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"Interchange fees, access pricing and sub-acquirers in payment markets"

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Interchange fees, access pricing and sub-acquirers in payment markets*

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Abstract

Sub-acquirers, also known as payment facilitators, have played a vital role in fostering merchant digital payments acceptance, particularly in developing countries. To provide access to digital payments (ie card acceptance) to merchants, sub-acquirers do not have a direct connection with the card network but through the acquirer. This paper aims to study the optimal pricing in the payments industry when: i) the sub-acquirers and acquirers compete in the same downstream market, and ii) the sub-acquirers enter niche markets that are not covered yet (eg micro and small-sized merchants). In the first scenario, a conflict arises as the acquirer might have incentives to deter entry by charging prohibitive access fees. In the second scenario, the acquirer obtains an extra profit from granting access to the card network for the sub-acquirers, and welfare increases. That said, the regulator can play a relevant role in the first scenario by setting an access fee to allow socially but not privately desirable entry.

Keywords: Access pricing, Interchange fees, Payment cards, Payment facilitators, Two-sided markets

JEL Classification: G21, L11, L4, L5

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1 Introduction

Over the last decades, credit, debit and prepaid cards have become more important in retail payments as a substitute for cash. Moreover, the coronavirus pandemic highlighted the relevance of digital payments; in particular, card payments as an alternative when fearing viral transmission through cash (banknotes and coins) (Alfonso et al., 2020; Auer et al., 2020). Despite these positive facts, low-income and unbanked people still use cash as their only payment instrument (Aurazo and Vega, 2021b; Shy, 2020) and many micro and small-sized businesses do not accept means of payment other than cash in developing countries. A few reasons behind the low merchant card acceptance are related to demand-side factors such as tax evasion (Aurazo, 2020; Aurazo and Vasquez, 2020; Aurazo and Vega, 2021a) or supply-side factors such as cost inefficiencies and operational risk management (Müller, 2023).

In this context, new players so-called payment facilitators/aggregators or more generally sub-acquirers[1], are playing a relevant role in fostering card acceptance, specially for micro and small-sized businesses and in developing countries. They offer a new value-added product by providing an easier and cheaper way of accepting cards for merchants. Indeed, sub-acquirers could bring an efficient remedy to the higher costs that merchants usually face (due to vertical and horizontal integration and exclusivity arrangements between acquirers and card networks) or the null perception of a real benefit from accepting payment cards[2]. Unlike acquirers, sub-acquirers do not have a direct connection with the card network but through the acquirer to provide merchant card acceptance, and thus an anti-competitive behaviour could arise.

The paper aims to analyse the optimal pricing (interchange fees, access charges, cardholder price and merchant discount rates) when the sub-acquirer competes with the acquirer in the same downstream market and in niche markets (which are not covered yet). In the first scenario, the acquirer might have incentives to deter entry by setting prohibitive access fees to sub-acquirers, while in the second scenario the acquirer is less likely to deter entry as it obtains an extra profit from granting access in this new market.

The model is built upon Rochet and Tirole (2011) but includes a sixth player (sub-acquirer) that can compete with the acquirer in the downstream market, and splits the acquiring market into upstream and downstream activities. On the one side, there is an upstream market in which the acquirer grants connection with the card network and allows transactions from sub-acquirers to be validated and processed; on the other side, there is a downstream market in which acquirers provide card acceptance to merchants and they can compete with sub-

[1] In the card industry, there is a large discussion about payment aggregators and payment facilitators. For simplicity, this paper treats both terms as sub-acquirers (third-party providers) that have a contractual relationship with acquirers to provide merchant card acceptance instead of a direct connection with the card network. For instance, Square, Stripe, and PayPal are all examples of sub-acquirers.

[2] For instance, in Peru both sub-acquirers Izipay and Vendemas allowed merchants to accept all the card networks at the point of sale when the main acquirers were exclusive with only one card network (Visa or Mastercard); ie instead of contracting with Niubiz and PMP separately and incurring double costs, small merchants opted to affiliate with the sub-acquirer to accept both card networks. Another example is MercadoPago which is an e-commerce platform that allows merchants to accept all cards in Latin America and the Caribbean.

acquirers. In the upstream market, the acquirers provide an essential input (bottleneck) to sub-acquirers and charge an access fee whenever sub-acquirers process a transaction in the downstream market.

From a regulatory perspective, the regulator can play an essential role in increasing welfare when the acquirer deters socially desirable entry by setting alternative access charges. That said, it is interesting to analyse the impacts of some alternative access regimes applied in other network industries such as the first-best rule (access fee equals to costs), the efficient cost pricing rule (ECPR) or another one[3]. In particular, a first-best rule (margin cost rule) or the ECPR leads to a welfare-increasing situation in which the sub-acquirer serves the whole downstream market. Lessons learned from the old debate on the utilities' bottlenecks show that marginal pricing (first-best rule) is not the best solution and the ECPR makes the owner of the infrastructure neutral between providing access to the upstream activity and operating in the downstream market (Tirole, 2022).

On the other side, when entry to niche markets occurs, ie markets that are not covered yet, the acquirers are less likely to deter entry as they obtain an extra profit from granting access, so welfare is increased as end users make transactions with cards instead of cash which is a less efficient means of payment. Therefore, in this context, the role that a regulator can play is less focused on access pricing (eg on quality and safety standards). However, although this scenario has been the most applicable in developing countries in recent years, sub-acquirers are entering markets traditionally served by acquirers, and vice versa, and thus the access charge is becoming a relevant variable in the market for payment cards.

In sum, the new market structure in the card industry could lead to some competition issues between acquirers and sub-acquirers which in turn hinders the promotion of card payments, particularly in activities where cash is still the king and for micro and small-sized businesses. That said, in markets that are already covered by the acquirers, they might have incentives to set an access fee such that they prevent efficient entry from new entrants such as sub-acquirers to maintain their incumbency in the downstream market. The markets for payment cards with sub-acquirers are thus a novel case of opening of competition in network industries. Therefore, it raises the questions whether payment card markets should be regulated since the owners of an essential infrastructure have little incentive to let others compete (Tirole, 2022)[4]. Although this paper describes the card industry, this new market structure could be easily extended to other payment markets.

Literature review. This paper contributes to the literature on both payment cards and access pricing. On the one hand, the paper does something novel by modeling the card industry with sub-acquirers. On the other hand, the paper extends the application of access pricing theory to payment cards which are also a network industry but this matter has not been analysed before.

Payment cards are usually defined as a two-sided market in which consumers and merchants

[3]The most applied access rule is the Baumol-Willig rule, also called the Efficient Price Cost Rule (ECPR) which states that price setting should be guided by efficiency considerations, which means that the access charge should not be as low as to allow an inefficient competitor to enter profitably nor as high as to render entry unprofitable to a more efficient rival.

[4]Similar settings can be found in telecoms, rails, electricity grids, water pipelines, among others.

interact through a card network to purchase goods and services without cash. There exist indirect network externalities, ie the utility of cardholders (merchants) increases when more merchants accept (cardholders use) cards as a means of payment. Rochet and Tirole (2003) formally define a two-sided market as one market in which the price structure (how much each side pays) matters rather than the price level (the sum of price for each side).

In this regard, some papers analyse the card industry through a monopoly card platform that serves directly to consumers and merchants (a closed or third-party scheme) as it can be easily extrapolated to platform monopolies in other business models (AirBnb, Google, Facebook, Uber, etc.) (Rochet and Tirole, 2003). However, most card schemes in practice are four-party in which the card network delegates the issuing and acquiring functions to third entities. For instance, Visa and Mastercard are the most typical examples within the four-party schemes, in which the interchange fee plays a crucial role in the price structure (Rochet and Tirole, 2003, 2006). This fee is an income from the acquirer to the issuer which allows the latter to give rewards to cardholders but also is a price floor for merchants which sometimes can hinder the merchant card acceptance. Therefore, in general, a higher interchange fee incentivizes cardholders to use their cards (it is more attractive for cardholders) while a lower interchange fee promotes merchant card acceptance (it is less costly for merchants). Carbo-Valverde et al. (2016) find that reductions of interchange fees have a considerable impact in increasing merchant acceptance and card transactions.

The optimal determination of the interchange fee has been the center of academic and policy discussions in the past years. On the research side, Baxter (1983) is the first to study this situation. Rochet and Tirole (2002, 2006, 2011) formalize the card industry and the determination of the interchange fee and its role in the price structure. Bedre-Defolie and Calvano (2013) analyse optimal interchange fees when consumers decide to adopt and use cards while merchants only make one decision (adoption). Ding and Wright (2017) analyse the price setting under different scenarios depending on the possibility of discriminating the cardholder price or not. Reisinger and Zenger (2019) study the interchange fee regulation and service investments, in which the card network invests to improve quality on both sides. Aurazo and Vasquez (2020) study how tax evasion through cash payments affects social and private interchange fees. Shy (2022) analyses the interchange fee set in the presence of cashless stores, cashless consumers, and cash-only consumers. From the policy side, some jurisdictions have established caps on interchange fees such as the EU, Brazil, Chile, U.S., South Africa, and Australia. In developing countries, some papers also argue that interchange fees should reflect tax evasion issues as it reduces the cost of cash from the merchant perspective (Aurazo and Vega, 2021a; Arango-Arango et al., 2022).

On the other side, the literature on access pricing has been widely analysed in utility industries such as telecommunications (Armstrong, 2002; Vogelsang, 2003). The issue arises when the monopoly owner of the essential facility also operates in the downstream market (a vertically integrated incumbent), and the entrant has to gain access to the incumbent to compete in the market for the final product. Therefore, the price the incumbent may charge for access is excessive and non-competitive. More recently, Tirole (2022) discusses the importance of preserving fair access by third parties to an essential facility in the digital era.

There are two different solutions discussed in the literature. One is to separate the vertically integrated monopoly, and the other is to regulate the access charge. In the latter case, which is of interest in this paper, it is important to distinguish between one-way and two-way access. In the first situation, the access moves in one direction, from the entrant to the incumbent, while in the second one, the access is bilateral as the entrant and the incumbent have to interconnect each other to compete in the downstream market. In contrast to the telecommunications industry where the access pricing is mainly two-way, the interconnection between an acquirer and a sub-acquirer in the market for payment cards is one-way.[5] As Vogelsang (2003) points out, the nature of one-way access regulation is exclusively driven by the containment of market power. In this regard, Bianchi et al. (2021) study interoperability (also understood as compatibility) in mobile payments distinguishing among mobile network interoperability, platform-level interoperability, and agent-level interoperability. In all these scenarios, the access charges play an important role in expanding the benefits of interoperable platforms.

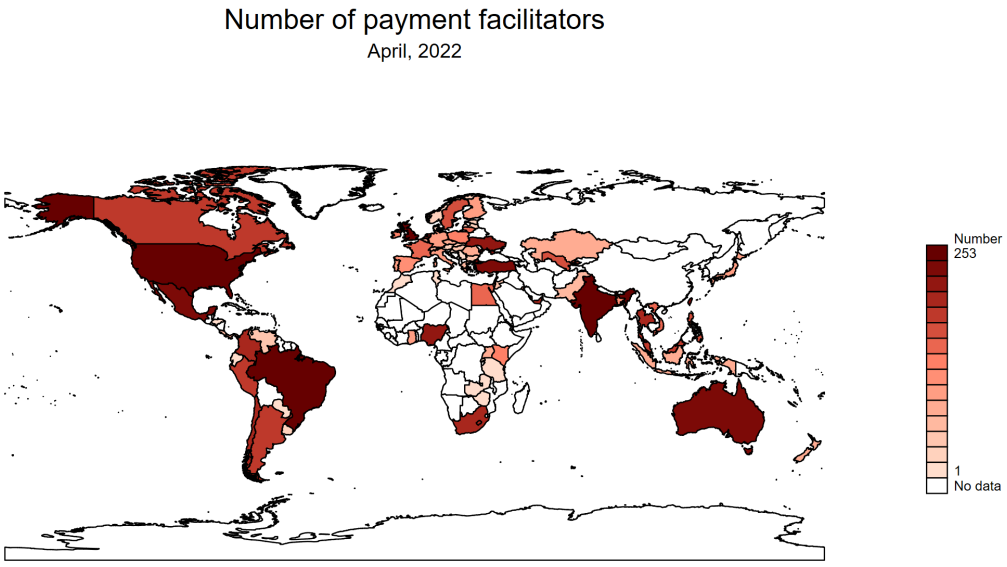
The paper is structured as follows. Section 2 describes the institutional background on sub-acquirers. Section 3 describes the model setup when sub-acquirers and acquirers compete in the same downstream market. Section 4 shows the socially and privately optimal fees (interchange fee and cardholder price). Section 5 discusses the implications of several access regimes applied traditionally in other network industries. Section 6 analyses the situation in which sub-acquirers enter niche markets that are not covered by the acquirers (eg micro and small-sized merchants). Finally, Section 7 gives the key insights of the paper.

2 Institutional background

Sub-acquirers play similar roles as acquirers: i) provide POS devices or payment solutions for e-commerce platforms to merchants, ii) deposit funds in the merchants' bank accounts, iii) have contractual responsibilities with merchants, among others. They invest in innovative products such as new point-of-sale (POS) devices (e.g, mobile apps that enable mobile phones to be used as POS devices) or provide value-added services such as account balances, access to loans in the financial sector or a shorter time to deposit funds in merchants' bank accounts. These players usually facilitate card payments in segments where the acquirer has to incur high costs or has no incentives to provide better services or even enter, either through e-commerce (on-line channels) or at the point-of-sale (on-site channels).

Unlike acquirers (and issuers), sub-acquirers are not members of the card networks. Moreover, sub-acquirers do not have a direct connection with the card network but through the acquirer to provide payment services to merchants, and so the acquirer is responsible for the sub-acquirer's compliance against the card network. In addition, the latter also means that sub-acquirers do not receive funds from card purchases directly from the card network, but is done indirectly by the acquirer (ie the card networks send settlement funds to the acquirer, and then it deposits them in the sub-acquirer's account). It is important to highlight that, from the acquirer perspective, sub-acquirers are not just large merchants but also they exert

[5]The interconnection problem can become two-way when two exclusive acquirers (ie one acquirer belonging to one card network) should interconnect each other.



Source: Mastercard

Figure 1: Number of sub-acquirers (payment facilitators) around the world

competition pressure in the acquiring market.

To have a better idea of what a sub-acquirer (payment facilitator) exactly is, Mastercard defines it as *"a service provider that is registered by an acquirer to facilitate transactions on behalf of sub-merchants"*. Visa, instead, defines it as a third-party agent that may sign a merchant acceptance agreement on behalf of an acquirer and receive settlement of transaction proceeds from an acquirer, on behalf of a sponsored merchant.[6]

According to data from Mastercard[7], there were 1,448 sub-acquirers around the world with an agreement within the Mastercard network as of April 2022, from which there were 382 sub-acquirers in Latin America while the Middle East and Africa had only 151 sub-acquirers registered. Figure 1 shows the distribution of sub-acquirers across countries. The United States is the largest country with sub-acquirers accounting for 252, followed by Brazil with 236. Much more far from them, the United Kingdom has registered 76 sub-acquirers, and India with only 60. Also, the reader can distinguish that most African countries have no registered sub-acquirers, as it can be presumably due to the expansion of mobile money which operates out of the card network infrastructures[8].

[6]For more detail, visit https://usa.visa.com/content/dam/VCOM/global/support-legal/documents/visa-payment-facilitator-model.pdf (last access on 15/04/2022).

[7]Data taken from https://www.mastercard.us/en-us/business/overview/start-accepting/payment-facilitators.html (last access on 15/04/2022).

[8]One of a few examples was the partnership between Safaricom and Visa in 2020 to enlarge access to digital payments for M-Pesa consumers and merchants in Kenya.

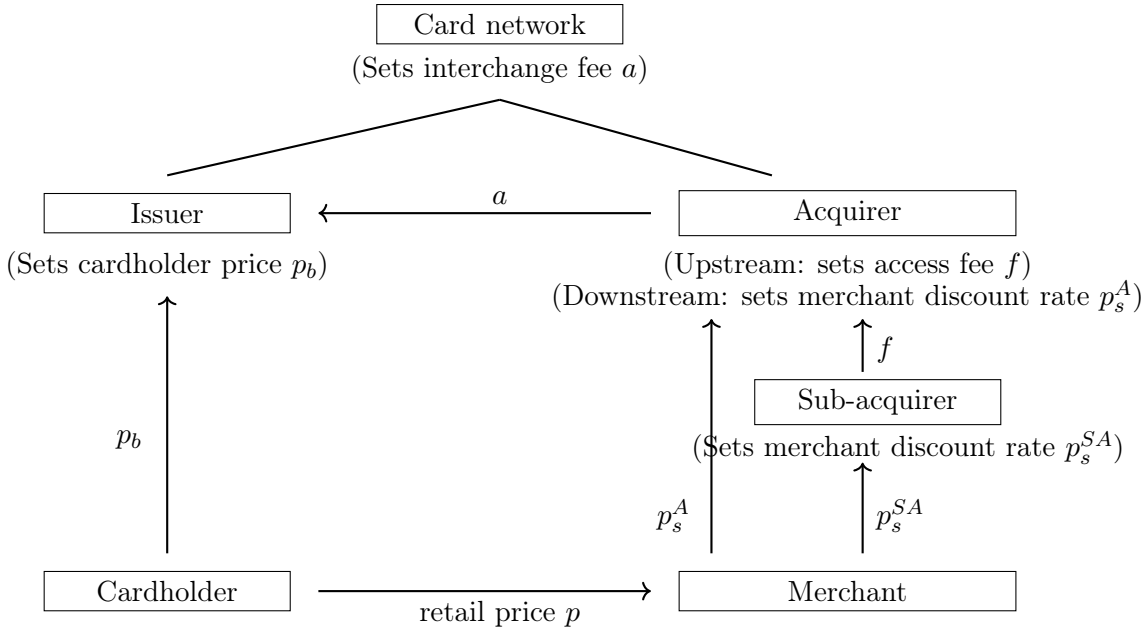


Figure 2: Four-party payment scheme with sub-acquirer

3 The model

Figure 2 describes the traditional four-party card scheme but considering the presence of a sub-acquirer. There are six agents, namely, consumers, merchants, issuers, acquirers, sub-acquirers, and card networks. The main modification is that the acquiring market is split into upstream and downstream activities, being the latter where the sub-acquirer can compete with the acquirer. However, the acquirer should grant access for the sub-acquirer to the card network as the latter does not have a direct relationship with the card network.[9] In Section 6, I analyse the case in which the sub-acquirer enters niche markets that are not covered by the acquirer.

Consumers and the issuing market. Consumers face an inelastic demand for a good and must decide on one store and once there, decide how to pay (by cash or by card). Whenever a card transaction is done, buyers pay issuers a transaction fee p_b, (negative if they receive air miles, interest-free period or any reward provided by the issuer). There are no annual fees (membership fees) and it is assumed all consumers have a card.

The consumer's convenience cost of paying by cash (equivalent to the convenience benefit of using a card since its cost is zero) differs across consumers and is a random variable $\widetilde{b_b}$ drawn from cumulative distribution function $H(b_b) = Pr(\widetilde{b_b} \leq b_b)$ with density $h(b_b) = H'(b_b)$. The distribution has a monotone hazard rate $\frac{h(b_b)}{1-H(b_b)}$.

[9]This model setup assumes that the acquirer has a market power in the upstream activity as the entrant (sub-acquirer) is a small firm. The situation is different whether the new entrant is a BigTech which might have buyer power over the acquirer. However, I can guess that in this scenario the BigTech will try to become a member of the card network (ie to become an acquirer) rather than being registered as a third-party provider.

Suppose, consumers pay the same retail price p regardless of the payment instrument (price coherence, uniform pricing, or the No Surcharge Rule). Therefore, a card payment is optimal if and only if $\widetilde{b_b} \geq p_b$. The proportion of card payments at the store is $D(p_b) = Pr(\widetilde{b_b} \geq p_b) = 1 - H(p_b)$. The average net cardholder benefit per card payment is defined by $v_b(p_b) = E[b_b - p_b | b_b \geq p_b]$ and is decreasing in p_b.

On the other hand, issuers incur a per-transaction cost c_b and receive an interchange payment of a from the acquirer in a card transaction known as interchange fee, and charge a constant markup ($m_I > 0$) above the total issuing costs, so the cardholder price is:

$$p_b = c_b - a + m_I$$

Merchants and the acquiring market. Merchants belong to the same retail market and they can contract with the acquirer (A) or the sub-acquirer (SA) to accept card payments and obtain a net convenience benefit of a card payment denoted by b_s^i where $i = \{A, SA\}$ whenever a consumer pays by card instead of cash. This merchant net benefit of card payments (or equivalently, net convenience cost of cash payments) is homogeneous across merchants and refers to the net convenience savings that merchants obtain from not having to handle and manage cash relative to cards.

Let us assume that, $b_s^{SA} \geq b_s^A$; ie the sub-acquirer provides the merchant a higher net convenience benefit than the acquirer does. For example, the reader can think about the time that merchants have to wait until funds derived from a purchase with a card are deposited in their bank account. Suppose, the acquirer guarantees merchants their funds will be in their accounts after 48 hours while the sub-acquirer enters the market with a disruptive strategy and ensures merchants that their funds will be deposited within 24 hours after the purchase. This shorter deposit time is positively valued by the merchant and then it increases his/her net convenience benefit from accepting cards. Similarly, this assumption can be realistic when sub-acquirers provide merchants a disruptive technology (contactless payments, QR codes, or links for non-present sales), so it reduces their sales time or improves their sales systems.

Since there is price coherence, the retail price p is the same regardless of the payment instrument. In addition, merchants pay a transaction fee known as merchant discount rate p_s^i to the firm with which is affiliated where $i = \{A, SA\}$. Therefore, merchants will accept card payments with firm i if $p_s^i \leq b_s^i$ where $i = \{A, SA\}$.

Given this setup, the merchant internalization condition can be expressed as:

$$v_b(p_b) \geq \left(p_s^A - b_s^A\right) \chi^A + \left(p_s^{SA} - b_s^{SA}\right) \chi^{SA} \tag{1}$$

where χ^A and χ^{SA} are the market shares for the acquirer and sub-acquirer, respectively. Let us assume that the average net cardholder benefit ($v_b(p_b)$) is sufficiently high, so Equation 1 is always satisfied.

Acquirers operate in the downstream and upstream activities. In the downstream market, they incur a per-transaction cost c_s^A, have to pay the interchange fee a to issuers and have an ex-post market power m_A^D if they are the sole provider, so the merchant discount rate p_s^A

is equal to total acquiring costs plus the markup.

$$p_s^A = c_s^A + a + m_A^D$$

In the upstream market, acquirers incur a cost of providing access for sub-acquirers to the card network denoted by c_e. They charge an access fee denoted by f to sub-acquirers whenever the latter enter the downstream market and capture a card transaction with their own POS device or payment solution in e-commerce platforms. Let us assume that there are no network fees (fees paid to card networks), so the total cost in the upstream activity is the cost of providing access plus the interchange fee that they have to pay to the issuer whenever a card payment is done.

On the other hand, the sub-acquirers cannot connect directly with card networks (ie there is no bypass). Therefore, if sub-acquirers enter the market, they have to contract with the acquirer (which owns an essential input like processing, connecting to the card network, and depositing funds from card purchases) to operate in the downstream market. In each card transaction, they have to pay an access fee f to the acquirer, and they incur a per-transaction cost c_s^{SA} to deliver merchants, which is assumed to be lower than the acquirer's cost; ie $c_s^A \geq c_s^{SA}$,ie we assume that sub-acquirers are more efficient than acquirers. In sum, we assume that sub-acquirers are doubly efficient as they provide a higher net convenience benefit to merchants while they incur lower costs than acquirers do.

Card network. The card platform is a non-profit organisation and maximises the joint profits of its members (issuers and acquirers) by setting an interchange fee that the issuer will receive in each card transaction from acquirers.[10] This interchange fee plays a crucial role in the card industry as it balances the development of each side by altering the price structure between cardholders and merchants.

The timing of the model is as follows:

Stage 1: The card network sets the interchange fee a.

Stage 2: Acquirer banks set the access fee f to be paid by sub-acquirers.

Stage 3: Given the access fee, the sub-acquirers decide whether to enter the downstream market or not. If they accept the access fee, the acquirer banks and sub-acquirers set simultaneously and non-cooperatively their merchant discount rates p_s^A and p_s^{SA}, respectively. Without entry of sub-acquirer, the acquirer is the sole provider in the downstream market and sets p_s^A. Issuer banks set the cardholder price p_b.

Stage 4: Retailers decide whether or not to accept cards, decide which firm (acquirer or sub-acquirer) to contract with, and set their retail prices p.

Stage 5: Consumers decide which retailers to patronize, and, after the realization of the benefit of paying by card, they decide which payment instrument to use.

The downstream market

[10]Notice that card networks are not concerned by the sub-acquirers since they are not members of the card scheme.

The merchant will contract with the firm that gives him/her the maximum net utility: $b_s^i - p_s^i$. Let us assume that if the merchant is indifferent, he/she will choose the sub-acquirer which provides a higher net convenience benefit from accepting cards ($b_s^{SA} \geq b_s^A$).

The total volume of card payments might be divided into those captured by the acquirer and by the sub-acquirer; ie $D_b(P_b) = D_b^A(P_b) + D_b^{SA}(P_b)$, so the market share of each competitor depends on the merchant discount rate charged by each one of them, as follows.

$$D_b^A(p_b) = \chi^A D_b(p_b), \;\; where \quad \chi^A = \begin{cases} 0 & \text{if } p_s^{SA} \leq b_s^{SA} - b_s^A + p_s^A \\ 1 & \text{if } p_s^{SA} > b_s^{SA} - b_s^A + p_s^A \end{cases}$$

$$D_b^{SA}(p_b) = \chi^{SA} D_b(p_b), \;\; where \quad \chi^{SA} = \begin{cases} 0 & \text{if } p_s^{SA} > b_s^{SA} - b_s^A + p_s^A \\ 1 & \text{if } p_s^{SA} \leq b_s^{SA} - b_s^A + p_s^A \end{cases}$$

Conditional on the entry of the sub-acquirer, the equilibrium prices are set as follows: the acquirer will set a merchant discount rate equal to their total costs in the downstream market $p_s^A = c_s^A + a$. The sub-acquirer will set a merchant discount rate such that the merchant is indifferent between contracting with the acquirer and sub-acquirer; so the maximum merchant discount rate the sub-acquirer will set is:

$$p_s^{SA} = b_s^{SA} - b_s^A + c_s^A + a \tag{2}$$

The upstream market

The sub-acquirer will enter the market if and only if the profit is non-negative; ie $\Pi^{SA} \geq 0$. Assuming there are no fixed costs nor an entry cost, the sub-acquirer enters the market only if the merchant discount rate is higher than the total cost of delivering merchants per transaction:

$$p_s^{SA} \geq c_s^{SA} + f \tag{3}$$

Using Equations 2 and 3, we can determine the maximum access fee that the sub-acquirer is willing to pay:

$$\bar{f} = a + \Delta b_s + \Delta c_s \tag{4}$$

where $\Delta b_s = b_s^{SA} - b_s^A$ is the difference between the net convenience benefit of card payments that merchants obtain, and $\Delta c_s = c_s^A - c_s^{SA}$ is the difference between acquirer's and sub-acquirer's costs.

When there is no entry, the acquirer's profit per transaction is $\Pi^A = m_A^D$ while if the sub-acquirer enters the market, the acquirer can steal the sub-acquirer's profit through the access charge. Therefore, the acquirer's profit is $\Pi^A = f - c_e - a = \Delta b_s + \Delta c_s - c_e$ and will allow entry to occur when

$$\Delta - c_e \geq m_A^D \tag{5}$$

where $\Delta = \Delta b_s + \Delta c_s$ is the total efficiency gains.

Equation 5 states that the acquirer will allow (deter) entry by setting the access charge slightly below (above) the access fee that makes merchants indifferent between contracting with sub-acquirers and acquirers when the upstream profits are higher (lower) than downstream profits.

Therefore, the entry is privately desirable when Equation 5 holds, and then the acquirer only operates in the upstream market. In other words, the acquirer has incentives to allow entry if and only if it creates efficiency gains which can be stolen through the access fee. This is the Chicago critique which states that a vertically related monopoly has no incentives to deter entry into the downstream market unless there exist efficiency gains (better quality product and/or lower production costs).

4 Socially and privately optimal interchange fees

This section shows the cardholder price and the interchange fees derived from three different maximisation problems, namely, social welfare, total user surplus, and monopoly platform.

4.1 Social welfare

With an inelastic final demand, the different components of the social welfare are:

Consumer surplus

$$CS = u - p - p_b D_b(p_b) - \int_{-\infty}^{p_b} b_b \cdot dH(b_b)$$

Where u is the utility of a good for consumers, p is the retail price, p_b is the cardholder price (reward program) and $\int_{-\infty}^{p_b} b_b \cdot dH(b_b)$ represents the expected convenience cost of cash payment.

Retailer's profit

$$RP = p - \gamma - \left(p_s^A \chi^A + p_s^{SA} \chi^{SA}\right) D_b(p_b) - \left(b_s^A \chi^A + b_s^{SA} \chi^{SA}\right) (1 - D_b(p_b))$$

Where γ is unit cost, p_s^i is the merchant discount rate charged by the acquirer ($i = A$) or the sub-acquirer ($i = SA$), b_s is the net convenience cost of cash, and χ^i is the market share in the downstream market with $i \in \{A, SA\}$.

Issuer's profit

$$\Pi_b = (p_b - c_b + a) D_b(p_b) = m_I D_b(p_b)$$

Where c_b is the issuer's cost, a in the interchange fee they receive from the acquirer/sub-acquirer, m_I is the ex-post markup they obtain.

Acquirer's profit

$$\Pi_A = \underbrace{\left[f - c_e - a\right] \chi^{SA} D_b(p_b)}_{\text{Upstream profit } \Pi_A^U} + \underbrace{\left[p_s^A - c_s^A - a\right] \chi^A D_b(p_b)}_{\text{Downstream profit } \Pi_A^D} = \left[(f - c_e - a) \chi^{SA} + m_A^D \chi^A\right] D_b(p_b)$$

Where f is the access charge they receive from the sub-acquirer, c_e is cost incurred in the upstream market to ensure access, c_s^A is the acquirer's cost in the downstream market, and m_A^D is the markup in the downstream market if they are the sole provider.

Sub-acquirer's profit

$$\Pi_{SA} = \left[p_s^{SA} - c_s^{SA} - f\right] \chi^{SA} D_b(p_b)$$

Where c_s^{SA} is the sub-acquirer's cost to provide merchant card acceptance in the downstream market.

Adding these components, social welfare is equal (up to a constant) to:

$$W = \int_{p_b}^{\infty} (b_b + b_s^A \chi^A + b_s^{SA} \chi^{SA} - c_b - c_s^A \chi^A - (c_s^{SA} + c_e)\chi^{SA}) \cdot dH(b_b) \tag{6}$$

Notice that the entry is socially desirable if and only if:

$$\Delta \geq c_e \tag{7}$$

which means that entry increases social welfare if the efficiency gains due to the entry of the sub-acquirer are higher than the cost of providing access for the sub-acquirer.

Therefore, the welfare is a single-peaked function of p_b reaching a maximum at:

$$p_b^W = c_b + (c_s^A - b_s^A)\chi^A + (c_s^{SA} + c_e - b_s^{SA})\chi^{SA} \tag{8}$$

And the corresponding interchange fee is:

$$a^W = c_b - p_b^W + m_I = (b_s^A - c_s^A)\chi^A + (b_s^{SA} - c_s^{SA} - c_e)\chi^{SA} + m_I \tag{9}$$

Therefore, the interchange that maximises social welfare is $a^W = b_s^A - c_s^A + m_I$ when the entry is not privately desirable (ie the acquirer operates in the downstream market, so $\chi^A = 1$ and $\chi^{SA} = 0$). Conversely, when the acquirer allows the sub-acquirer to enter ($\chi^A = 0$ and $\chi^{SA} = 1$), the interchange fee is $a^W = b_s^{SA} - c_s^{SA} - c_e + m_I$.

4.2 Total user surplus

The total user surplus (TUS) only focuses on the end users rather than all economic agents (Rochet and Tirole, 2011), thus it is just the sum of the consumer surplus and the retailer's profit:

$$TUS \equiv \int_{p_b}^{\infty} (b_b - p_b) \cdot dH(b_b) + \left[(b_s^A - p_s^A)\chi^A + (b_s^{SA} - p_s^{SA})\chi^{SA}\right] D_b(p_b)$$

$$TUS = \int_{p_b}^{\infty} \left[b_b - p_b + (b_s^A - p_s^A)\chi^A + (b_s^{SA} - p_s^{SA})\chi^{SA}\right] \cdot dH(b_b) \tag{10}$$

Therefore, the cardholder price that maximises TUS is:

$$p_b^{TUS} = c_b + m_I + (c_s^A + m_A^D - b_s^A)\chi^A + (c_s^A + \Delta b_s - b_s^{SA})\chi^{SA} \tag{11}$$

The interchange fee that corresponds to this maximisation is:

$$a^{TUS} = b_s^A - c_s^A - m_A^D \chi^A \tag{12}$$

Therefore, the interchange that maximises total user surplus is $a^{TUS} = b_s^A - c_s^A - m_A^D$ when the acquirer deters entry in the downstream market. In contrast, when the entry is privately desirable, the interchange fee is $a^{TUS} = b_s^A - c_s^A$.

When the entry is socially desirable, the entry of the sub-acquirer increases both social welfare and total user surplus. In the first function, the sub-acquirer leads to higher merchant benefits and lower costs of providing merchants. In the second function, end-users benefit from entry by eliminating the acquirer's markup in the detriment of not benefiting from total efficiency gains. These higher levels of social welfare and total user surplus are translated into lower cardholder prices and higher interchange fees. Figure 3 shows the levels of the interchange fees.

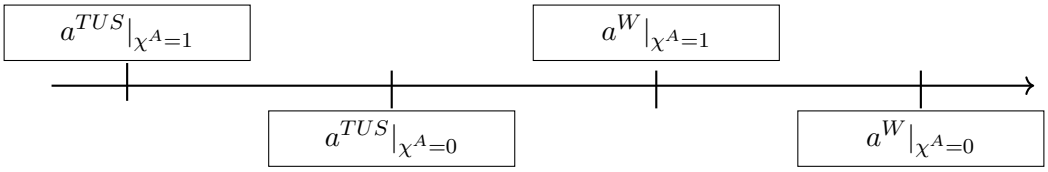


Figure 3: Interchange fee levels when entry occurs or not

4.3 Monopoly platform

As the card platform is a non-profit organisation, it seeks to set an interchange fee that maximises the net income of issuers and acquirers. Notice that the sub-acquirer's profits are not directly taken into consideration by the card network, but indirectly as it affects the acquirer's profits through the profits in the upstream activity. The interchange fee set by the card network is restricted to the maximum interchange fee that merchants are willing to accept which is derived from the merchant internalization condition in Equation 1.

Using Equation 2 which determines the merchant discount rate set by the sub-acquirer, given that it enters the market, the maximum interchange fee derived from the merchant internalization condition is:

$$a \leq v_b(p_b) + b_s^A - c_s^A - m_A^D \chi^A \tag{13}$$

The optimization problem of the monopoly card platform is as follows:

$$\max_a [\Pi_b + \Pi_A] = \Bigg[\underbrace{m_I}_{\text{Issuer's markup}} + \underbrace{(f - a - c_e)\,\chi^{SA}}_{\text{Acquirer's upstream profit}} + \underbrace{m_A^D \chi^A}_{\text{Acquirer's downstream markup}} \Bigg] D_b(p_b) \tag{14}$$

s.t. i) Equation 13 and ii) $f \leq \bar{f}$

This optimization problem can be re-expressed as:

$$\max_a [\Pi_b + \Pi_A] = \left[m_I + (\Delta - c_e)\,\chi^{SA} + m_A^D \chi^A \right] D_b(p_b) \tag{15}$$

s.t. i) Equation 13

The first-order condition is

$$\frac{\partial \Pi}{\partial a} = h(c_b - a + m_I) > 0$$

which implies that the interchange fee is set at the maximum level to ensure merchant acceptance as well as the cardholder price:

$$a^M = v_b(p_b^M) + b_s^A - c_s^A - m_A^D \chi^A \iff p_b^M = c - b_s^A + m_I(p_b^M) + m_A^D(p_b^M)\chi^A - v_b(p_b^M) \quad (16)$$

5 Public intervention and alternative access regimes

The entry of sub-acquirers or new competitors is not necessarily privately and socially desirable at the same time. Issues arise when entry is socially desirable but not privately, so the acquirer has incentives to deter entry. In particular, by using Equations 5 and 7:

$$\Delta - c_e \geq m_A^D \geq 0 \quad (17)$$

Therefore, notice that when the entry is privately desirable, it is also socially desirable but the opposite is not necessarily true. Therefore, the regulator can increase both social welfare and total user surplus by setting an access charge. Conversely, when the acquirer has incentives to allow entry, ie when entry is privately desirable, the public intervention by setting the access fee only has distributive effects.

In this section, we compare the level of the interchange fee resulting from three different alternative access regimes set by the card platform or a regulator instead of the acquirer.

5.1 First-best rule (cost margin rule)

Whenever the acquirer processes a transaction either from the merchant directly or from the sub-acquirer, the acquirer has to pay the interchange fee to the issuer, which allows the latter to incentivize cardholders to use their cards, but it also has to incur a per-transaction cost of providing access for the sub-acquirer (if necessary). Therefore, in the absence of other network fees, the interchange fee and the cost of providing access (lower than the cost of serving merchants directly) are the only directly attributable costs when the sub-acquirer contracts with the acquirer. Therefore, this access regime states the access charge set by the regulator should be $f^g = a + c_e$.

The sub-acquirer will decide to enter the market if and only if this access charge leads to non-negative profits, in other words, if the access charge according to the margin rule is not higher than the maximum access fee the sub-acquirer is willing to pay, ie $f^g \leq \bar{f}$.

Using Equation 4, we have:

$$f^g \leq a + \Delta c_s + \Delta b_s \iff \Delta \geq c_e \quad (18)$$

Notice that Equation 18 holds if and only if the entry is socially desirable.

As a result of this access policy, the sub-acquirer fully covers the downstream market while the acquirer only provides access in the upstream market, ie $\chi^A = 0$ and $\chi^{SA} = 1$. The sub-acquirer's profits are $\Pi^{SA} = \Delta - c_e \geq 0$ while the acquirer's profits are zero $\Pi^A = f^g - a - c_e = 0$.

Under this access rule, the interchange fee resulting that maximises the social welfare is $a^W = b_s^{SA} - c_s^{SA} - c_e + m_I$ while the interchange fee that maximises total user surplus is $a^{TUS} = b_s^A - c_s^A$.

5.2 Efficient cost price rule (ECPR)

A usual access regime applied in other network industries is the ECPR which internalizes the opportunity cost of the incumbent. Therefore the access fee should be equal to the interchange fee plus the opportunity cost of the acquirer; ie the acquirer markup in the downstream market, thus we have: $f^g = a + c_e + m_A^D$. Under this scenario, the sub-acquirer will enter the market and gain all the downstream market if and only if $f^g \leq \bar{f}$.

Using Equation 4, we have:

$$f^g \leq a + \Delta c_s + \Delta b_s \iff \Delta - c_e \geq m_A^D \tag{19}$$

That is, if the entry is privately desirable. Notice that now this condition should be held by the sub-acquirer rather than by the acquirer.

As a result of this access policy, the sub-acquirer fully covers the full downstream market as they provide a higher quality product. Then, the sub-acquirer's profits are $\Pi^{SA} = \Delta - c_e - m_A^D \geq 0$ while the acquirer's profits are $\Pi^A = m_A^D$. Under this access rule, the interchange fees resulting that maximise the social welfare and TUS are the same as under the first-best rule.

5.3 Cost plus markup rule

This access regime allows the acquirer to have an alternative ex-post markup (m_A^U) above their costs, ie the regulator sets the access charge as $f^g = a + c_e + m_A^U$. However, the implications of the interchange fees depend on the magnitude of the recognized markup. There are three scenarios to be discussed:

Case 1: $\Delta - c_e > m_D^A > m_A^U$

This scenario allows the sub-acquirer to enter the market and the acquirer gains a profit less than its markup in the downstream market.

As a result of this access policy, the sub-acquirer fully covers the downstream market while the acquirer only provides access in the upstream market-, ie $\chi^A = 0$ and $\chi^{SA} = 1$. Then, the sub-acquirer's profits are $\Pi^{SA} = \Delta - c_e - m_A^U \geq 0$ while the acquirer's profits are $\Pi^A = m_A^U \geq 0$.

Under this access rule, the interchange fee resulting that maximises the social welfare is $a^W = b_s^{SA} - c_s^{SA} - c_e$. In addition, the interchange fee that maximises TUS is $a^{TUS} = b_s^A - c_s^A$

Case 2: $\Delta - c_e > m_U^A > m_D^A$

In this case, the regulator ensures a higher profit to the acquirer relative to the downstream margin. The sub-acquirer will still enter the market as it can make positive profits. Thus, the resulting interchange fees are the same as in Case 1.

Case 3: $m_U^A > \Delta - c_e > m_D^A$

This access regime considers a higher markup for acquirers even higher than the net gains of efficiency. Consequently, the sub-acquirer does not enter the market and the downstream

is covered by the acquirer, ie $\chi^A = 1$ and $\chi^{SA} = 0$. Under this access rule, the social welfare maximizing interchange fee is $a^W = b_s^A - c_s^A$. And, the interchange fee that maximises total user surplus is $a^{TUS} = b_s^A - c_s^A - m_A^D$.

In sum, Table 1 shows the results of these three access regimes discussed.

	First-best rule $f = a + c_e$	ECPR $f = a + c_e + m_A^D$	Cost plus markup $f = a + c_e + m_A^U, m_A^U > \Delta - c_e$
a^W	$b_s^{SA} - c_s^{SA} - c_e + m_I$	$b_s^{SA} - c_s^{SA} - c_e + m_I$	$b_s^A - c_s^A + m_I$
a^{TUS}	$b_s^A - c_s^A$	$b_s^A - c_s^A$	$b_s^A - c_s^A - m_A^D$
a^M	$b_s^A + v_b(p_b) - c_s^A$	$b_s^A + v_b(p_b) - c_s^A$	$b_s^A + v_b(p_b) - c_s^A - m_A^D$
Π_A^U	0	$m_A^D D_b(p_b)$	-
Π_A^D	-	-	$m_A^D D_b(p_b)$
Π_{SA}	$(\Delta - c_e)D_b(p_b)$	$(\Delta - c_e - m_A^D)D_b(p_b)$	-

Table 1: Key results under different access regimes

6 Entry to niche markets

The sections above consider the scenario in which acquirers and sub-acquirers compete in the same downstream market that is currently covered by the acquirer. In this section, I analyse the situation in which sub-acquirers enter niche markets that are not covered yet (eg micro and small-sized merchants).

The no coverage can be motivated by diverse factors. For instance, the niche markets can be characterized by some idiosyncratic aspects that the acquirer misunderstands, eg there is tax evasion, informality, or high dependence on cash which is difficult to overcome (Aurazo, 2020), the costs to incur are higher than the maximum willingness-to-pay of merchants (cost-driven exclusion), higher operational risks management (Müller, 2023), and thus entering this segment is not profitable for the acquirer. The reader can think about the following example. There is a small merchant dedicated to selling street food, who lives day-to-day, and her ecosystem is entirely based on cash. This segment is not covered by the acquirer as it might be difficult to change the merchant's mind at the expense of higher costs. This small merchant is more likely to evade taxes, operate small-ticket transactions, and be more sensitive to high merchant discount rates. Therefore, if the acquirer enters this market, it is quite likely that her current service does not match well with the small merchant's needs and then there would be no merchant card acceptance. Thus, sub-acquirers often provide card acceptance to small merchants with an innovative product that meets their needs. For instance, sub-acquirers in Peru were initially focused on small merchants who were not able to multi-home (they were not able to contract with Visa and Mastercard's acquirers at the same time) and then offered an interoperable POS that allowed them to accept payments with all card networks.

Let us assume that there are two separate markets (the traditional and the niche market) in which there is a mass of 1 of consumers and merchants in each one. Also, assume for simplicity that the card network and issuers perfectly observe in which market the transac-

tion is done and then can discriminate prices (interchange fees and cardholder prices) across markets. Finally, assume that the acquirer has a constant ex-post markup in the traditional market denoted by m_A^D and an ex-post markup in the upstream market denoted by m_A^U in the niche market. The sub-acquirers have an ex-post markup in the downstream market denoted by m_{SA}^D.

Therefore, the cardholder price in the market i is $p_b^i = c_b - a^i + m_I^i$ where $i = \{A, SA\}$ refers to the traditional (A) and the niche market (SA). In the traditional market, the merchant discount rate set by the acquirer is $p_s^A = c_s^A + a^A + m_A^D$. In the niche market, the access fee set by the acquirer in the upstream market is $f = c_e + a^{SA} + m_A^U$ while the merchant discount rate set by the sub-acquirer is $p_s^{SA} = c_s^{SA} + f + m_{SA}^D$.

The cardholder will use his/her card in market i if the net benefit is at least equal to the cardholder price set by the issuer $p_b^i \leq b_b^i$. Meanwhile, the merchant in market i will accept card payments if the merchant discount rate is not higher than the sum of net convenience benefit plus the net consumer benefit from using cards $p_s^i \leq b_s^i + v_b^i(p_b^i)$. For convenience, let us assume that $c_s^A > b_s^{SA} > c_s^{SA}$ which ensures that the acquirer has no incentives to enter the niche market.

Therefore, the social welfare is denoted by

$$W = \underbrace{\int_{p_b^A}^{\infty} (b_b^A + b_s^A - c_b - c_s^A) \cdot dH(b_b^A)}_{\text{Social welfare in traditional market}} + \underbrace{\int_{p_b^{SA}}^{\infty} (b_b^{SA} + b_s^{SA} - c_b - (c_s^{SA} + c_e)) \cdot dH(b_b^{SA})}_{\text{Social welfare in niche market}}$$

Notice that the entry of the sub-acquirer to the niche market increases the total social welfare as there are now merchants accepting cards and then consumers are replacing cash with cards. Before the entry, the acquirer was not covering the niche market and then the merchant ecosystem in that market was entirely based on cash.

Therefore, the interchange fees that maximise the social welfare in each market are:

$$a^{W,A} = b_s^A - c_s^A + m_I^A \quad \text{and} \quad a^{W,SA} = b_s^{SA} - (c_s^{SA} + c_e) + m_I^{SA} \tag{20}$$

Regarding the total user surplus, it is now denoted by:

$$TUS = \underbrace{\int_{p_b^A}^{\infty} \left[b_b^A - p_b^A + b_s^A - p_s^A\right] \cdot dH(b_b^A)}_{\text{TUS in the traditional market}} + \underbrace{\int_{p_b^{SA}}^{\infty} \left[b_b^{SA} - p_b^{SA} + b_s^{SA} - p_s^{SA}\right] \cdot dH(b_b^{SA})}_{\text{TUS in the niche market}}$$

Therefore, the interchange fees that maximises the total user surplus in each market are:

$$a^{TUS,A} = b_s^A - c_s^A - m_A^D \quad \text{and} \quad a^{TUS,SA} = b_s^{SA} - (c_s^{SA} + c_e) - (m_{SA}^D + m_A^U) \tag{21}$$

Finally, the monopoly platform will maximise:

$$\Pi = \Pi_I + \Pi_A = \underbrace{\left(m_I^A + m_A^D\right) D_b(p_b^A)}_{\text{Banks' profit in the traditional market}} + \underbrace{\left(m_I^{SA} + m_A^U\right) D_b(p_b^{SA})}_{\text{Banks' profit in the niche market}}$$

s.a. $p_s^i \leq b_s^i + v_b^i(p_b^i)$ where $i = \{A, SA\}$

Therefore, the interchange fees that maximises banks' profit in each market are:

$$a^{M,A} = b_s^A - c_s^A + v_b^A \quad \text{and} \quad a^{M,SA} = b_s^{SA} - (c_s^{SA} + c_e) + v_b^{SA} \tag{22}$$

Notice that the monopoly platform does not consider the sub-acquirer's profit in the niche market. This is not an issue when the ex-post markup is constant as it implies that the sub-acquirer will perfectly pass through. However, when the markup is not constant, then the interchange fee that the monopoly platform sets in the niche market could be far from optimal.

Consider now an alternative joint banks' profit the banks' including the sub-acquirer in the niche market as follows:

$$\widehat{\Pi} = \Pi_I + \Pi_A + \Pi_{SA} = \left(m_I^A + m_A^D\right) D_b(p_b^A) + \left(m_I^{SA} + m_A^U + m_{SA}^D(p_s^{SA})\right) D_b(p_b^{SA})$$

s.a. $p_s^i \leq b_s^i + v_b^i(p_b^i)$ where $i = \{A, SA\}$

Let's focus on the niche market, and letting $c^{SA} = c_s^{SA} + f(a^{SA})$, the markup can be expressed as $m_{SA}^D(p_s^{SA}(c^{SA})) = p_s^{SA}(c^{SA}) - c^{SA}$ and $p_b^{SA} = c_b + a^{SA} + m_I^{SA}$.

As there is pass-through in the upstream market (ie $f^{'}(a) = 1$), the first-order condition is

$$\frac{\partial \widehat{\Pi}}{\partial a^{SA}} = 0 \rightarrow \left(m_I^{SA} + m_A^U + m_{SA}^D\right) D^{'} + m_{SA}^{D\ '} D = 0$$

where $m_{SA}^{D\ '}$ is the partial derivative w.r.t the interchange fee and takes the value of 0 when there is perfect pass-through, above 0 when there is cost amplification, and below 0 when there is cost absorption.

Therefore, as the reader can notice the internalization of the sub-acquirers' profits by the monopoly platform becomes relevant when the sub-acquirer has a variable margin.

Unlike the case in which sub-acquirers enter markets covered by the acquirer, in niche markets the interconnection problem as well as the foreclosure issue are less important as the acquirer does not have any incentive to deter entry. On the contrary, the acquirer obtains an extra benefit from granting access for the sub-acquirers to the card network in the niche market. Likewise, both society and end users are now better off in comparison to the situation in which the niche market is not covered. In this scenario, the necessity of setting access charges in the upstream market is less important. However, although this scenario has been the most applicable in developing countries in recent years, sub-acquirers are entering markets traditionally served by acquirers, and vice versa, which leads to the scenario discussed previously. Therefore, the access charge between acquirers and sub-acquirers becomes a relevant variable in the market for payment cards.

7 Conclusion

This paper presents a model of the card industry considering the presence of sub-acquirers, also known as payment facilitators. The novelty relies on splitting the acquiring market into

two different activities. On the one side, there is an upstream market in which the acquirer grants connection with the card network and allows transactions from sub-acquirers to be validated and processed; on the other side, there is a downstream market in which acquirers provide card acceptance to merchants and they can compete with sub-acquirers. In the upstream market, the acquirers provide an essential input (bottleneck) to sub-acquirers and charge an access fee whenever sub-acquirers process a transaction in the downstream market. This new market structure is not only restricted to payment cards but also could be extended to any payment platform.

The paper aims to analyse the optimal prices set within the card industry in this new environment, ie how the interchange fee, the merchant discount rate, and the access fee are set when the sub-acquirer enters the acquiring market. For that purpose, we study two opposite situations. The first one is when the acquirer and the sub-acquirer are competing in the same downstream market, and the former grants access for the latter to the card network, which means that the acquirer provides an "essential facility". In this scenario, some competition issues can arise as the acquirer may have incentives to deter (socially desirable) entry. That said, the regulator can play a relevant role in increasing social welfare by setting an access fee to allow socially but not privately desirable entry. In particular, a first-best rule (margin cost rule) or the commonly applied efficient cost price rule (ECPR) leads to a social welfare-increasing situation in which the sub-acquirer serves the whole downstream market.

On the other side, when the entry to niche markets occurs, ie the sub-acquirer enters markets that are not covered yet, the acquirer is less likely to deter entry as it obtains an extra profit from granting access in this new market. Likewise, both society and end users are better off as they can make transactions with cards instead of cash which is a less efficient means of payment. Therefore, in this context, the role that a regulator can play is less focused on access pricing. However, although this scenario has been the most applicable in developing countries in recent years, sub-acquirers are entering markets traditionally served by acquirers, and vice versa, and thus the access charge is becoming a relevant variable in the market for payment cards.

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