplification case).

**Proposition 8.** Under complete single-homing, the interchange fee \(a^{SH}\) set by competing networks is equal to the monopoly interchange fee \(a^m\). \(a^{SH}\) is thus larger than or equal to the socially optimal IF, equal to \(\min(a^m, a^W)\).
Figure 2: Comparison of buyer prices (in the cost absorption case) when two card associations compete:
- when consumers single-home, the outcome is $p_{BH}^{SH}$ (i.e., the same as in the case of a single network),
- when consumers multi-home, the outcome is $p_{BH}^{MH}$. It is larger than the price $p_{BH}^{TUS}$ that maximizes total user surplus in the cost absorption case (as represented here) but may be lower in the cost amplification case.

We can now summarize the results for the homogeneous-merchant case.

In the case of Bertrand competition among issuers ($m = 0$), the tourist test and the welfare and TUS thresholds coincide, as shown in Figure 3.

$$a^{MH} = a^T + (1 - \alpha)\frac{D_B}{D_B}$$
$$a^T = b_S - c_S$$
$$a^{SH} = a^T + \alpha v_B$$

Figure 3: The perfect competition case

However, when issuers have some ex post market power (which seems to be the belief of Competition Authorities in many regions of the world) the tourist test threshold can be too high or too low, depending on whether cost absorption ($m' < 0$) or cost amplification prevails. This is represented in Figure 4.
7.3 Heterogeneous merchants

Let us return to the extension of Section 6, in which merchants differ in their convenience benefit $b_S$, and compare the payment system’s choice of interchange fee with the TUS and welfare benchmarks obtained in Section 6. The following result (whose proof can be

\[ a^W = a^T + m \]
\[ a^{SH} = a^T + s \]

when $s > m$

23This assumes that retail profit decreases with retail cost, so that merchants’ profit decreases with $a$. 

Figure 4a: Optimal values of the interchange from the points of view of merchants, cardholders and social welfare (cost absorption case)

Figure 4b: Optimal values of the interchange fee from the points of view of merchants, cardholders and social welfare (cost amplification case)
found in Appendix 4) assumes that the issuers’ margin \( m \) is constant, so that \( p_B + p_S \) is itself a constant, and equal to \( c + m \).

**Proposition 9.** Assume that merchants differ in the net convenience benefit \( b_S \) that they derive from card transactions and that issuers’ margin is constant (perfect cost passthrough).

\( i \) Provided that social welfare is quasi-concave in the buyer price, the IF selected by a monopoly association is lower than the socially optimal value if and only if average merchant surplus per card payment exceeds cardholders’:

\[
v_S (\hat{b}_S^m) > v_B (p_B^m).
\]  

(25)

\( ii \) This condition is stronger than the average tourist test \( p_S < E (b_S | b_S > \hat{b}_S) \) when \( \alpha < 1 \), and equivalent to it when \( \alpha = 1 \).

\( iii \) When total user surplus is quasi-concave in the buyer price, this condition is also necessary and sufficient for the monopoly IF to be lower than the value that maximizes total user surplus.

Proposition 9 shows that when the merchant homogeneity assumption is relaxed, the price structure chosen by a monopoly platform, in the absence of a regulation, is no longer systematically biased in favor of cardholders.\(^{24}\) Intuitively, issuers want to maximize volume and do not account for buyer and seller surpluses. The bias induced by a private choice of IF depends on the relative surplus of the two groups of users. When the average net benefit of retailers from card payments \( v_S \) is greater than the average net benefit of consumers \( v_B \), the IF chosen by a monopoly platform is too low, from both viewpoints of social welfare and total user surplus.

To prove Proposition 9 (see Appendix 4), one first demonstrates that in the absence of IF regulation, a monopoly network chooses the price structure \((p_B^m, p_S^m)\) that maximizes volume \( V = D_B D_S \) subject to \( p_B + p_S \) being constant. It is characterized by the equality of the semi-elasticities, where the sellers’ semi-elasticity must be reduced to account for their internalization of buyer surplus:

\[
\frac{D'_B}{D_B} (p_B^m) = \frac{D'_S}{D_S} (\hat{b}_S^m) \left[ 1 + \frac{\partial s}{\partial p_B} \right].
\]  

(26)

\(^{24}\)Condition (25) is never satisfied when merchants are homogeneous. As established by Proposition 6, the monopoly IF is then higher than or equal to the socially optimal IF, which is consistent with Proposition 9.
8 Conclusion

Merchants may accept a payment card even when their net benefit from doing so is negative. Accordingly, we introduced the “tourist test” (would the merchant want to refuse a card payment when a non-repeat customer with enough cash in her pocket is about to pay at the cash register?). The tourist test is attractive because it caps the merchant discount at a level at which the payment system cannot exploit the internalization effect to force merchants to accept a retail-cost-increasing means of payment. We analyzed its relevance as an indicator of “excessive” interchange fees. The relevant welfare benchmarks for this analysis are (a) short-term total welfare, (b) short-term consumer welfare, and (c) consumer welfare when issuer entry and offerings respond to industry profitability.

The paper’s first contribution has been to assess whether the tourist test is a proper test for detecting excessive interchange fees. While merchants are not forced into transactions that they would not wish ex post when the IF passes the tourist test, we showed that the tourist test may yield false positives even if we focus on total user surplus (TUS), which does not account for issuers’ markups. First, in the short run, the TUS-maximizing IF fails the tourist test if the issuing industry’s prices exhibit cost amplification (conversely, cost absorption leads to false negatives). Second, in the long term, issuer markups translate into entry and thereby lower prices and increased variety, and so the short-term analysis yields TUS-maximizing IFs that are smaller than their long-term counterpart. Third, merchants are heterogenous, and an interchange fee that properly guides cardholders’ decisions must reflect the average, not the marginal merchant benefit. This implies that the merchants who benefit least from the card, say the large retailers, are likely to fail the tourist test at the social optimum.

In the absence of platform competition or under cardholder single-homing and merchant homogeneity, the interchange fee chosen by issuers exceeds the short-term socially optimal level if and only if the fraction of cardholder benefits internalized by merchants (which depends on how knowledgeable about merchants’ acceptance policies cardholders are) exceeds the issuers’ per transaction markup. Under platform competition and multi-homing, the IF is smaller than the value that maximizes consumer surplus (cardholders’ plus merchants’ surplus), and a fortiori the value that maximizes social welfare.

An indirect contribution of the paper has been to supply a theoretical framework in which platforms’ business strategies and antitrust-concerns can be taken to the data. Besides its two-sidedness, a novel and central aspect of the environment considered here
is the (partial) internalization of buyer surplus by sellers. The identification of supply and demand functions and the estimation of welfare are policy relevant and intellectually challenging questions on the empirical agenda.
References


Appendix 1: The Hotelling-Lerner-Salop model satisfies Assumption 1

There is a continuum of consumers (of total mass normalized to one) with quasi-linear preferences. They spend their income on a composite good or “cash good” taken as a numeraire and on one unit of a “card good” sold by $R$ retailers (being a “card good” means that consumers can pay by card as long as merchants accept it. “Cash goods” include leisure/work). The utility from purchasing the card good can differ across consumers, but is large enough, so that the aggregate demand for the card good is constant and equal to one.\textsuperscript{25} To capture the intensity of competition in the (card good) retail sector, we use the Lerner-Salop model of product differentiation: Retailers and consumers are located uniformly on a circle of length normalized to one. The timing is as follows:

1. First, each consumer learns his preference across brands of the card good offered by the retailers, as well as the prices chosen by the retailers. Furthermore, he learns all stores’ card acceptance policies with probability $\alpha$, and does not learn any with probability $1 - \alpha$. The consumer then chooses which store to patronize. The optimal choice minimizes the sum of three terms: the retail price $p_R^j$, the transportation cost $t\Delta^j$ incurred for going to the store (where $\Delta^j$ is the distance to the store and $t > 0$ is a given parameter), and the expected transaction cost associated with the payment mode (this term is detailed below).

2. Second, after choosing a store, the consumer learns his convenience benefit of using a card rather than cash in the particular instance, and chooses the payment mode among the ones accepted by the retailer. For simplicity, we restrict the analysis to two payment modes: card (if it is accepted by the retailer) and an alternative payment mode (cash or check). The relative cost $\tilde{b}_B$ of this alternative payment mode for the consumer (also equal to his convenience benefit for a card payment) is random, and drawn from another continuous distribution with cumulative distribution function $H$:

\[
H (b_B) = \Pr \left( \tilde{b}_B \leq b_B \right). \tag{27}
\]

We adopt the convention that $\tilde{b}_B$ is the convenience cost of a cash/check payment and 0 is that for a card payment.

\textsuperscript{25}The analysis of the variant where the demand for the card good is elastic is more complex but gives similar results. It is available from the authors upon request.
As we noted, this convenience benefit $\tilde{b}_B$ is observed by the consumer only once he is in the store. The net benefit of paying by card is thus equal to the difference $\tilde{b}_B - p_B$. A card payment is optimal for the consumer whenever this net benefit is positive. The proportion of card payments is denoted $D_B (p_B)$:

$$D_B (p_B) = \Pr \left( \tilde{b}_B > p_B \right) = 1 - H (p_B).$$ \hfill (28)

Retailers $j = 1, \cdots, R$ compete in two stages.\(^{26}\)

1. First, they simultaneously decide whether to accept the card. We denote the decision of retailer $j$ by a variable $x^j$ equal to one if retailer $j$ accepts the card, and zero if he does not.

2. Second, they simultaneously set their retail prices: $p^j_R$ is chosen by retailer $j$ so as to maximize his profit:

$$\pi^j = \left[ p^j_R - \gamma - b_S - x^j (p_S - b_S) D_B (p_B) \right] y^j,$$

where $\gamma$ is the cost of producing the card good, and $b_S$ is the cost of the alternative payment mode for the seller (assumed for the moment to be constant across sellers). We adopt a convention similar to that for cardholders: $b_S$ is the retailer’s cost of a cash/card payment, while that for a card payment is normalized at 0. Thus $(p_S - b_S) D_B (p_B)$ represents the expected net cost of card payments for the seller (incurred only when $x^j = 1$). Finally, $y^j$ represents the market share of retailer $j$.

Retailer $j$’s market share is a function of the retail prices set by retailer $j$ and his neighbors $j - 1$ and $j + 1$, as well as the card acceptance decisions $x^j$, $x^{j-1}$ and $x^{j+1}$:

$$y^j = \frac{1}{R} + \frac{1}{2t} \left[ p^{j-1}_R + p^{j+1}_R - 2p^j_R - \alpha \left( x^{j-1} + x^{j+1} - 2x^j \right) s_B (p_B) \right]$$ \hfill (30)

where

$$s_B (p_B) \equiv \int_{p_B}^{\infty} (b_B - p_B) dH (b_B)$$

denotes the expected surplus that a buyer derives from the option of paying by card, and $\alpha \in [0, 1]$ represents the proportion of consumers who are informed about the card.

\(^{26}\)The timing here is irrelevant: the equilibrium would be the same if the first and second stages were simultaneous. This is because we assume that consumers’ transactional benefits are drawn ex post.
acceptance decisions of retailers.\textsuperscript{27} Our next proposition relates the retailers’ acceptance decision to prices $p_B$ and $p_S$ and to the internalization parameter $\alpha$.\textsuperscript{28}

**Proposition 10.** The retail sector equilibrium is unique and symmetric.

- retailers (all) accept the card if and only if:
  \[ p_S \leq b_S + \alpha v_B (p_B) \]  \tag{31}

(otherwise none accepts the card). If this condition is satisfied, then:

- retailer pass through card transaction costs (or benefits) into the retail price:
  \[ p^*_R = \gamma + b_S + \frac{t}{R} - (b_S - p_S) D_B (p_B) \]  \tag{32}

(\textit{where $\gamma + b_S$ is the marginal cost of a cash transaction and $\frac{t}{R}$ the Hotelling mark-up}), and the total profit of the retail sector is constant:
  \[ \pi = \frac{t}{R}, \]  \tag{33}

- consumers’ total purchase cost is given by:
  \[ \left[ \gamma + E \left( b_B \right) + b_S \right] + \frac{5t}{4R} - \phi_1, \]  \tag{34}

where $\phi_1$ is obtained by taking $\alpha = 1$ in formula (31).

**Proof of Proposition 10**

Suppose, first, that all retailers accept the card. In this case, formulas (29) and (30) show that the profit of retailer $j$ is maximized when

\[ 0 = \frac{\partial \pi_j}{\partial p^*_R} = y_j - \left[ p^*_R - \gamma - b_S - (p_S - b_S) D_B (p_B) \right] / t. \]

The equilibrium market shares are all equal \( y^j \equiv \frac{1}{R} \), and so are retail prices:

\[ p^*_R \equiv p^*_R = \left[ \gamma + b_S + \frac{t}{R} \right] - (b_S - p_S) D_B (p_B) \]

\textsuperscript{27}It may seem strange that when $\alpha < 1$ some consumers know the prices, but not the card acceptance decisions. Note however that a) they do not need to know all retail prices (as in Lal-Matutes 1994, it suffices that they know at least one price for the reasoning to apply), and b) whether they know some price or not, card acceptance helps attract consumers but in this latter case, the more general functional form posited in Assumption 1 is needed.

\textsuperscript{28}Proposition 10 can easily be extended to the case where two card networks offer identical cards and set identical IFs.
which establishes formula (32). Consumer total purchase cost is then equal to the sum of the retail price $p^*_R$, the average transportation cost $\frac{t}{4R}$ and the expected transaction cost for the cardholder $E \left( \tilde{b}_B \right) + \int_{p_B}^{\infty} (p_B - b) dH (b_B)$. Formulas (34) and (33) are then immediate.

Suppose now that retailer $j$ considers rejecting the card. A new price equilibrium arises where all retailers except $j$ increase their price and market share, whereas retailer $j$ decreases his price and market share but also his cost (assuming $b_S < p_S$). It is easy to check that the net effect is to decrease retailer $j$’s profit if and only if

$$\phi_\alpha \equiv (b_S - p_S) D_B (p_B) + \alpha \int_{p_B}^{\infty} (b_B - p_B) dH (b_B) \geq 0.$$  

We call $\phi_\alpha$ the weighted total user surplus. Intuitively, with a linear demand (stemming from the uniform distribution of consumers), retailer $j$ can lower his price by $\alpha \int_{p_B}^{\infty} (b_B - p_B) dH (b_B)$ and keep the same market share as when he accepts the card. The first term in the latter inequality is (minus) the cost saving associated with rejecting the card. The condition is thus equivalent to the assertion that accepting the card maximizes the perceived or weighted total user surplus, where only a fraction $\alpha$ of the buyer surplus from using the card is internalized. More formally, since $\phi_\alpha$ has the same sign as $\frac{\phi_\alpha}{D_B(p_B)}$, we have that:

$$\phi_\alpha \geq 0 \iff \frac{\phi_\alpha}{D_B(p_B)} = b_S - p_S + \alpha v_B(p_B) \geq 0.$$  

This condition ends the proof of formula (31) and, thus, of Proposition 10. The equilibrium is unique. 

### Appendix 2: Welfare and TUS optima under heterogeneous merchants

Social welfare is given by:

$$W = \int_{p_S - s(\alpha, p_B)}^{\infty} \int_{p_B}^{\infty} [b_S + b_B - c] dH (b_B) dG (b_S)$$

and total user surplus has the same expression with $[b_S + b_B - c - m]$ as the integrand.

Social welfare is maximized for a value $p_B^W$ of buyers’ price such that:

$$\frac{\partial W}{\partial p_B}(p_B^W, \tilde{b}_S^W) = \frac{\partial W}{\partial b_S}(p_B^W, \tilde{b}_S^W) \left( 1 + \frac{\partial s}{\partial p_B}(\alpha, p_B^W) \right).$$
Using formula (35) we see that
\[ \frac{\partial W}{\partial p_B}(p_B^w, \hat{b}_S^w) = D'_B(p_B^w) \int_{\hat{b}_S^w}^\infty (p_B^w + b_S - c)dG(b_S). \]

Now by definition:
\[ v_S(\hat{b}_S^w)D_S(\hat{b}_S^w) = \int_{\hat{b}_S^w}^\infty (b_S - \hat{b}_S^w)dG(b_S). \]

Thus we can write:
\[ \frac{\partial W}{\partial p_B}(p_B^w, \hat{b}_S^w) = D'_B(p_B^w)D_S(\hat{b}_S^w) \left[ v_S(\hat{b}_S^w) + m - s(\alpha, p_B^w) \right]. \]

Similarly
\[ \frac{\partial W}{\partial b_S}(p_B^w, \hat{b}_S^w) = D'_S(\hat{b}_S^w)D_B(p_B^w) \left[ v_B(p_B^w) - s(\alpha, p_B^w) + m \right]. \]

Thus the first-order condition for welfare maximization can be rewritten as:
\[ \frac{D'_B(p_B^w)}{D_B(p_B^w)} \left[ v_S(\hat{b}_S^w) + m - s(\alpha, p_B^w) \right] = \frac{D'_S(\hat{b}_S^w)}{D_S(\hat{b}_S^w)} \left[ v_B(p_B^w) - s(\alpha, p_B^w) + m \right] \left( 1 + \frac{\partial s}{\partial p_B} (\alpha, p_B^w) \right) \]

This is equivalent to formula (19).

**Appendix 3: Retailers’ acceptance decisions under partial multi-homing**

For simplicity, this appendix takes as given the proportions of buyers who own the two cards. Specifically, let \( \beta_k \) \((k = 1, 2)\) denote the proportion of buyers who own only card \( k \) (the single-homers) and \( \beta_{12} \) denote the proportion of buyers who own both cards (the multi-homers). Like before, we assume for simplicity that all consumers have a card\(^{29}\) (i.e., \( \beta_1 + \beta_2 + \beta_{12} = 1 \)) and also that only a proportion \( \alpha \in [0, 1] \) of consumers are aware of retailers’ card acceptance policy before they select which store to patronize. The next proposition characterizes the equilibrium of the retail sector (both in terms of card acceptance and retail prices) as a function of payment card prices and parameters \( \alpha, \beta_1, \beta_2 \) and \( \beta_{12} \).

**Proposition 11.** At the equilibrium of the retail sector:
- retailers accept both cards if and only if:
  \[ \beta_1 \phi_\alpha (p_B^1) + (\beta_2 + \beta_{12}) \phi_\alpha (p_B^2) \geq \max \left[ 0, (\beta_1 + \beta_{12}) \phi_\alpha (p_B^1), (\beta_2 + \beta_{12}) \phi_\alpha (p_B^2) \right] \quad (37) \]

\(^{29}\)This is not inconsistent with our model, which assumes that issuers do not charge fixed fees to cardholders.
If this condition is satisfied then:

- **retail prices**\(^{30}\) are given by:

\[
p_{R}^* = \left[ \gamma + bs + \frac{t}{R} \right] - \beta_1 (bs - p_S^1) D_B (p_B^1) - (\beta_2 + \beta_{12}) (bs - p_S^2) D_B (p_B^2),
\]

- aggregate demand for the card good equals\(^{31}\) \(\beta_1 D (u_1^*) + (\beta_2 + \beta_{12}) D (u_2^*),\)

- consumer surplus equals \(\beta_1 S (u_1^*) + (\beta_2 + \beta_{12}) S (u_2^*),\)

- finally, the total profit of the retail sector is

\[
\pi_R = \frac{t}{R} [\beta_1 D (u_1^*) + (\beta_2 + \beta_{12}) D (u_2^*)]
\]

**Proof of Proposition 11:**

It proceeds similarly to that of Proposition 10. In equilibrium, retailers accept the (set of) cards that maximize the expectation of weighted user surplus \(\phi_\alpha\) over all buyers. Accepting only card \(k (k = 1, 2)\) allows a fraction \((\beta_k + \beta_{12})\) of buyers to pay by card generating weighted user surplus \(\phi_\alpha (p_B^k)\). The right-hand side of condition (37) corresponds to the maximum of three outcomes: accepting no card, accepting card 1 alone, and accepting card 2 alone. The left-hand side of condition (37) corresponds to the expectation of weighted user surplus when the merchant accepts both cards. In this case multi-homers prefer to use card 2 (since \(p_B^2 \leq p_B^1\)), which explains the fraction \((\beta_2 + \beta_{12})\) of buyers who use card 2. This establishes the first bullet point in Proposition 11. Retail prices (second bullet point) are given at equilibrium by the average unit cost faced by merchants (including the net cost of card payments) plus a constant margin \(\frac{t}{R}\). The other bullet points are immediate.

**Appendix 4: Proof of Proposition 9**

Given our assumption that issuers’ margin is constant, their profit is maximized for a value \(p_B^M\) of buyers’ price that maximizes the volume of card transactions, given by:

\[
V(p_B) = D_B(p_B)D_S(\hat{b}_S(p_B)),
\]

\(^{30}\)We assume that retailers find it too costly or are not allowed to charge different prices for transactions settled through different cards.

\(^{31}\)For simplicity, we assume that the determinants of the choice of cards by consumers are independent from the parameters that determine the gross utility \(\hat{u}\) obtained by consumers when they consume the card good.
where \( \hat{b}_S(p_B) = c + m - p_B + s(\alpha, p_B) \).

Now \( p_B^m \) is given by the first-order condition:

\[
\frac{V'}{V}(p_B^m) = \frac{D'_B(p_B^m)}{D_B} - \frac{D'_S(\hat{b}_S^m)}{D_S}(1 + \frac{\partial s}{\partial p_B}(\alpha, p_B^m)) = 0,
\]

which gives (26).

When social welfare is quasi-concave with respect to the buyer price, the privately optimal IF (associated with buyer price \( p_B^m \)) is excessively low whenever

\[
\Delta \equiv \frac{\partial W}{\partial p_B}(p_B^m, \hat{b}_S^m) - \left[ 1 + \frac{\partial s}{\partial p_B}(\alpha, p_B^m) \right] \frac{\partial W}{\partial \hat{b}_S}(p_B^m, \hat{b}_S^m) < 0.
\]

Adapting the formulas obtained above, we see that

\[
\Delta = D'_B(p_B^m)D_S(\hat{b}_S^m) \left[ v_S(\hat{b}_S^m) + m - s(\alpha, p_B^m) \right]
- [1 + \frac{\partial s}{\partial p_B}(\alpha, p_B^m)]D'_S(\hat{b}_S^m)D_B(p_B^m)[v_B(p_B^m) - s(\alpha, p_B^m) + m].
\]

Applying condition (26) allows us to simplify this expression:

\[
\Delta = D'_B(p_B^m)D_S(\hat{b}_S^m) \left[ v_S(\hat{b}_S^m) + m - s(\alpha, p_B^m) - v_B(p_B^m) + s(\alpha, p_B^m) - m \right],
\]

Thus \( \Delta < 0 \iff v_S(\hat{b}_S^m) > v_B(p_B^m) \), and the proof of Proposition 9i) is complete.

For establishing 9ii) it suffices to notice that \( v_S(\hat{b}_S^m) = E(b_S(\hat{b}_S^m) - p_B^m + s(\alpha, p_B^m)) \) and that \( s(\alpha, p_B^m) \leq v_B(p_B^m) \), with strict inequality when \( \alpha < 1 \) and equality when \( \alpha = 1 \).

Part iii) results from the comparison of formulas (19) and (26)

Appendix 5: Heterogeneity in internalization

Let us investigate heterogeneity in \( \alpha \) (\( b_S \) being the same for all merchants). Merchants accept cards if and only if their internalization parameter \( \alpha \) exceeds a critical value \( \alpha^*(p_B) \) defined implicitly by the relation:

\[
b_S = p_S - s(\alpha, p_B) = c + m(p_B) - p_B - s(\alpha, p_B),
\]

(We assume that there is cost absorption or cost passthrough \( (m' \leq 0) \). In this case, \( \alpha^* \) is a decreasing function\(^{32} \) of \( p_B \). Thus increasing \( p_B \) gets more merchants on board. Social

\(^{32}\)Since \( \alpha^* \leq 1 \) and \( v'_B \geq -1 \), the assumption \( m' \leq 0 \) implies that the right-hand side of (38) decreases in \( p_B \).
welfare has a simple expression:

\[
W = \left[ \int_{p_B}^{\infty} (b_B + b_S - c) dH(b_B) \right] \cdot \Pr(\alpha \geq \alpha^*(p_B)).
\]

At the (first best) social optimum all merchants accept cards \((\alpha^* = \alpha_{\min}, \text{where } \alpha_{\min} \text{ is the minimum value of } \alpha \text{ among merchants})\) and:

\[
p_{BW}^* = c - b_S.
\]

This can be implemented by setting the interchange fee at

\[
a = b_S - c_S + m = a^W,
\]

provided this is compatible with universal merchant acceptance:

\[
s \left( \alpha_{\min}, p_{BW}^* \right) \geq m \left( p_{BW}^* \right).
\]

If this condition is not satisfied, let \(\psi(p_B) = \Pr(\alpha \geq \alpha^*(p_B))\) denote the proportion of merchants who accept cards, as a function of the cardholder price \(p_B\). The socially optimal level of \(p_B\), which we denote \(p_{BW}^*\), satisfies:

\[
\frac{W'(p_B)}{W(p_B)} = \frac{(p_B + b_S - c)D'_B}{\int_{p_B}^{\infty} (b_B + b_S - c) dH(b_B)} + \frac{\psi'(p_B)}{\psi(p_B)} = 0.
\]

By contrast, a monopoly network selects a cardholder price \(p_B^m\) that maximizes the profit of issuers:

\[
\Pi = m(p_B)D_B(p_B)\psi(p_B).
\]

Therefore \(p_{BW}^m\) satisfies:

\[
\frac{\Pi'}{\Pi} = \frac{m'}{m}(p_B) + \frac{D'_B}{D_B}(p_B) + \frac{\psi'(p_B)}{\psi(p_B)} = 0.
\]

Under monotone comparative statics (that is, if \(\Pi\) is log concave) we can compare \(p_{BW}^m\) and \(p_{BW}^W\). Indeed if \(m' \leq 0\) then, given that \(D'_B \leq 0\), and

\[
\frac{p_B + b_S - c}{\int_{p_B}^{\infty} (b_B + b_S - c) dH(b_B)} < \frac{1}{D_B},
\]

we have:

\[
\frac{\Pi'(p_B^m)}{\Pi} = 0 = \frac{W'(p_B^W)}{W(p_B^W)} \geq \frac{D'_B}{D_B}(p_B^W) + \frac{\psi'(p_B^W)}{\psi(p_B^W)} \geq \frac{\Pi'}{\Pi}(p_B^W),
\]

39
which implies, by log concavity of $\Pi$, that

$$p_B^W \geq p_B^m.$$ 

Similarly total user surplus can be written as:

$$TUS(p_B) = \left[ \int_{p_B}^{\infty} [b_B + b_S - c - m(p_B)] dH(b_B) \right] \psi(p_B).$$

The term between brackets is maximum for a value of $(p_B)$ that is above $p_B^T$ (this is because we have assumed cost absorption: see Table 1).

Since $\psi' > 0$, log concavity assumptions guarantee that this is a fortiori true of $p_B^{TUS}$. Therefore $a_{TUS} < a^T$.

Thus we have shown:

**Proposition 12.** When the internalization parameter $\alpha$ is heterogenous across merchants and there is cost absorption or pass through ($m' \leq 0$), the interchange fee selected by a monopoly association is (weakly) bigger than the socially optimal interchange fee.\(^{33}\)

Moreover, under the same assumptions, the tourist test threshold is above the level of the interchange fee that maximizes total user surplus.

\(^{33}\)For analogous reasons, the buyer price $p_B^{SH}$ that results from competition between identical platforms when cardholders single-home is greater than $p_B^m$. This contrasts with the case of homogeneous merchants, where $p_B^{SH} = p_B^m$. 

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