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"Gatekeeping at the counter: The regulation of stacked payment platforms"

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Abstract

This paper explores the pricing of ancillary payment services by platforms and its implications for welfare. We distinguish between two types of platforms: vertical platforms that operate their own closed payment schemes, and stacked platforms that offer payment services through open schemes operated by third parties. We analyze the impact of a regulation mandating platforms to provide access to third-party payment services and examine the regulation of interchange fees within the context of stacked platforms.

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1 Introduction

Consumer-to-business payment services are increasingly being offered by digital platforms as part of larger ecosystems. Examples include Venmo (PayPal), Google Pay, Pumpkin, Lydia, Samsung Pay, Apple Pay, Android Pay, Afterpay, and others. These payment services are typically optional but require the users to consume the platform's basic service (e.g., web search, social networking, messaging, marketplace, or mobile device).

Platforms offering ancillary payment services use various business models. Some of them are advertising-based (e.g., Google), whereas others are marketplaces (e.g., Venmo) or are financed by an access price (e.g., Apple). Moreover, they can be either *vertical*, meaning that payments are executed through a closed scheme owned and operated by the platform (e.g., Venmo), or *stacked,* meaning that payments are executed through an open scheme where a third party acts as a settlor (e.g., Apple).

The provision of ancillary payment services by digital platforms raises interesting pricing questions. Do merchants have incentives to internalize the option value for consumers of being able to pay through the platform? Is the provision of these payment services efficient? How does the price of these services change with the presence of a zero lower bound on the consumer access price? What are the differences between vertical and stacked platforms?

The availability of ancillary payment services on many dominant platforms also raises the question of whether such services should be regulated, and if so, how. For example, the EU Digital Markets Act, which recently came into effect, requires platforms designated as "gatekeepers" to provide unrestricted access to third-party payment service providers and to ensure effective interoperability between these providers and their ecosystems. It is also natural to explore how optimal interchange fee regulation for stacked platforms compares to the optimal regulation when payments are made directly with the card.

We develop a model to address these questions. The model features a monopolistic platform, a mass of consumers, and a single merchant. The platform offers a basic service as well as an ancillary payment service, and obtains revenues from selling consumer attention to advertisers. If the platform is vertical, it charges the merchant and consumers access prices and payment fees. If the platform is stacked, it charges the merchant and consumers access prices, while the payment scheme sets an interchange fee (which determines the payment fees paid by the merchant and consumers). If both the merchant and a given consumer join the platform, they meet with probability one. However, if at least one of them does not join the platform, they meet with a probability lower than one. The lower this probability, the higher the platform's essentiality for trade.

First, we examine how the merchant sets her price for given access prices and payment fees, assuming that the merchant charges consumers the same price regardless of whether they make a purchase on or outside the platform. Specifically, we investigate the merchant's incentives to internalize in her price the consumers' option value of being able to pay through the platform. We find that the merchant does so if the payment fee charged by the platform to buyers is sufficiently low, but not otherwise.

Next, we examine the platform's pricing decision under *laissez-faire*. Merchant internalization is detrimental to the platform as it hinders its ability to extract rents from the merchant. If the level of consumer payment fee that ensures ex-post efficiency of payment leads to merchant internalization, then a vertical platform may decide to under-provide the payment service to prevent such internalization. This departs from the conventional wisdom that, if prices are transparent and pricing is unconstrained, a monopolist will efficiently provide ancillary goods. For a stacked platform, we first consider the scenario where the platform has a first-mover advantage, meaning it sets access prices for the merchant and consumers before the payment scheme sets the interchange fee. In this case, the outcome mirrors that of a vertical platform. We then turn to the scenario in which the payment scheme sets the interchange fee before the platform sets access prices, and show that merchant internalization occurs in this case. Finally, we examine Pareto-efficient Nash equilibria of the game where the platform and the payment scheme make their decisions simultaneously, and show that the platform may over-provide the payment service in this case. Relative to the case of vertical platform, the payment fee for consumers is lower, and merchant internalization is more likely to occur.

Thus, our analysis reveals two key potential inefficiencies under *laissez-faire*. First, the provision of ancillary payment services by the platform may be inefficient with both under- and over-provision possible. Second, merchant internalization may occur, leading to pecuniary externalities on consumers who do not join the platform.

These inefficiencies highlight the need for regulation. First, we consider vertical platforms and investigate the effects of a public intervention - similar to the EU Digital Markets Act - requiring that third-party providers are able to offer payment services in multi-purpose platforms under conditions similar to those of the platform itself. We begin by assuming that consumers can choose which payment scheme to use, while merchants are obliged to adopt all available payment schemes (a situation we refer to as *consumer-centric* competition). We show that such a regulation does not address either of the two potential inefficiencies identified earlier. However, it does improve welfare by favoring the selection of a more efficient payment technology. Next, we consider a scenario where merchants can choose their preferred payment scheme, while consumers are forced to use the merchant's choice in order to complete transactions (a situation we refer to as *merchant-centric competition*). We find that such a regulatory intervention may mitigate merchant internalization but may exacerbate the inefficient provision of payment services, resulting in an ambiguous overall impact on welfare.

Second, we examine interchange fee regulation for stacked platforms. To ensure that payment usage is ex-post efficient, the interchange fee must be set above the tourist-test level (i.e., the level that leaves the merchant indifferent between payment methods). However, to prevent merchant internalization, payment service needs to be under-provided, which could be achieved with an interchange fee either above or below the tourist-test level. Our analysis shows that, in most cases, the optimal fee is at least as high as the tourist-test level, and there are scenarios where the optimal regulation results in over-usage of the payment service. We also find that optimal regulation always leads to a payment fee for consumers (resp., the merchant) that is weakly lower (resp., higher) than in the case of a stacked platform with full bargaining power over the payment scheme.

Related literature. This paper contributes to the literature on add-ons (e.g., Shapiro, 1994; Ellison, 2005; Gabaix and Laibson, 2006; Gomes and Tirole, 2018). We highlight a new channel through which the pricing of ancillary payment services may be inefficient even if prices are transparent and pricing is fully unconstrained. Central to this channel is the concept of *missed sales* introduced by Gomes and Tirole (2018).

Our work also relates to the literature on the pricing of payment services and interchange fee regulation (e.g., Rochet and Tirole, 2002, 2011; Wright, 2003, 2012). While this literature treats payment as a standalone service, we study payment as an ancillary service. This distinction turns out to be crucial. First, we establish that merchant internalization may not happen, whereas it always occurs in previous studies. Second, we show that the logic of the tourist test (Rochet and Tirole, 2002) becomes incomplete when payment is provided as an ancillary service.

Finally, part of our analysis relates to the literature on interoperability (e.g., Katz and Shapiro, 1985; Farrell and Saloner, 1992; Bianchi et al., 2023; Bourreau and Krämer, 2023). We add to this literature by examining the welfare effects of a regulation requiring digital platforms that offer ancillary payment services to ensure interoperability with third-party payment service providers, allowing them to offer their services under conditions similar to those of the platform.

2 Model and preliminaries

2.1 Setup

Payoffs. The economy is populated by a unit-mass continuum of consumers (or buyers) and one merchant (or seller). A monopolistic platform offers a basic service (e.g., social networking, web search, or messaging) as well as a payment service.

Consumers are heterogeneous in their valuations for the platform's basic service, which we denote by u. For each consumer, u is an iid draw from a binary distribution with support $\{\underline{u}, \bar{u}\}$, where $\bar{u} > 0 > \underline{u}$, assigning probability f (resp., $1 - f$) to $\underline{u}$ (resp., $\bar{u}$). The platform charges an access price P_B to unlock the basic good, and obtains advertising revenue $a \geq 0$ per consumer; its marginal cost is zero.[1] To simplify the exposition, we assume that $\underline{u}$ is sufficiently negative so that the access price never reaches $\underline{u}$ in equilibrium (i.e., market coverage is always partial by the platform).

Consumers share a homogeneous valuation $v > 0$ for the merchant's product, who charges a price ρ for it and, for simplicity, faces a zero marginal cost. The platform charges an access fee P_S for the merchant to be able to sell her product through the platform. If either the merchant or a consumer do not join the platform, they meet with probability $1 - \alpha \in [0, 1]$; if they both join, they meet with probability one. Meeting the merchant enables each consumer to learn the price ρ and (possibly) purchase the good. Accordingly, the parameter α measures the platform's essentiality regarding the trade activity. Naturally, platforms that offer marketplace features (such as Venmo or WhatsApp Pay) should exhibit larger α's than platforms that serve essentially as payment facilitators (such as ApplePay).

The benefit of using the platform's payment service (as opposed to completing the purchase outside of the platform), denoted by b_B, is heterogeneous across consumers.[2] For each consumer, b_B is an iid draw from the cdf $G(\cdot)$, which support is $\mathbb{R}$ and density is $g(\cdot)$. In turn, the merchant enjoys a benefit $b_S \geq 0$ for receiving the payment through the platform. Consumers pay p_B and the merchant pays p_S for each transaction conducted in the platform's payment service.

We distinguish two cases regarding the provision of payments by the platform:

[1] Consumer access price can be negative, that is, the platform can subsidize participation.

[2] This dimension of heterogeneity is of first-order importance, as it is common that consumers use the platform's basic service, but forego paying through the platform: For instance, consumers who transact with merchants on WhatsApp business accounts may use either WhatsApp Pay or an instant payment solution to complete purchases, iPhone users employ ApplePay in only a fraction of purchases, which is also the case of Samsung smartphone users, browsers on Google, etc.

- Vertical platform: In this case, payments are executed through a closed scheme owned and operated by the platform. Accordingly, the payment fees p_B and p_S are chosen by the platform together with its access prices P_B and P_S.[3] The platform faces a cost c per transaction.

- Stacked platform: In this case, payments are executed through an open scheme which settlor is a third party. The scheme relies on a perfectly competitive acquiring sector, which marginal cost per transaction is c_S, and an oligopolistic issuing sector. Specifically, issuers compete in an asymmetric Bertrand fashion with c_B (resp., $\hat{c}_B$) being the second (resp., first) lowest issuing cost. Accordingly, the most efficient issuer corners the market and reaps profit $c_B - \hat{c}_B$ per transaction. As is usually assumed in the literature, the payment scheme settlor chooses the interchange fee i to maximize issuer profits. Equilibrium in the issuing and acquiring markets implies that the payment fees p_B and p_S are given by

$$p_S = i + c_S \qquad \text{and} \qquad p_B = c_B - i.$$

One natural example of a vertical platform is Venmo (which is owned by PayPal), where consumers hold pre-paid accounts and may use these funds to pay affiliated merchants. ApplePay is a typical stacked platform, relying on traditional card networks (e.g., Visa and Mastercard) to process payments.

Information. Having joined the platform, consumers make a purchasing decision once they meet the merchant (and learn the price ρ), but before observing b_B. Having decided to purchase the good, each consumer observes b_B and pays through the platform if and only if $b_B \geq p_B$. Anticipating their own payment behavior, consumers decide to purchase the good if and only if

$$v + B(p_B) - \rho \geq 0, \tag{1}$$

where $B(p_B)$ is the ex-ante benefit (or option value) of being able to pay through the platform,

$$B(p_B) \equiv \int_{p_B}^{+\infty} (b_B - p_B)\, dG(b_B), \qquad \text{and} \qquad W(p_B, c) \equiv \int_{p_B}^{+\infty} (b_B + b_S - c)\, dG(b_B)$$

is the ex-post welfare produced by paying through the platform (to be in use shortly).

Consumers decide whether to join the platform knowing the realization of u, and taking expectations over the convenience of trading through the platform. Consumers do not observe the merchant's price or the realized benefit b_B at the moment of joining the platform.

[3] As will be clear below, a vertical platform only needs one price for consumers (either p_B or P_B) and one for merchants (either p_S or P_S).

Accordingly, a consumer with valuation u for the platform's basic service, who believes that the merchant joined the platform and anticipates to purchase the good (once in the platform) at the price ρ^a, decides to join if and only if

$$u + v + B(p_B) - \rho^a - P_B \geq (1-\alpha)\max\{v - \rho^a, 0\}. \tag{2}$$

Crucially, the consumer compares the utility from joining with that obtained outside of the platform. By not joining, the consumer meets the merchant with probability $1-\alpha$ and does not enjoy the option of using the platform's payment service. Hence, she expects to purchase the good if and only if $v \geq \rho^a$.

The timing of the model is therefore:

1. The platform sets the access prices (P_B, P_S); if it is vertical, it also chooses (p_B, p_S); if it is stacked, the payment scheme sets interchange fee i; all these fees are public;

2. Having observed the participation benefit u, each consumer decides whether to join or not the platform; the merchant also decides whether or not to join the platform and sets the price ρ;

3. Consumers who joined (resp., did not join) the platform meet the merchant with probability one (resp., $1-\alpha$), in which case they learn the price ρ and decide whether to purchase the good;

4. Those consumers who joined the platform and wish to buy the good then observe b_B and decide whether to use the platform's payment service.

We look for a perfect bayesian equilibrium.

2.2 Integrated benchmark

We first consider a benchmark where the vertical platform is integrated with the merchant. Before characterizing the profit-maximizing price profile in this case, let us make two preliminary observations. First, it follows from $W(p_B, c) = \int_{p_B}^{+\infty} (b_B + b_S - c)\, dG(b_B)$ that the payment choice is ex-post efficient if and only if $p_B = c - b_S$. Second, the set of non-dominated prices for the merchant is $\{v, v + B(p_B)\}$. If the merchant sets $\rho = v$, she sells to both consumers who have joined the platform and those who have not (but have met the merchant). If she sets $\rho = v + B(p_B)$, that is, if she internalizes consumers' option value of being able to pay through the platform, she only sells to consumers who have joined the platform, which leads to a negative (pecuniary) externality on consumers who do not join the platform. We will say that there is *merchant internalization* in the latter scenario (and no merchant internalization in the former).

The following lemma states that inefficiencies relating to payment provision and merchant internalization do not arise in the integrated benchmark.

Lemma 0. *Consider the benchmark where the vertical platform is integrated with the merchant. Then the profit-maximizing price profile is such that merchant internalization does not occur (i.e., $\rho = v$) and payment choice is ex-post efficient (i.e., $p_B = c - b_S$).*

2.3 Merchant pricing

Consider a price profile $\mathbf{p} = (P_B, P_S, p_B, p_S)$. In order to describe the merchant's decisions, let us denote by

$$\bar{p}_S(\mathbf{p}) \equiv \frac{P_S}{1-f} + (1 - G(p_B))(p_S - b_S)$$

the average merchant's payment per participating consumer.

We can now introduce the following two participation conditions:

$$\bar{p}_S(\mathbf{p}) \leq B(p_B) + v\left(\frac{\alpha - f}{1-f}\right), \tag{3}$$

$$\bar{p}_S(\mathbf{p}) \leq \alpha v. \tag{4}$$

Condition (3) describes the merchant's participation decision in case of merchant internalization. Namely, it compares the average merchant's payment (left-hand side) with the average profit gain relative to not being listed in the platform (right-hand side), each expressed per participating consumer. When the platform is essential for trade ($\alpha = 1$), the merchant's profit gain consists of the option value $B(p_B)$, internalized in the retail price of the good, in addition to v. When the platform is nonessential for trade ($\alpha = 0$), the latter consists of $B(p_B)$ discounted by the amount of lost profits from non-participating consumers (who forgo buying the good, as its price is above v). The cases where the platform expands the merchant's demand (albeit not being fully essential) are captured by $\alpha \in (0, 1)$.

In turn, condition (4) describes the merchant's participation decision in case of no internalization. Similarly to condition (3), it compares the average merchant's payment with her average profit gain. The latter equals αv, which corresponds to the demand expansion generated by the platform times the profit margin.

Let the threshold $\hat{p}_B$ uniquely solve

$$\frac{f}{1-f} = \frac{B(p_B)}{(1-\alpha)v}.$$

The next lemma reveals that merchant internalization occurs (resp., does not occur) if $p_B \leq \hat{p}_B$ (resp., $p_B \geq \hat{p}_B$).

Lemma 1. *Consider a price profile $\mathbf{p} = (P_B, P_S, p_B, p_S)$. In the sub-game that follows:*

1. ***Internalization:*** *Under $p_B \leq \hat{p}_B$, the merchant joins the platform if and only if (3) holds, in which case she sets $\rho = v + B(p_B)$.*

2. ***No internalization:*** *Under $p_B \geq \hat{p}_B$, the merchant joins the platform if and only if (4) holds, in which case she sets $\rho = v$.*[4]

When deciding whether to internalize consumers' option value of being able to pay through the platform by setting $\rho = v + B(p_B)$, the merchant weighs the increase in on-platform revenues relative to setting $\rho = v$ against the loss of off-platform revenues. Lemma 1 shows that merchant internalization occurs whenever the price of the payment service p_B is low enough, so that a large amount of payments happen through the platform. Holding p_B fixed, note that an increase in the essentiality parameter α has a negative effect on potential off-platform revenues, rendering merchant internalization more likely.

It is useful to compare the result above with the seminal work of Rochet and Tirole (2002, 2011). These authors implicitly assume that $f = 0$, that is, all consumers have access to paying through the platform. Accordingly, there is always merchant internalization, since $\hat{p}_B \to \infty$ as $f \to 0$.

3 Laissez-faire

We now characterize the behavior of a vertical platform as well as that of a stacked platform (together with the payment scheme it uses) under *laissez-faire*.

3.1 Vertical platform

The following condition is useful to determine the equilibrium:

[4] If $p_B = \hat{p}_B$, the merchant is indifferent between both options and the participation constraints (3) and (4) coincide.

$$W(\min\{c - b_S, \hat{p}_B\}, c) - W(\max\{c - b_S, \hat{p}_B\}, c) \geq (1-\alpha)v\frac{f}{1-f} \tag{5}$$

Proposition 1. *In the unique equilibrium under a vertical platform:*

1. *If (5) is violated, merchant internalization does not occur. The platform sets*

$$p_B^v = \max\{c - b_S, \hat{p}_B\}, \qquad P_B^v = \bar{u} + B(\max\{c - b_S, \hat{p}_B\}),$$

while p_S^v, P_S^v satisfy (3) with equality.

2. *If (5) is is satisfied, merchant internalization does occur. The platform sets*

$$p_B^v = c - b_S, \qquad P_B^v = \bar{u},$$

while p_S^v, P_S^v satisfy (4) with equality. Payment choice is ex-post efficient.

Merchant internalization harms the platform because it hinders its ability to extract rents from the merchant by leading to missed sales outside the platform. In an ideal world (from the perspective of the platform), the platform can set the consumer payment fee at the level that ensures ex-post efficiency of payments without inducing merchant internalization. Otherwise, the platform may find it profitable to under-provide payments to prevent merchant internalization. In this case, losses from decreasing payment efficiency are outweighed by the gains from increased rent extraction from the merchant. When the latter does not hold, payment use is ex post efficient and merchant internalization occurs.

3.2 Stacked platform

We now consider the case of a stacked platform. It is useful to derive first the equilibrium under a modified timing in which either the platform or the payment scheme enjoys a first-mover advantage. Let us start with the case in which the platform sets a pair (P_B, P_S), after which the scheme sets interchange fee i and let us call the *platform-optimal equilibrium* the resulting equilibrium. The following remark shows that the equilibrium outcome in this case is the same as the one under a vertical platform with cost $c_B + c_S$.

Remark 1. *The unique sub-game perfect equilibrium of the modified game is such that:*

1. *If (5) is violated, the platform sets*

$$P_B = \bar{u} + B(\max\{c - b_S, \hat{p}_B\}), \quad P_S = (1-f)\left(\alpha v - (1 - G(p_B^v))(c_B + c_S - p_B^v - b_S)\right),$$

following which the scheme sets $i = c_B - p_B^v$.

2. If (5) is satisfied, the platform sets

$$P_B = \bar{u}, \qquad P_S = v\,(\alpha - f) + (1-f)W(c_B + c_S - b_S, c_B + c_S),$$

following which the scheme sets $i = b_S - c_S$.

The above remark shows that the platform sets P_S^s such that the highest interchange fee compatible with merchant participation leads to $p_B = p_B^v$, that is, the vertical-platform optimum. This price squeeze results from the strong bargaining power that the platform has in this case. In this scenario, the platform does not need to create a payment solution in-house. This may explain why some of the most powerful platforms (such as Apple) keep relying on open schemes (such as Visa and Mastercard) instead of developing their own proprietary closed scheme.

Let us now consider the modified game in which the payment scheme enjoys a first-mover advantage: it sets the interchange fee i, after which the platform picks (P_B, P_S). We call the resulting equilibrium the *scheme-optimal equilibrium.* Denote $\bar{i}$ the largest solution to:

$$W(c_B - i, c_B + c_S) = \left(\frac{f-\alpha}{1-f}\right) v,$$

and notice that it induces merchant internalization because $\bar{i} > c_B - \hat{p}_B$. We make the following remark.

Remark 2. *The unique sub-game perfect equilibrium of the modified game is such that the scheme sets $i = \bar{i}$, following which the platform sets*

$$P_B = \bar{u}, \quad \textit{and} \quad P_S = v\,(\alpha - f) + (1-f)W(c_B - \bar{i}, c_B + c_S).$$

Under this timing, the payment scheme sets the interchange fee such that the highest access fee compatible with merchant participation leaves the platform indifferent between having the merchant or not. The strong bargaining power that the scheme derives from its first-mover advantage allows it to capture all surplus from trade.

Let us now consider the original game, in which the platform's decision about access prices (P_B, P_S) and the scheme's decision about the interchange fee i are simultaneous. We call a *negotiated equilibrium* any Nash equilibrium that is Pareto-efficient and that differs from the platform- and scheme-optimal equilibria. The following proposition characterizes the set of negotiated equilibria.

Proposition 2. *Under a stacked platform, the set of negotiated equilibria is as follows:*

- If (5) is satisfied then the set of negotiated equilibria, indexed by $i \in (b_S - c_S, \bar{i})$*, is such that merchant internalization always occurs and the platform sets*

$$P_B^s(i) = \bar{u} \quad and \quad P_S^s(i) = v\,(\alpha - f) + (1-f)W(c_B - i, c_B + c_S).$$

- If (5) is violated then the set of negotiated equilibria, indexed by $i \in (c_B - p_B^v, \bar{i})$*, is such that:*

1. *If* $i \leq c_B - \hat{p}_B$*, no merchant internalization occurs and the platform sets*

$$P_B^s(i) = \bar{u} + B(c_B - i) \;\; and \;\; P_S^s(i) = (1-f)\left(\alpha v - (1 - G(c_B - i))(i + c_S - b_S)\right).$$

2. *If* $i > c_B - \hat{p}_B$*, merchant internalization occurs and the platform sets*

$$P_B^s(i) = \bar{u} \quad and \quad P_S^s(i) = v\,(\alpha - f) + (1-f)W(c_B - i, c_B + c_S).$$

Negotiated equilibria capture the idea that both parties concede on something and reflect possibly different bargaining powers (for reasons outside of the model). Relative to the vertical pricing case, the payment fee for consumers p_B (weakly) decreases, reflecting scheme's pressure to increase usage, and merchant internalization becomes more likely to occur. Moreover, there may be over-usage of the payment service.

4 Regulation

4.1 Vertical platform: Third-party access and interoperability

Platforms that offer a proprietary payment scheme typically opt for a closed system, where the issuing and acquiring roles are performed by the platform itself (or by a contractual partner). This closed architecture, together with the fact that platforms typically enjoy market power in their basic market, have led regulators to fear anti-competitive practices. In particular, concerns about tying motivated the European Commission to posit in the Digital Markets Act (DMA) that

> ...gatekeepers should, therefore, be required to ensure, free of charge, effective interoperability with, and access for the purposes of interoperability to, the same operating system, hardware or software features that are available or used in the provision of its own complementary and supporting services and hardware.

According to the DMA, third-party providers should be able to offer payment services in multi-purpose platforms under conditions similar to those of the platform. In line with this principle, we will now study the effect of a pro-competitive regulation that enables the entry of competing payment schemes in the platform ecosystem and requires that effective interoperability is provided by the platform.

We consider the cases where (i) consumers can choose which payment scheme to use, while merchants are obliged to adopt all available payment schemes (call it *consumer-centric* competition), and where (ii) merchants can choose their preferred payment scheme, while consumers are forced to use the merchant's choice in order to complete the transaction (call it *merchant-centric* competition).

We assume that all alternative payment services incur an issuing cost $\tilde{c}$ with $\tilde{c} < c$. We index payment services by $j \in \{0, 1, \ldots, N\}$ where $N \geq 2$, with the understanding that $j = 0$ is the platform itself. Accordingly, we let $c^0 \equiv c$ and $c^j \equiv \tilde{c}$ for $j \neq 0$. Payment services (inside the platform) are homogeneous in the eyes of consumers, in that they all deliver the convenience benefit b_B relative to a payment outside of the platform. This assumption is consistent with the requirement of effective interoperability. Accordingly,

$$W(p_B, \tilde{c}) \equiv \int_{p_B}^{+\infty} (b_B + b_S - \tilde{c})\, dG(b_B)$$

is the ex-post welfare produced by paying through an alternative payment system.

4.1.1 Consumer-centric competition

Assume that merchants in the platform should accept payment initiation from any service operating in the platform, while consumers can choose which payment service to use.

The timing of the model is as follows:

1. The platform publicly sets the access fee profile $\mathbf{p} = (P_B, P_S, p_B^0, p_S^0)$;

2. Alternative payment services simultaneously post fee profiles $(p_B^1, p_S^1), \ldots, (p_B^N, p_S^N)$, which are observed by the merchant but not by consumers;

3. Having observed the participation benefit u and the fee profile $\mathbf{p}$, each consumer decides whether to join or not the platform; the merchant also decides whether or not to join the platform and sets the price ρ;

4. Consumers who joined (resp., did not join) the platform meet the merchant with probability one (resp., $1-\alpha$), in which case they learn the price ρ and decide whether to purchase the good;

5. Those consumers who joined the platform and wish to buy the good then observe b_B and decide how to pay for the good.

Proposition 3. *Under consumer-centric competition, the equilibrium outcome is as in Proposition 1 after replacing c with $\tilde{c}$.*

Under consumer-centric competition, payment service providers use funds collected from the merchant to "bid" for consumers (which fully dissipates their profits). The equilibrium outcome is as in the *laissez-faire* regime after replacing c with $\tilde{c}$. In other words, the equilibrium prices implement the monopolistic optimum with a more efficient payment service. The equilibrium also features a prize squeeze, in that the platform uses the merchant access fee to set an upper bound on the payment service fee that can be charged to the merchant. Interestingly, consumer-centric competition does not address either of the two potential inefficiencies previously discussed (i.e., the inefficiency of payment provision and merchant internalization). However, it does improve welfare by favoring the selection of a more efficient payment technology.

4.1.2 Merchant-centric Competition

The timing of the model is as in the previous subsection, with appropriate modifications in periods 3 and 5:

1. The platform publicly sets the access fee profile $\mathbf{p} = (P_B, P_S, p_B^0, p_S^0)$;

2. Alternative payment services simultaneously post fee profiles $(p_B^1, p_S^1), \ldots, (p_B^N, p_S^N)$, which are observed by the merchant but not by consumers;

3. Having observed the participation benefit u and the fee profile $\mathbf{p}$, each consumer decides whether to join or not the platform; the merchant also decides whether or not to join the platform, sets the price ρ and chooses a payment service;

4. Consumers who joined (resp., did not join) the platform meet the merchant with probability one (resp., $1-\alpha$), in which case they learn the price ρ and decide whether to purchase the good;

5. Those consumers who joined the platform and wish to buy the good then observe b_B and decide to pay for the good either with the merchant's payment service or outside of the platform.

Denoting by

$$\bar{p}_B \equiv \arg\max_{p_B} \{(1 - G(p_B))(p_B - (\tilde{c} - b_S))\},$$

we have the following result.

Proposition 4. *Assume that $\hat{p}_B \leq \tilde{c} - b_S$. Under merchant centric competition, each payment service sets $p_B^j = \bar{p}_B$ and $p_S^j = \tilde{c} - \bar{p}_B$.*

Under merchant-centric competition, payment service providers use funds collected from consumers to "bid" for the merchant (again, their profits are fully dissipated). As a result, the payment fee for consumers is the one that the merchant would choose if it owned the payment service. Such a "monopolistic" pricing on the consumer side leads to a severe under-utilization of the payment service, which may prevent merchant internalization. Thus, merchant-centric competition may make merchant internalization less of a concern but may amplify the inefficiency of payment provision, potentially resulting in a negative overall impact on social welfare.

4.2 Stacked platform: Interchange fee regulation

We now consider interchange fee regulation with a stacked platform. Let us first consider the maximum interchange fee i^t that passes the tourist test (Rochet and Tirole, 2011), that is the interchange fee that leaves the merchant indifferent between payment methods. Formally, $i^t \equiv b_S - c_S$, which leads to $p_B = c_B - i^t = c_B + c_S - b_S$. In this case, payment choice is not ex-post efficient because the price born by consumers does not reflect the actual issuer cost ($\hat{c}_B$ rather than c_B) due to the existence of market power in the issuer market. For ex-post efficiency, the interchange fee has to exceed the tourist-level i^t. Specifically, it should be set at

$$i^* \equiv b_S - c_S + (c_B - \hat{c}_B) > i^t,$$

which leads to

$$p_S = b_S + (c_B - \hat{c}_B) \text{ and } p_B = \hat{c}_B + c_S - b_S.$$

In the context of stacked platforms, there are two rationales behind interchange fee regulation. The first one relates to the usual objective of guaranteeing that payment usage is ex-post efficient. The second one is to prevent merchant internalization. On the one hand, ensuring that payment usage is ex-post efficient requires the interchange fee to be above the tourist-test level. On the other hand, preventing merchant internalization requires under-usage of the payment service. The latter happens both for values of the interchange fee that are (weakly) below the tourist-test level and values that are above the tourist-test level. In order to describe how a regulator maximizing utilitarian welfare (the sum of consumer surplus, the platform's profit, and issuer profits) sets the interchange fee, we introduce the following condition:

$$W(\min\{\hat{c} - b_S, \hat{p}_B\}, \hat{c}) - W(\max\{\hat{c} - b_S, \hat{p}_B\}, \hat{c}) \geq (1-\alpha)v\frac{f}{1-f} \tag{6}$$

where $\hat{c} \equiv \hat{c}_B + c_S$.

Proposition 5. *Consider a stacked platform with full bargaining power over the payment scheme, and denote by i^e the efficient interchange fee.*

1. *If (6) is violated and $\hat{p}_B \leq \hat{c} - b_S$, the efficient interchange fee is $i^e = i^*$.*
2. *If (6) is violated and $\hat{p}_B > \hat{c} - b_S$, the efficient interchange fee equals $i^e = c_B - \hat{p}_B$.*
3. *If (6) is satisfied, the efficient interchange fee is is $i^e = i^*$.*

Recall that the platform, exerting full bargaining power over the payment scheme, is able to implement the vertical-platform optimum (see Remark 2), which implies that it appropriates all the rents enjoyed by the merchant and participating consumers. However, consumer fees charged by the platform do not reflect issuing costs (because of market power in the issuing sector). Consistent with this, a key implication of Proposition 5 is that optimal regulation always leads to a payment fee for consumers (resp., the merchant) that is weakly lower (resp., higher) than under laissez-faire.

5 Conclusion

Our analysis highlights the inefficiencies that arise from the provision of ancillary payment services by digital platforms. We show that vertical platforms may under-provide payment services to prevent merchant internalization. We also establish that while under-provision is less of a concern with stacked platforms, over-provision may occur in this case, making merchant internalization more likely than with vertical platforms.

Additionally, our paper offers insights into the welfare effects of regulations that require interoperability with third-party payment service providers or impose caps on interchange fees. We find that mandated interoperability may increase the cost-efficiency of payments in consumer-centric competition but could lead to severe under-provision in merchant-centric competition. We also show that, in the case of stacked platforms, the utilitarian welfare-maximizing interchange fee is often higher than the tourist-test level used in current practice.

Our analysis can be extended in several directions. First, our model assumes that a stacked platform may only charge consumers and merchants, but possesses no instrument to charge or remunerate issuers and acquirers. This assumption is inconsequential in our setting, where competition is Ã la Bertrand, which guarantees that there is complete pass-through between issuers and consumers, and acquirers and merchants, respectively. However, in other contexts, stacked platforms may prefer to charge payment intermediaries (issuers and/or acquirers) rather than final users (consumers and/or merchants). Second, we assume that the consumer access price can be negative. However, moral hazard by consumers (or outright fraud) may prevent the platform from subsidizing participation, constraining it to set a non-negative access price for consumers. Third, we suppose that merchants charge the same price regardless of the payment method used by consumers. Allowing merchants to price-discriminate across payment methods would be a natural extension of our analysis.

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Appendix: Proofs

Proof of Lemma 0. Conditional on setting $\rho = v$, a vertical platform integrated with the merchant maximizes total profits

$$(1-f)(P_B + a + v + (1 - G(p_B)(p_B + b_S - c) + f(1-\alpha)v$$

with respect to P_B and p_B subject to the participation constraint of consumers with valuations $\bar{u}$:

$$\bar{u} + B(p_B) - P_B \geq 0.$$

This amounts to maximizing

$$(1-f)(\bar{u} + a + v + W(p_B)) + f(1-\alpha)v$$

with respect to p_B. Hence, conditional on setting $\rho = v$, payment is ex-post efficient (i.e., $p_B = c - b_S$) and total profits are given by

$$(1-f)(\bar{u} + a + v + W(c - b_S)) + f(1-\alpha)v.$$

Conditional on setting $\rho = v + B(p_B)$, a vertical platform integrated with the merchant maximizes total profits

$$(1-f)(P_B + a + v + B(p_B) + (1 - G(p_B)(p_B + b_S - c)$$

with respect to P_B and p_B subject to the participation constraint of consumers with valuations $\bar{u}$:

$$\bar{u} - P_B \geq 0.$$

This amounts to maximizing

$$(1-f)(\bar{u} + a + v + W(p_B))$$

with respect to p_B. Hence, conditional on setting $v + B(p_B)$, payment is again ex-post efficient (i.e., $p_B = c - b_S$), but total profits are now given by

$$(1-f)(\bar{u} + a + v + W(c - b_S)).$$

It follows from the comparison of total profits under $\rho = v$ and $\rho = v + B(p_B)$ that a vertical platform integrated with the merchant finds it optimal to set $\rho = v$. Q.E.D.

Proof of Lemma 1. We prove claim 1 first. The merchant is willing to join the platform while setting $\rho = v + B(p_B)$ if and only if

$$(1-f)\left(v + B(p_B) + (1 - G(p_B))(b_S - p_S)\right) - P_S \geq (1-\alpha)v,$$

which is equivalent to

$$\frac{P_S}{1-f} + (1 - G(p_B))(p_S - b_S) \leq v + B(p_B) - \frac{(1-\alpha)v}{1-f}.$$

The incentive constraint is

$$(1-f)\left(v + B(p_B) + (1 - G(p_B))(b_S - p_S)\right) - P_S$$

$$\geq (1-f)\left(v + (1 - G(p_B))(b_S - p_S)\right) - P_S + f(1-\alpha)v$$

which is equivalent to

$$\frac{f}{1-f}(1-\alpha)v \leq B(p_B) \qquad \Longleftrightarrow \qquad \frac{f}{1-f} \leq \frac{B(p_B)}{(1-\alpha)v},$$

as claimed.

We now prove claim 2. The merchant is willing to join the platform while setting $\rho = v$ if and only if

$$(1-f)\left(v + (1-G(p_B))(b_S - p_S)\right) - P_S + f(1-\alpha)v \geq (1-\alpha)v,$$

which is equivalent to

$$\frac{P_S}{1-f} + (1-G(p_B))(p_S - b_S) \leq \alpha v.$$

The IC constraint is

$$(1-f)\left(v + (1-G(p_B))(b_S - p_S)\right) - P_S + f(1-\alpha)v$$

$$\geq (1-f)\left(v + B(p_B) + (1-G(p_B))(b_S - p_S)\right) - P_S,$$

which is equivalent to

$$\frac{f}{1-f}(1-\alpha)v \geq B(p_B) \qquad \Longleftrightarrow \qquad \frac{f}{1-f} \geq \frac{B(p_B)}{(1-\alpha)v},$$

as claimed. Q.E.D.

Proof of Proposition 1. The platform chooses the price profile $\mathbf{p} = (P_B, P_S, p_B, p_S)$ to maximize

$$(1-f)\left(P_B + a + (1-G(p_B))(p_B + p_S - c)\right) + P_S, \tag{7}$$

where the merchant's pricing decision is characterized in Lemma 1. Without loss of optimality, we can set $P_S = 0$ and choose p_S to make the merchant's participation condition binding.

Consider first the case where the platform's optimum involves the merchant setting the price $\rho = v$. By Lemma 1, this can be implemented if and only if $p_B \geq \hat{p}_B$. That condition (4) is binding is equivalent to

$$(1-G(p_B))(p_S - b_S) = \alpha v. \tag{8}$$

After plugging (8) into the objective (7), the platform's problem can be restated as

$$\Pi_0 \equiv \max_{(P_B, p_B)} \left\{(1-f)\left(P_B - B(p_B) + W(p_B, c) + a + \alpha v\right)\right\}$$

subject to $p_B \geq \hat{p}_B$ and the participation constraint of consumers with valuation $\bar{u}$:

$$\bar{u} + B(p_B) - P_B \geq 0.$$

Therefore, $P_B = \bar{u} + B(p_B)$ and

$$\Pi_0 = \max_{p_B} \{(1-f)(\bar{u} + W(p_B, c) + a + \alpha v)\} \qquad \text{s.t. } p_B \geq \hat{p}_B.$$

Therefore, $p_B^v = \max\{c - b_S, \hat{p}_B\}$ and

$$\Pi_0 = (1-f)(\bar{u} + W(\max\{c - b_S, \hat{p}_B\}) + a + \alpha v).$$

Consider now the case where the platform's optimum involves the merchant setting the price $\rho = v + B(p_B)$. By Lemma 1, this can be implemented if and only if $p_B \leq \hat{p}_B$.

After plugging (3) into the objective (7), the platform's problem can be restated as

$$\Pi_1 \equiv \max_{(P_B, p_B)} \{(1-f)(P_B + a + v + W(p_B, c)) - (1-\alpha)v\}$$

subject to $p_B \leq \hat{p}_B$ and the participation constraint of consumers with valuation $\bar{u}$: $\bar{u} - P_B \geq 0$.

Therefore, $P_B = \bar{u}$ and $p_B^v = \min\{c - b_S, \hat{p}_B\}$, in which case

$$\Pi_1 = (1-f)(\bar{u} + a + v + W(\min\{c - b_S, \hat{p}_B, c\})) - (1-\alpha)v.$$

The optimum is then obtained by comparing Π_0 and Π_1. Accordingly, the platform does (resp., not) induce merchant internalization if condition (5) does (resp., not) hold. Q.E.D.

Proof of Proposition 2. If the merchant does not participate at the platform, the platform gets

$$(1-f)(\bar{u} + a)$$

Under merchant internalization, the platform gets

$$(1-f)(\bar{u} + a + v + W(p_B, c_B + c_S)) - (1-\alpha)v$$

Therefore, the lowest p_B compatible with merchant participation satisfies

$$(1-f)(\bar{u} + a + v + W(p_B, c_B + c_S)) - (1-\alpha)v = (1-f)(\bar{u} + a)$$

Let $\underline{p_B}$ solve

$$W(p_B, c_B + c_S) = \frac{(1-\alpha)v}{1-f} - v$$

Moreover, Pareto-efficient Nash equilibria entail $p_B \leq c - b_S$ if (5) is satisfied, and entail $p_B \leq p_B^v$ if (5) is violated.

Then the set of Nash equilibria is such that $p_B \in [\underline{p_B}, \bar{p_B}]$, P_S given by either (3) with equality or (4) with equality depending on whether merchant internalization occurs or not, and P_B given by either $\bar{u}$ or $\bar{u} + B(p_B)$ depending on whether merchant internalization occurs or not. The upper threshold $\bar{p_B}$ is either $c - b_S$ or p_B^v depending on whether (5) is satisfied or violated.

Thus, using the fact that $p_B = c_B - i$ (and noting that $\underline{p_B} = c - \bar{i}$) we have the following:

- If (5) is satisfied then the set of Pareto-efficient equilibria, indexed by $i \in [b_S - c_S, \bar{i}]$, is such that merchant internalization always occurs and the platform sets

$$P_B^s(i) = \bar{u} \quad \text{and} \quad P_S^s(i) = v\,(\alpha - f) + (1 - f)W(c_B - i, c_B + c_S).$$

- If (5) is violated then the set of Pareto-efficient equilibria, indexed by $i \in [c_B - p_B^v, \bar{i}]$, is such that:

1. If $i \leq c_B - \hat{p}_B$, no merchant internalization occurs and the platform sets

$$P_B^s(i) = \bar{u} + B(c_B - i) \;\text{ and }\; P_S^s(i) = (1 - f)\left(\alpha v - (1 - G(c_B - i))(i + c_S - b_S)\right).$$

2. If $i > c_B - \hat{p}_B$, merchant internalization occurs and the platform sets

$$P_B^s(i) = \bar{u} \quad \text{and} \quad P_S^s(i) = v\,(\alpha - f) + (1 - f)W(c_B - i, c_B + c_S).$$

The set of negotiated equilibria is obtained from the set Pareto-efficient equilibria by removing the the platform- and scheme-optimal equilibria from that set. Q.E.D.

Proof of Proposition 3. In any equilibrium, it must hold that $p_B^j = \tilde{c} - p_S^j$ for all $j = 1, ..., N$. Moreover, under consumer-centric competition, all payment services $j = 1, ..., N$ set their payment fees $\left(p_B^j, p_S^j\right) = (\tilde{p}_B, \tilde{p_S})$ such that the merchant's participation constraint is binding.

Consider first the case where the platform's optimum involves the merchant setting the price $\rho = v$. By Lemma 1, this can be implemented if and only if $\tilde{p_B} \geq \hat{p}_B$.

The platform maximizes its profit

$$(1 - f)(P_B + a) + P_S$$

with respect to (P_B, P_S) subject to the merchant participation constraint

$$\frac{P_S}{1 - f} + (1 - G(\tilde{p}_B))(\tilde{c} - \tilde{p}_B - b_S) \leq \alpha v,$$

and the participation constraint of consumers with valuation $\bar{u}$:

$$\bar{u} + B(\tilde{p}_B) - P_B \geq 0.$$

It is straightforward that both constraints are binding at the optimum. Therefore, the platform's maximization program can be restated as

$$\begin{aligned}\tilde{\Pi}_0 &\equiv \max_{\tilde{p}_B}(1-f)[\bar{u} + B(\tilde{p}_B) + a + \alpha v - (1-G(\tilde{p}_B))(\tilde{c} - \tilde{p}_B - b_S)] \\ &= \max_{\tilde{p}_B}(1-f)[\bar{u} + W(\tilde{p}_B, \tilde{c}) + a + \alpha v)]\end{aligned}$$

subject to $\tilde{p}_B \geq \hat{p}_B$. The solution to this program is $\tilde{p}_B^v = \max\{\tilde{c} - b_S, \hat{p}_B\}$. Thus,

$$\tilde{\Pi}_0 = (1-f)[\bar{u} + W(\max\{\tilde{c} - b_S, \hat{p}_B\}, \tilde{c}) + a + \alpha v)].$$

Consider now the case where the platform's optimum involves the merchant setting the price $\rho = v + B(\tilde{p}_B)$. By Lemma 1, this can be implemented if and only if $\tilde{p}_B \leq \hat{p}_B$.

The platform maximizes its profit

$$(1-f)(P_B + a) + P_S$$

with respect to (P_B, P_S) subject to the merchant participation constraint

$$\frac{P_S}{1-f} + (1-G(\tilde{p}_B))(\tilde{c} - \tilde{p}_B - b_S) \leq B(\tilde{p}_B) + v\left(\frac{\alpha - f}{1-f}\right),$$

and the participation constraint of consumers with valuation $\bar{u}$:

$$\bar{u} - P_B \geq 0.$$

Again, both constraints are binding at the optimum. Therefore, the platform's maximization program can be restated as

$$\begin{aligned}\tilde{\Pi}_1 &\equiv \max_{\tilde{p}_B}(1-f)[\bar{u} + a + B(\tilde{p}_B) - (1-G(\tilde{p}_B))(\tilde{c} - \tilde{p}_B - b_S)] + v(\alpha - f) \\ &= \max_{\tilde{p}_B}(1-f)[\bar{u} + a + v + W(\tilde{p}_B, \tilde{c})] - (1-\alpha)v\end{aligned}$$

subject to $\tilde{p}_B \geq \hat{p}_B$.The solution to this program is $\tilde{p}_B^v = \min\{\tilde{c} - b_S, \hat{p}_B\}$. Thus,

$$\tilde{\Pi}_1 = (1-f)[\bar{u} + a + v + W(\min\{\tilde{c} - b_S, \hat{p}_B\}, \tilde{c})] - (1-\alpha)v.$$

The optimum is then obtained by comparing $\tilde{\Pi}_0$ and $\tilde{\Pi}_1$. Accordingly, the platform does (resp., not) induce merchant internalization if the condition obtained from condition (5) by replacing c with $\tilde{c}$ does (resp., not) hold. Therefore, the equilibrium outcome is as in Proposition 1 after replacing c with $\tilde{c}$. Q.E.D.

Proof of Proposition 4. In any equilibrium, it must hold that

$$p_B^j = \tilde{c} - p_S^j$$

for all alternative payment service providers $j = 1, ..., N$, and the platform does not sell its payment service. Moreover, under merchant-centric competition, all alternative payment services $j = 1, ..., N$ must set payment fees that maximize the merchant's profit in equilibrium, which implies that all prices are equal: $p_B^j = p_B$ and $p_S^j = p_S$. Since $p_B + p_S = \tilde{c}$, the merchant's profit is given by

$$\pi^m(p_B, P_S) = \begin{cases} (1-f)[v + B(p_B) + (1 - G(p_B))(p_B - \tilde{c} + b_S)] - P_S & \text{if} \quad p_B \leq \hat{p}_B \\ (1-f)[v + (1 - G(p_B))(p_B - \tilde{c} + b_S)] + f(1-\alpha)v - P_S & \text{if} \quad p_B \geq \hat{p}_B \end{cases}$$

and can be rewritten as

$$\pi^m(p_B, P_S) = \begin{cases} (1-f)[v + W(p_B, \tilde{c})] - P_S & \text{if} \quad p_B \leq \hat{p}_B \\ (1-f)[v + (1 - G(p_B))(p_B - \tilde{c} + b_S)] + f(1-\alpha)v - P_S & \text{if} \quad p_B \geq \hat{p}_B \end{cases}$$

Since $W(p_B, \tilde{c})$ is increasing in p_B over $[0, \tilde{c} - b_S]$ and $\hat{p}_B \leq c - b_S$ then $\pi^m(p_B, P_S)$ is increasing in p_B over $[0, \hat{p}_B]$. This implies that

$$\arg\max_{p_B \geq 0} \pi^m(p_B, P_S) = \arg\max_{p_B \geq \hat{p}_B} \pi^m(p_B, P_S) = \arg\max_{p_B \geq \hat{p}_B} (1 - G(p_B))(p_B - \tilde{c} + b_S).$$

Moreover, $(1 - G(p_B))(p_B - \tilde{c} + b_S) = W(p_B, \tilde{c}) - B(p_B)$ is also increasing in p_B over $[0, \tilde{c} - b_S]$ and, therefore, over $[0, \hat{p}_B]$, because $B(p_B)$ is decreasing in p_B. This implies that

$$\arg\max_{p_B \geq \hat{p}_B} (1 - G(p_B))(p_B - \tilde{c} + b_S) = \arg\max_{p_B \geq 0} (1 - G(p_B))(p_B - \tilde{c} + b_S) = \bar{p}_B.$$

Hence,

$$\arg\max_{p_B \geq 0} \pi^m(p_B, P_S) = \bar{p}_B.$$

Thus, each payment service sets $p_B^j = \bar{p}_B$ and $p_S^j = \tilde{c} - \bar{p}_B$. Q.E.D.

Proof of Proposition 5. Written as a function of the interchange fee, aggregate welfare is:

$$\mathcal{W}(i) \equiv \begin{cases} (1-f)(a + v + W(c_B - i, \hat{c})) & \text{if} \quad c_B - i < \hat{p}_B \\ (1-f)(a + v + W(c_B - i, \hat{c})) + f(1-\alpha)v & \text{if} \quad c_B - i \geq \hat{p}_B. \end{cases}$$

Recall from Section 2 that we rule out the possibility that consumers with valuation $\underline{u}$ access the platform in equilibrium. This amounts to assuming that $\underline{u}$ is sufficiently negative.

Consider first the case where $\hat{p}_B \leq \hat{c} - b_S$. (which implies that (6) is violated). Here, the ex-post efficient interchange fee i^* is such that merchant internalization does not occur, as, in equilibrium, $p_B = c_B - i^* = \hat{c}_B + c_S - b_S = \hat{c} - b_S \geq \hat{p}_B$. Because i^* maximizes $W(c_B - i, \hat{c})$, it is immediate that it also maximizes $\mathcal{W}(i)$.

Consider now the case where $\hat{p}_B > \hat{c} - b_S$ (which is necessary for (6) to be satisfied). Here, there are two candidates for the optimum. The regulator either sets $i^e = i^*$, in which case merchant internalization occurs and

$$\mathcal{W}(i^*) = (1 - f)(a + v + W(\hat{c} - b_S, \hat{c})),$$

or sets $i^e = c_B - \hat{p}_B$, in which case $p_B = \hat{p}_B$, merchant internalization does not occur, and

$$\mathcal{W}(c_B - \hat{p}_B) = (1 - f)(a + v + W(\hat{p}_B, \hat{c})) + f(1 - \alpha)v.$$

Direct comparison reveals that $\mathcal{W}(c_B - \hat{p}_B) \geq \mathcal{W}(i^*)$ if and only if (6) is violated. Q.E.D.