# Entry of Non-financial Firms and Competition in the Retail Payments Market

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# Contents

# Entry of Non-financial Firms and Competition in the Retail Payments Market

We investigate the effects of a non-financial firm's entry on competition in the retail payments market, from the perspective of duopoly between an incumbent and an entrant in conditions of vertical restraints. Considering the cross-platform externalities in payment processing, differentiated preferences for payment platforms, and competitive bottleneck on the consumer side, we derive the following results.

When only the entry of a vertically integrated (or end-to-end service) provider is allowed, either all merchants choose to multi-home or no entry occurs, regardless of the regulatory requirement. On the other hand, if the entry of a downstream-only (or front-end service) provider is possible, a partial multi-homing equilibrium result can emerge for some conditions under which the entry of an end-to-end service provider does not occur. In addition, due to the lowered entry cost, the overall welfare is greater when the entry of downstream-only service is possible although the entire increase in welfare goes to the entrant. Without regulation, however, the vertically integrated incumbent does not voluntarily provide the back-end service to the entrant when the merchant's benefit from the payments service is not sufficiently high. It suggests the need for proper regulatory measures to reach a socially desirable outcome from the new entry in the retail payments market.

**Keywords:** FinTech, Entry, Retail payments, Front-end, Vertical restraints

**JEL classification:** L11, G23, G28

## 1. Introduction

The recent advances in information and communications technology (ICT) have led to the rapid development and expansion of new and innovative financial services, often termed FinTech. According to Accenture (2014), worldwide investment in FinTech has grown three times over the past five years. While innovations are happening in various areas of finance, retail payments currently draw the biggest attention and have become an extremely competitive area because (i) non-cash payments have increased rapidly,[1] (ii) payment acquisition has emerged as a key area for innovation in FinTech (Capgemini and RBS, 2013), and (iii) front-end services provide the additional strategic value for payment service providers due to their proximity to consumers (Busch and Moreno, 2014).

The retail payments landscape is characterized by a wide diversity of payment instruments and activities along the different stages of the payment process.[2] To provide retail payment services to consumers, a payment platform needs to complete all stages of the payment process. On the other hand, due to the tiered structure of that process, the platform may not need to own all necessary facilities and related licenses to provide payment services to consumers if it can access and use those of other platforms.

Taking into account the stages of the payment chain, type of service provided, and the predominant types of relationships with banks, CPMI (2014) classifies non-financial payment service providers into four categories: (i) front-end providers (ii) back-end providers (iii) operators of retail payment infrastructures, and (iv) end-to-end providers.[3] We specifically focus here on the competition

1) From 2009 to 2012, the world's annual growth rate of non-cash payment was 7.5%, and increased to, 9.4% in 2013. (Capgemini and RBS, 2013)

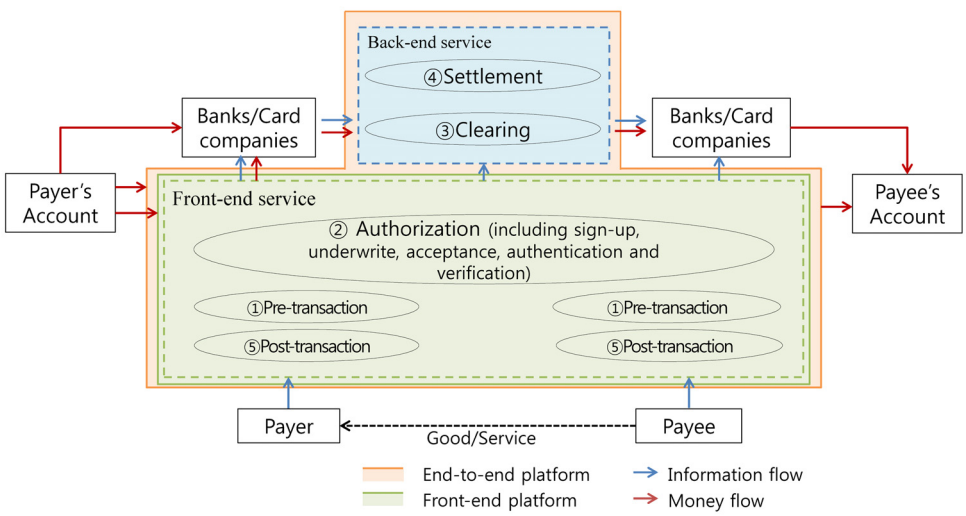
2) CPMI (2014) categorizes the payment process into five stages: (i) pre-transaction, (ii) authorization, (iii) clearing, (iv) settlement, and (v) post-transaction. A more detailed list of the different activities in each stage can be found in CPMI (2014). DeGennaro (2006) also provides a detailed analysis of the payment card process and associated risks.

3) In CPMI (2014), back-end providers includes back-end services like data centers, security firms, audit or compliance entities. Operators of retail payment infrastructures are defined as specialists in clearing and settlement services. We use 'back-end' in a more abstract sense, to indicate every service other than those from front-end providers.

between the front-end and end-to-end providers, which are the types that face the consumers directly.

Frond-end providers, including ApplePay and various payment gateway(PG) services, offer the total or parts of front-end services such as pre-transaction, authorization, and post-transaction. They often rely on the back-end services and infrastructures provided by others, possibly rival end-to-end providers in the market, and paying the fees. End-to-end providers, on the other hand, including banks, credit card companies,[4] PayPal and Alipay(China) can afford both the front-end and back-end services, including the total or part of the clearing and settlement process, with their own infrastructure. In the context of industrial organization, the end-to-end

Figure 1: Payment Process Overview




Notes : This figure is a retail payment process diagram which describes the flows of information and money, the boundaries of front-end and back-end services, and frond-end and end-to-end platforms.

4) To be sure, VISA and Master, unlike AMEX, Discover and Diners Club, can be technically classied as (iii) operators of retail payment infrastructures. They only provide networks between acquirers and issuers, mostly financial institutions. Considering the aspect of consumers' perception, however, we regard them as end-to-end providers.

providers can be considered as vertically integrated firms while the front-end providers are downstream firms.[5] The retail payments market is in this sense a downstream market. Figure 1 represents the process of retail payments.

CPSS (2012) documents a number of economic characteristics of the retail payments market. First, the provision of payment service bears the characteristics of network industries and often generates economics of both scale and scope. Second, the consumption of payment service often benefits from 'cross-platform externalities', as each additional merchant that accepts a payment service increases the value of the service for all consumers. New networks are often hard to establish because a critical mass of users is required to meet the network's start-up cost needs. It is, thus, no coincidence that non-financial firms that enter the retail payments market are often big ICT companies or their affiliates such as Paypal, ApplePay, Alipay and KakaoPay, which already possess vast numbers of users.

We investigate the effects of a non-financial firm's entry to the retail payments market, the existing firm's response to their entry, and the equilibrium fees and market shares from the perspectives of vertical restraints and duopolistic competition. Specifically, we consider an environment in which the provision of front-end services by an entrant, which is a non-financial firm providing novel payment acquisition services, is technically possible via the back-end services and the infrastructure available from its competitor, an incumbent financial company providing relatively less novel payments services. We derive the following results.

In the case when only entry of an end-to-end provider is allowed, either all or no merchants choose to subscribe to both the incumbent's and the entrant's platforms, or multi-home, as is often observed in the previous literature such as Rochet and Tirole (2003). The merchants' multi-home choices depend upon whether the merchant benefit of payment service exceeds a cutoff level. In the case of entry with front-end service, the same result still occurs as in the previous case if the merchant benefit of payment service exceeds a cutoff level. If not, however, a partial multi-homing of merchants in equilibrium, something scarcely

5) Details concerning vertical restraints can be found in Rey (2012). Mariotto and Verdier (2014) also provide a survey of how the industrial organization (IO) literature can be used to study the impact of recent technological innovations on the retail banking industry.

found in the literature, may emerge for some external conditions under which no entry of end-to-end provider occurs.[6] This result requires that the incumbent, an end-to-end provider, cannot deny the provision of its back-end service to the entrant, a front-end only provider. Finally, overall welfare is enhanced with front-end only entry.[7] We provide an explanation as follows.

In our model, the cross-group externality from the consumer side influences both the merchants' benefits from transaction and their chances of sales separately. A merchant's objective function is quadratic with respect to the entrant's consumer share, which is marginally affected by the merchant's decision to subscribe to the entrant's platform. The quadratic functional form opens the possibility of existence of an inner solution, unlike in the case with the linear form often used in the literature. If only entry by an end-to-end provider is allowed, merchants' subscription decision on the entrant is still a corner solution, which means that all or no merchants subscribe to the entrant's platform. If the entry of a front-end provider is possible, however, the competitive pressure is weakened because the incumbent can collect fees, assuming per transaction, for providing back-end service or infrastructure access to the entrant. The incumbent is now less pressed to lower the per transaction fee charged to merchants, and, in this case, for some conditions under which no merchants choose to subscribe to the entrant's platform when only the entry of an end-to-end provider is allowed, an inner solution may appear, meaning that some, but not all, merchants may choose to subscribe to the entrant's platform.

Our results also provide some insights into the effects of the regulation. In the absence of regulation, the incumbent will want to deny the entry of a front-end service provider if the merchant benefit of payment service is lower than a cutoff level. That is, without regulation, the entry will not occur. The result implies, if other conditions such as security issues are met, that regulation of the back-end

6) Choi (2010) and Liu and Serfes (2013) derive partial multi-homing results from the horizontally dierentiated preference for platforms while we present an endogenous solution result without it.

7) We recommend a cautious interpretation of this result, however, because the eventual welfare enhancement is derived from the (assumed) lower cost of the entry with front-end service. ln addition, some may find unsatisfactory that the payment platforms take the entire additional surplus.

infrastructure provision by the incumbent may be a necessary requirement.

Baxter (1983) first proposes the idea of payment platform's charging differentiated prices to two-sided consumers, cardholders and merchants. Since Baxter (1983), many of studies in retail payments have focused on either (i) the "intercharge fee" between payment networks,[8] or (ii) the effect of legal obligations such as "no-surcharge" (e.g., Edelman and Wright, 2015) and "must-take-card" rules (e.g., Rochet and Tirole, 2011). Most of the literature has adopted a kind of two-sided market model, which is the standard approach when cross-platform externalities exist.

We build a model combining a two-sided market and vertical restraints. While the usage externality model (e.g., Rochet and Tirole, 2003) is regarded better-suited for the payment card context, we adopt the membership externality model[9] (e.g., Armstrong, 2006) for the following reasons: First, the recent retail payments market competition has been triggered by the entry of non-financial, usually information tech-based, firms whose strength is providing better user experience in payment services than the existing financial firms via online or smart devices. Unlike the previous literature, our focus is more on the competition between the retail payment platforms than the change in sales/purchase. The approach of Armstrong (2006) is more suitable in this case. Moreover, the competitive bottleneck model of Armstrong (2006) is basically the same as Rochet and Tirole (2003)[10] if there are fixed fees, and consumers use a single card, a situation that applies to our model. The integration with the vertical restraints model is simpler with the membership externality approach, and allow us to focus better on the competition between payment platforms.

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8) The role of interchange fees is the internalization of consumers' externality by imposing on the acquirer a fee paid to the issuer. Verdier (2011) provides an excellent literature survey on the issue of interchange fees.

9) The membership externality approach is originally intended for such services as media, shopping malls, and social networks where all cross-group interactions are assumed to occur via platforms. Figure 1 of Rochet and Tirole (2006) nicely describes the difference between membership and usage externalities.

10) In the analysis by Rochet and Tirole (2003), the credit card platforms levy charges purely on a per-transaction basis, and there are no lump-sum fees for either side. In a symmetric equilibrium, all retailers accept both credit cards (or neither) while consumers always use their preferred cards.

The rest of this paper is organized as follows. Section 2 describes the model. Section 3 characterizes the equilibrium when only the entry of end-to-end provider is allowed, and Section 4 does the same process when the entry of front-end provider is possible. Section 5 interprets the results and provides implications. Finally, Section 6 concludes the paper.

## 2. The Model

### 2.1. Players and Transactions

There are two payments platforms in the retail payments market: an incumbent $I$ and a potential entrant $E$. Adopting the vertical restraints context, we define an end-to-end payment service provider as a vertically integrated financial firm providing front-end services to consumers and owning its own infrastructure, including license, for the back-end services such as clearing and settlement. In contrast, a front-end provider is a downstream firm providing only front-end, or face-to-face, services for consumers such as payments acquisition and transaction finalization. In our model, $I$ is an end-to-end provider, and $E$ may enter either as an end-to-end or as a front-end provider. In the latter case, $E$ must be able to aord the back-end services provided by $I$.[11] The fee for using the incumbent's bank-end services (or leasing its infrastructure) is assumed to be affected by the regulatory requirements. Without regulation, the incumbent can determine $r$.

There are $N$ consumers, indexed by $n$, where $N$ is a sufficiently large number. The consumer's transactional benefit from the payment service by platform bears a positive cross-group externality from the share of merchants subscribing to the platform, which is the key feature of a two-sided market. Moreover, the consumer's utility is additionally affected by consumers' horizontal preferences over payments platforms, as well as the quality of the payment service from each platform. Finally, consumers can choose only one platform (i.e., single-home) for a transaction.

11) An example of this case is the relationship in the US between ApplePay, which only performs payments acquisition, and American Express.

There are $M$, which is also sufficiently large, merchants indexed by $m$. Like that of consumers, the merchants' transactional benefit from the payment service also bears a positive cross-group externality from the share of consumers subscribing to the platform. Unlike consumers, however, merchants can choose to subscribe to either (single-home) or both (multi-home) payment platforms. Specically, all merchants subscribe to the incumbent's payment platform: $s_I$ is assumed to be always 1.[12] They do not have any horizontal preference between $I$ and $E$, either.

**Assumption 2.1** *For the rest of this paper, we assume the following:*

1. *There are indefinitely repeated periods of transactions in each of which every consumer always purchases one unit product.*
2. *At each period, the types of every consumer and merchant are randomly determined, following a uniform probability distribution, along a unit circle, and matched with the nearest counterpart.*
3. *The merchants are risk-neutral, and decisions are based only on ex ante payoffs.*
4. *Products are homogenous, and all merchants charge the same price.*

Assumption 2.1 states the differences in the natures of transactional uncertainty between consumers, who single-home for payment and face no uncertainties in purchasing, and merchants, who can multi-home and face uncertainties.[13] That is, at each stage, consumers treat *transactional* charges and per *fixed* charges in the same manner, but merchants do not. Depending upon a random match result, a merchant may sell none, one or multiple products at each stage. Finally, Item 4 makes the payoff from the sale/purchase be a constant, which thus does not need to be considered in the decision making.

12) This assumption also reflects the relationship between ApplePay and AMEX, in the sense that an ApplePay user needs to already have a pre-issued AMEX card.

13) If we consider the whole life-cycle of payment, then we would need to consider the possibility of multi-homing in consumers' subscriptions to payment platforms, which would make model more complicated and less tractable. Instead, we focus here on the decision at the time of transaction, when a consumer chooses only one payment method.

### 2.2. Payoffs

The game has three stages. In the first stage the entrant makes the entry decision and, if it enters, chooses the type of entry – as either an end-to-end or front-end provider. In the second stage the incumbent and the entrant choose the fees. The actual transactions happen in the third stage, where Assumption 2.1 is applied.

The platforms charge customers $a_I^C$ and $a_E^C$, respectively, per period.[14] The consumer's transactional benefits, $b^C s_I$ and $b^C s_E$, increase with the share of merchants subscribe to each platform. Thus, $b^C$ is the value when all merchants subscribe to a payment platform. Note that $b^C$ is the same for both platforms. Next, $B_I$ and $B_E$ ($B_I < B_E$) are the consumers' maximum possible benefits from the payment services by platforms *I* and *E*, respectively. Finally, consumers have a horizontal preference over platforms and are uniformly distributed along (0, 1) indexed by individual consumer's bliss point of platform preference $x$, which is referred to as consumer *type*. The incumbent and the entrant are located at 0 and 1, respectively. The marginal cost for a difference in preference is *t*.

If a consumer of type $x$ chooses *I* and purchases a product from merchant $m$, her utility per transaction is

$$u_n^I = b^C \cdot s_I - a_I^C + B_I - t \cdot x,$$

and if $x$ chooses $E$, her utility per transaction for choosing $E$ is

$$u_n^E = b^C \cdot s_E - a_E^C + B_E - t \cdot (1 - x).$$

We define and derive *threshold type* $\hat{x}$ of consumers who are indifferent between *I* and *E* from the following equation:

14) A fixed fee for consumer in this case is meaningless because, in Assumption 2.1, a consumer is assumed to buy one unit of the product for sure in every period.

$$b^C s_I - a_I^C + B_I - t\hat{x} = b^C s_E - a_E^C + B_E - t(1-\hat{x}),$$

which leads to

$$\hat{x} = 1/2 + (b^C(s_I - s_E) - (a_I^C - a_E^C) + B_I - B_E)/(2t).$$

The consumers on the left of $\hat{x}$, or whose types are less than $\hat{x}$, choose the incumbent and those on the right of $\hat{x}$, whose types are greater than $\hat{x}$, choose the entrant. Because $\hat{x} \in (0,1)$, $\hat{x}$ and $1-\hat{x}$ also coincide their respective platform's market share. From now on, we abuse notation and use $\hat{x}$ and $1-\hat{x}$ to represent the respective platforms' market shares.

Platforms $I$ and $E$ charge merchants $a_I^M$ and $a_E^M$, respectively, for their service fee per transaction, and $F_I$ and $F_E$ as subscription or fixed fee. $b^M$ is the per transaction benefit to merchants from the payment process itself, which is the same for both $I$ and $E$. Like in the case of the consumer benefit from transaction, the merchant benefit is also aected by the share of consumers choosing the payment platform, and $b^M$ is the value when all consumers choose the service from one payment platform.

Unlike consumers, merchants are not sure about the numbers of sales. Merchant $m$'s expected payoff from sales via $I$'s payment service is

$$\pi_m^I = (N\hat{x}/(Ms_I))(p_m - c_m + b^M\hat{x} - a_I^M) - F_I,$$

and that via $E$'s payments service

$$\pi_m^E = (N(1-\hat{x})/(Ms_E))(p_m - c_m + b^M(1-\hat{x}) - a_E^M) - F_E,$$

where $\hat{x}/s_I$ and $(1-\hat{x})/s_E$ are the expected numbers of transactions and $F_I$ and $F_E$ fixed fees per period for the access to platform $I$ and $E$, respectively. If $m$ chooses to multi-home, its expected payoff per transaction is simply the sum of the expected payoffs from accessing each platform's consumer group, or $\pi_m^I + \pi_m^E$,

because the consumers cannot multi-home at the time of purchase. For simplicity, we assume that $p_m = c_m$ hereafter.

Note that, in our model, the merchant's objective function is quadratic in the payment platform's consumer share, because the cross-group externality influences both the transaction benefit, and the chance of sales. First, a greater consumer share of a platform increases the merchants' benefits from transaction processing, $b^M\hat{x}$ and $b^M(1-\hat{x})$ respectively, via the platform, by reducing the distance of matching with consumers. Second, a greater share also increases the expected numbers of consumers, $N\hat{x}/(Ms_I)$ and $(1-\hat{x})/s_E$ respectively, that visit a merchant. Because the functional form is important to deriving our result, we present our rationale as follows:

Suppose that all merchants and consumers are differentiated and randomly determined along a unit line (or circle for mathematical comprehension) and that the reciprocal of the distance between the matched merchant and consumer affects the benefit of payment services. Suppose also that the allocation of position is random for each stage, but the match between merchants and consumers is assortative (i.e., matching with the nearest neighbor). In this case, given a uniform distribution, if there are $M$ merchants, then a consumer's expected distance to the nearest merchant is proportional to $1/M$. The same logic holds for the merchants, which leads to a positive cross-group externality in the transactional benefit from payment services. For merchants, this cross-group externality is a different, if not mutually exclusive, kind of externality compared to the increased expected number of sales, which is not applicable for consumers because of the unit purchase per period assumption. Thus, the merchants' utility is a quadratic function of the share of consumers.

We now see the payment platforms' payoffs. Let $C_I$, $C_E$ and $c_E$ be the long-run average per-period costs of the incumbent, the end-to-end provider entrant, and the front-end entrant.[15] Assumption 2.2 states the relations and values of the long-run average costs.

15) The investment on the infrastructure is, of course, often done in a fixed, one-time fashion. $C_I$, $C_E$ and $c_E$ should be understood in the context of long-run average costs.

**Assumption 2.2** *(Long-run average costs per periods)*

- $C_I < C_E$ : *New networks are often hard to establish and that new entrants often have less experience and pay extra cost for leaning and adapting themselves to new environments.*
- $c_E < C_I$ : *The entrant only need to directly own the facilities for front-end service provision (or payment acquisition).*
- $C_E \geq N(t-\delta)/(16t^2)$ : *The level of 'sufficiently high' long-run average cost.*

If both the incumbent and the entrant are vertically integrated platforms, then the payoffs per period for each platform are

$$\Pi_I = N\hat{x}a_I^C + (N\hat{x}/s_I)a_I^M + F_I Ms_I - C_I, \text{ and}$$
$$\Pi_E = N(1-\hat{x})a_E^C + (N(1-\hat{x})/(Ms_E))a_E^M + F_E Ms_E - C_E,$$

respectively.

Alternatively, $E$ can choose to lease $I$'s infrastructure and pays $r$ per transaction as a fee for back-end services or a rent for the infrastructure access.[16] In that case, the payoffs per period are

$$\Pi_I = N\hat{x}a_I^C + N(1-\hat{x})r + (N\hat{x}/(Ms_I))a_I^M + F_I Ms_I - C_I, \text{ and}$$
$$\Pi_E = N(1-\hat{x})(a_E^C - r) + (N(1-\hat{x})/(Ms_E))a_E^M + F_E Ms_E - c_E,$$

respectively. Assumption 2.3 relates to the regularity conditions that enable the mathematical tractability and sensibility of the results:

16) The rent payment can be a lump sum. The payoff equations do not change at all other than through the adding and subtracting of the transfer payments to the incumbent and from the entrant, reflecting the present discount of the per-period fee.

**Assumption 2.3** *(Ranges and values of parameters)*

- $t+\delta>0$ *and* $t-b^C \leq \delta \leq -b^C/2$ *where* $\delta = B_I - B_E$*: The threshold type* $\hat{x} \geq 1$ *when* $s_E = 0$*. This also implies that the entrant's service is strictly better than the incumbent's, but the value of the incumbent's service to the consumer of type* $x=1$ *is still non-negative.*

- $b^C \geq b^M \geq t$ *and* $b^C \geq 1 \geq t$*: (i) The consumer's benefit from transaction processing service is greater than the merchant's benefit, (ii) the merchant benefit is greater than the marginal distaste(cost) of the consumer's platform preference, and (iii) the marginal distaste is smaller than the longest horizontal distance, so that all consumers choose the incumbent in the case of no new entry.*

- $2t-1 < b^M < 3t$*: The lower and upper bounds of* $b^M$ *for mathematical sensibility.*

## 3. Result: Entry with Vertical Integration

### 3.1. Payment Platforms' Choice

With Assumption 2.3, the threshold type $\hat{x}$ is rewritten as

$$\hat{x} = 1/2 + (b^C(1-s_E) - (a_I^C - a_E^C) + \delta)/(2t). \tag{1}$$

The incumbent payment platforms' payoff is then rewritten as

$$\Pi_I = N(1/2 + b^C(1-s_E) - (a_I^C - a_E^C) + \delta)/(2t))(a_I^C + a_I^M) + F_I M - C_I,$$

and the entrant's is as

$$\Pi_E = N(1/2 - b^C(1-s_E) - (a_I^C - a_E^C) + \delta)/(2t))(a_E^C + a_E^M) + F_E M s_E - C_E,$$

respectively. Note that $\Pi_I$ and $\Pi_E$ are concave quadratic functions of $a_I^C$ and $a_E^C$, but linear functions of $a_I^M$ and $a_E^M$. That is, both $I$ and $E$ set up their merchant fees up to where the merchants' profits bind at zero.

A merchant's payoffs from a sale via payment platform $I$ and $E$, after plugging in $\hat{x}$ derived from Eq.(1) and $s_I = 1$, are

$$\pi_m^I = \frac{Nb^M}{M}(1/2 + (b^C(1-s_E) - (a_I^C - a_E^C) + \delta)/(2t))^2 - \frac{Na_I^M}{M}(1/2 + (b^C(1-s_E) - (a_I^C - a_E^C) + \delta)/(2t)) - F_I$$

and

$$\pi_m^E = \frac{Nb^M}{Ms_E}(1/2 - (b^C(1-s_E) - (a_I^C - a_E^C) + \delta)/(2t))^2 - \frac{Na_E^M}{Ms_E}(1/2 - (b^C(1-s_E) - (a_I^C - a_E^C) + \delta)/(2t)) - F_E,$$

respectively.

All merchants' collective subscription decision to the entrant's platform determines the value of $s_E$ in equilibrium. Note that, by controlling the value of per period fee $F_E$, the entrant always makes the merchants' participation constraint binds at zero. (i.e., $\pi_m^E = 0$) In this case, the collective subscription decision result in equilibrium is the same as the (marginal) merchant's subscription decision to the entrant's platform, which is determined by the zero-profit constraint $\pi_m^E = 0$ (if $s_E > 0$) and the first order condition $\partial \pi_m^E / \partial s_E = 0$, or non-negative if $s_E = 1$.

We now investigate the payment platforms' choice of fees. The first order condition for the incubment's choice of merchant fee $a_I^M$

$$\frac{\partial \Pi_I}{\partial a_I^M} = N(1/2 + (b^C(1-s_E) - (a_I^C - a_E^C) + \delta)/(2t))$$

is always either positive or negative, regardless of the value of $a_I^M$. That is, $a_I^M$ is a corner solution. The corner solution result is the same for the entrant's first order condition, which is

$$\frac{\partial \Pi_E}{\partial a_E^M} = N(1/2 - (b^C(1-s_E) - (a_I^C - a_E^C) + \delta)/(2t)).$$

The first order condition for the incumbent's choice of consumer's fee is

$$\frac{\partial \Pi_I}{\partial a_I^C} = N(1/2 + (b^C(1-s_E) - (a_I^C - a_E^C) + \delta)/(2t)) - N(a_I^C + a_I^M)/(2t) = 0,$$

which can be rewritten as

$$t + b^C(1-s_E) + a_E^C + \delta = 2a_I^C + a_I^M.$$

The first order condition for the entrant's choice is

$$\frac{\partial \Pi_E}{\partial a_E^C} = N(1/2 - (b^C(1-s_E) - (a_I^C - a_E^C) + \delta)/(2t)) - N(a_E^C + a_E^M)1/(2t) = 0,$$

which can be rewritten as

$$t - b^C(1-s_E) + a_I^C - \delta = 2a_E^C + a_E^M,$$

respectively.

### 3.2. Merchants' Decision on Multi-homing

With a competitive bottleneck on the consumer side, the incumbent wishes to minimize the consumers' fee and increase the consumer share while recoup the revenue from merchants. The incumbent will set $a_I^C = 0$ and $a_I^M = t + b^C(1 - s_E) + \delta$ with the first order condition of $a_I^M > 0$.

We separate two cases (i) $b^M - 2t < 0$ and (ii) $b^M - 2t > 0$. The first case, of a low merchant benefit, may reflect the feature of offline transactions, where face-to-face transactions lead to a depreciation in the value of service from retail payments platform. The second case of a high merchant benefit, is suitable for online and mobile transactions, where receiving service from the payment platform is a must.

$$Case\ I\text{: } b^M - 2t < 0$$

The first order condition for all merchants' collective, or the marginal merchant's, subscription decision is

$$\begin{aligned}\frac{\partial \pi_m^E}{\partial s_E} =& -(b^M - 2t)(1/2 - (b^C(1 - s_E) + \delta + a_E^C)/(2t))^2 \\ &+ (b^M - 2t)(1/2 - (b^C(1 - s_E) + \delta + a_E^C)/(2t))b^C s_E/t \\ &- a_E^C(1/2 - (b^C(1 - s_E) + \delta + a_E^C)/(2t)) + a_E^C b^C s_E/(2t) = 0,\end{aligned}$$

which leads to the following equation

$$s_E^2 = \left(\frac{a_E^C - t + b^C + \delta}{b^C}\right)^2 - \frac{2ta_E^C(a_E^C - t + b^C + \delta)}{(b^M - 2t)(b^C)^2}\ .$$

The greater value of $a_E^C$ leads to the greater level of $s_E$, the share of merchants subscribing to the entrant's platform. Thus, $s_E = 1$, $a_E^C = (t - \delta)/2$, $a_E^M = 0$, and $F_E = Nb^M(t - \delta)/(16t^2M)$.

The entrant's payoff is

$$\Pi_E = N(2t - b^M)(t-\delta)^2/(16t^2) - C_E,$$

which leads to propositions:

**Proposition 1** *When $b^M - 2t < 0$ , no entry occurs as long as Assumption 2.2 is satisfied. If the assumption about the value of $C_E$ is not satisfied, an entry occurs and all merchants choose to multi-home.*

In practice, it is uncommon to observe any new payment platform charging positive consumer fees. Our result here implies that the long-run average cost for a potential entrant may be actually high enough to give up the entry.

$$Case\ II: b^M - 2t < 0$$

Unlike Case I, the value of $s_E$ now decreases in $a_E^C$. The consumers' fees of both platforms are zero, and $a_I^M$ and $a_E^M$ are as follows:

$$a_I^M = t + (b^C(1-s_E) + \delta$$

and

$$a_E^M = t - (b^C(1-s_E) + \delta.$$

$\pi_m^E$ is then rewritten as

$$\frac{N(b^M - 2t)}{Ms_E}(1/2 - (b^C(1-s_E) + \delta)/(2t))^2 - F_E.$$

The merchant's payoff is convex quadratic and, thus, the optimal share of subscription to the entrant's platform binds at $s_E = 1$. The first order condition for a merchant's subscription to the entrant's platform is

$$\frac{\partial \pi_m^E}{\partial s_E} = -\frac{N(b^M - 2t)}{M(s_E^2)}(1/2 - (b^C(1-s_E)+\delta)/(2t))^2 + \frac{2N(b^M-2t)}{Ms_E}(1/2-(b^C(1-s_E)+\delta)/(2t))\frac{b^C}{(2t)} = 0,$$

and we thus have

$$s_E = 1 - (t-\delta)/b^C,$$

which is the critical mass the entrant needs to reach for a successful entry. It is greater than zero, and less than one.

The merchant fees are derived as $a_I^M = t+\delta$ and $a_E^M = t-\delta$, respectively, and the threshold, or the incumbent's consumer market share, is $\hat{x} = 1/2 + \delta/(2t)$. Plugging in these values, we know that the value of a merchant's benefit from the entrant's payment services $N/M(b^M - 2t)(1/2 - \delta/(2t))^2$ is greater than zero. The entrant sets $F_E$ as this value, so that $\pi_m^E$ becomes zero. The merchant benefit from the incumbent's service, $N/M(b^M - 2t)/(4t^2)(t+\delta)^2$, is also greater than zero, and by the same logic the incumbent sets $F_I$ as this value so that $\pi_m^I$ is zero.
The incumbent's payoff, $\Pi_I$, is

$$\Pi_I = N(1/2 + \delta(2t))(t+\delta) + N(b^M - 2t)/(4t^2)(t+\delta)^2 - C_I,$$

and the entrant's payoff, $\Pi_E$, is

$$\Pi_E = N(1/2 - \delta(2t))(t-\delta) + N(b^M - 2t)/(4t^2)(t-\delta)^2 - C_E.$$

While the entrant's revenue is greater than the incumbent, note that the result for the entrant is achieved out of assumptions resulting in a corner solution $s_E = 1$ derived from the first order conditions. If for some reason $s_E < 1$ at the time of entry, the merchant fee and revenue will decrease, possibly to lower than $C_E$, which is assumed to be greater than $C_I$. In addition, the entrant's cost $C_E$ is

assumed to be greater than the incumbent's cost $C_I$, whose market share is certainly established at $s_I = 1$.

The following proposition summarizes the results:

**Proposition 2** *When $b^M - 2t > 0$, an entry occurs and every merchant subscribes to both payment platforms (i.e., multi-home).*

One plausible interpretation of the results of this section is that $b^M - 2t < 0$ is a case of merchants' benefit per offline transaction from payments service, and $b^M - 2t > 0$ is the case of the benefit per online or mobile transaction. That is, the current buzz about online-to-offline (O2O) payment services by non-financial firms such as Alipay, which extend online end-to-end payment services to offline transactions, may not turn out to be a real success unless those services increase the value of the benefit per transaction to merchants.[17] On the other hand, if the value to merchants is greater than a certain level, O2O payment services will become widespread.

## 4. Results: Entry with Front-end Service Only

### 4.1. Payment Platforms' Choice

Suppose first that the back-end service, or the infrastructure access, fee $r$ paid to the incumbent is exogenously determined, but that the incumbent can still control the per transaction fees of consumers and merchants, $a_I^C$ and $a_I^M$, respectively, as well as the merchant's fixed fee $F_I$ per period as in the previous section. The same conditions apply to the entrant, too.

17) Decreasing the value of $t$ also generates the same effect. In this paper, however, we assume that $t$ is an intrinsic value to consumers and cannot be changed by either payment platforms or merchants, which is a common assumption in a linear city model.

With the entry of a front-end service only provider, the incumbent's payoff is now

$$\begin{aligned}\Pi_I = & N(1/2 + b^C(1-s_E) - (a_I^C - a_E^C) + \delta)/(2t))(a_I^C - a_I^M) \\ & + N(1/2 - (b^C(1-s_E) - (a_I^C - a_E^C) + \delta)/(2t))r + F_I M - C_I\end{aligned}$$

and the entrant's is

$$\Pi_E = N(1/2 - (b^C(1-s_E) - (a_I^C - a_E^C) + \delta)/(2t))(a_E^C + a_E^M - r) + F_E M s_E - c_E.$$

The first order conditions for the choice of consumers' fees are

$$\begin{aligned}\frac{\partial \Pi_I}{\partial a_I^C} = & N(1/2 + (b^C(1-s_E) - (a_I^C - a_E^C) + \delta)/(2t))(a_I^C + a_I^M) \\ & - N(2t)(a_I^C + a_I^M - r) = 0, \text{ and} \\ \frac{\partial \Pi_E}{\partial a_E^C} = & N(1/2 - (b^C(1-s_E) - (a_I^C - a_E^C) + \delta)/(2t)) \\ & - N/(2t)(a_E^C + a_E^M - r) = 0,\end{aligned}$$

respectively, which can be rewritten as

$$\begin{aligned}& t + b^C(1-s_E) + a_E^C + \delta + r = 2a_I^C + a_I^M, \text{ and,} \\ & t - b^C(1-s_E) + a_I^C - \delta + r = 2a_E^C + a_E^M.\end{aligned}$$

These first order conditions show that both payment platforms will increase (aggregate) fees by $r$, compared with the results in the previous section. Unlike the previous section, both payment platforms may choose to charge consumers positive fees because of the rent $r$.

Note that the first order conditions for the choice of merchants' fees

$$\frac{\partial \Pi_I}{\partial a_I^M} = N(1/2 + (b^C(1-s_E) - (a_I^C - a_E^C) + \delta)/(2t))$$

and

$$\frac{\partial \Pi_E}{\partial a_E^M} = N(1/2 - (b^C(1-s_E) - (a_I^C - a_E^C) + \delta)/(2t))$$

are the same as in the previous section, which implies that $a_I^M$ and $a_E^M$ are corner solutions, too. We first assume no-surcharge rule for comparability with the case of the entry of an end-to-end provider, and then show that the equilibrium result actually satisfies the first order conditions $\partial \Pi_I / \partial a_I^M > 0$ and $\partial \Pi_E / \partial a_E^M > 0$, respectively.

For consumers, the inclusion of $r$ does not affect their decision as long as the consumer fee is zero, and the threshold type

$$\hat{x} = 1/2 + (b^C(1-s_E) + \delta)/(2t)$$

is the same as what we derived in the previous section. On the other hand, the merchant charges are increased by $r$ as

$$a_I^M = t + (b^C(1-s_E) + \delta) + r \text{ and}$$
$$a_E^M = t - (b^C(1-s_E) + \delta) + r,$$

respectively.

### 4.2. Merchants' Choice on Multi-homing

A merchant's payoff from the incumbent's payment service is

$$\pi_m^I = N/M(b^M - 2t)(1/2 + (b^C(1-s_E) + \delta)/(2t))^2 - N/M(1/2 + (b^C(1-s_E) + \delta)/(2t))r - F_I$$

and it is

$$\pi_m^E = \frac{N(b^M - 2t)}{Ms_E}(1/2 - (b^C(1-s_E) + \delta)/(2t))^2 + \frac{2Ntr}{Ms_E}(1/2 - (b^C(1-s_E) + \delta)/(2t)) - F_E$$

from the entrant's payments service. As in the previous section we separate the two cases:

$$Case\ I\text{: } b^M - 2t < 0$$

The first order condition for a merchant's subscription decision to the entrant's platform is

$$\begin{aligned}\frac{\partial \pi_m^E}{\partial s_E} = &- \frac{N(b^M - 2t)}{Ms_E^2}(1/2 - (b^C(1-s_E)+\delta)/(2t))^2 \\ &+ \frac{2N(b^M - 2t)}{Ms_E}(1/2 - (b^C(1-s_E)+\delta)/(2t))\frac{b^C}{2t} \\ &- \frac{2Ntr}{Ms_E^2}(1/2 - (b^C(1+\delta)/(2t)) = 0.\end{aligned}$$

This first order condition is rewritten as

$$(b^M - 2t)(b^C)^2 s_E^2 - (b^M - 2t)(t - b^C - \delta)^2 - 4t^2 r(t - b^C - \delta) = 0$$

which should lead to the solution $s_E^*$,

$$s_E^* = \frac{1}{b^C}\sqrt{(t - b^C - \delta)^2 + \frac{4t^2 r(t - b^C - \delta)}{(b^M - 2t)}}\ .$$

The value of $s_E^*$ is larger than the value of the critical mass derived in the previous section, which is $1 - (t-\delta)/b^C$. $s_E^*$ still can be less than one, depending on parameters, which implies a partial multi-homing result in equilibrium. Note that the entrant may need to compensate for the losses of merchants from sales by making $F_E$ negative in this case.

Now we have $\hat{x} = 1/2 + (b^C(1-s_E^*)+\delta/(2t)$, $a_I^M = t + (b^C(1-s_E^*)+\delta) + r$, and $a_E^M = t - (b^C(1-s_E^*)+\delta) + r$. Knowing that $F_I$ and $F_E$ are set so that merchants have zero payoffs, $F_I$ is derived from

$$\pi_m^I = \frac{N}{M}\hat{x}(b^M\hat{x} - a_I^M) - F_I = 0,$$

which leads to

$$F_I = N/M(b^M - 2t)(1/2 + (b^C(1 - s_E^*) + \delta)/(2t))^2 - N/M(1/2 + (b^C(1 - s_E^*) + \delta)/(2t))r.$$

Likewise $F_E$ is derived from

$$\pi_m^E = \frac{N(1-\hat{x})}{Ms_E^*}(b^M(1-\hat{x}) - a_E^M) - F_E = 0,$$

which leads to

$$F_E = \frac{N(b^M - 2t)}{Ms_E^*}(1/2 - (b^C(1 - s_E^*) + \delta)/(2t))^2 + \frac{2Ntr}{Ms_E^*}(1/2 - (b^C(1 - s_E^*) + \delta)/(2t)).$$

Finally, the incumbent's and the entrant's payoffs are

$$\Pi_I = 2Nt(1/2 + (b^C(1 - s_E^*) + \delta)/(2t))^2 + Nr + F_I M - C_I, \text{ and}$$
$$\Pi_E = Nb^M(1/2 - (b^C(1 - s_E^*) + \delta)/(2t))^2 + Nr(2Nt - 1)(1/2 - (b^C(1 - s_E^*) + \delta)/(2t)) - c_E,$$

respectively. Unlike the case of the previous section, now $\Pi_E$ can be positive and $t - b^C(1 - s_E^*) - \delta > 0$ is satisfied, depending on the values of parameters. That is both $\partial\Pi_I/\partial a_I^M > 0$ and $\partial\Pi_E/\partial a_E^M > 0$ are satisfied.

Given that the incumbent provides the back-end infrastructure to the entrant with an exogenous $r$, the following proposition summarizes the result in the case of front-end only entry:

**Proposition 3** *If $b^M - 2t < 0$, then unlike in the case of entry with vertical integration (or as an end-to-end provider), there exists a partial multi-homing equilibrium where some, but not all, merchants choose to subscribe to both platforms.*

*Case II*: $b^M - 2t > 0$

The value of $s_E^*$, derived from the first order condition, is now the critical mass initially required for successful entry. For any $s_E > s_E^*$, the first order condition is positive, which leads to the corner solution $s_E^* = 1$. If there is no real-valued solution for $s_E^*$, the first order condition is always positive for $s_E \in [0,1]$. That is, no critical mass is necessary and every merchant chooses multi-home.

Knowing that the equilibrium share of the merchant's subscription binds at $s_E = 1$, the threshold type is the same as in the previous section, $\hat{x} = 1/2 + \delta/(2t)$, and the merchants' fees are $a_I^M = t + \delta + r$ and $a_E^M = t - \delta + r$, respectively. After plugging in these values, the merchant's fixed fees for the incumbent's payment service is derived from

$$\pi_m^I = N/M(b^M - 2t)(1/2 + \delta/(2t))^2 - N/M(1/2 + \delta/2t))r - F_I,$$

and that for the entrant's is

$$\pi_m^E = N/M(b^M - 2t)(1/2 - \delta/(2t))^2 - N/M(1/2 - \delta/(2t))r - F_E.$$

Finally, the platforms' profits are

$$\Pi_I = Nb^M(1/2 + \delta/(2t))^2 + N(1/2 - \delta/(2t))r - C_I$$

for the incumbent, and

$$\Pi_E = Nb^M(1/2 - \delta/(2t))^2 - N(1/2 - \delta/(2t))r - c_E$$

for the entrant.

**Proposition 4** *If* $b^M - 2t > 0$, *the corner solution,* $s_E = 1$, *is reached: all merchants choose to subscribe to both platforms in equilibrium. The critical mass of merchants' subscription sometimes needs to be reached, depending upon the values of the parameters.*

## 5. Regulatory Implications

Previous studies such as Iacobucci (2014) note that the single monopoly profit theory does not necessarily hold in two-sided market settings. Thus, we need to check whether the incumbent has an incentive to voluntarily provide the back-end services or the infrastructure access to the entrant. Note that, with respect to the rent $r$, the incumbent's payoff:

$$\Pi_I = 2Nt(1/2 + (b^C(1 - s_E^*) + \delta)/(2t))^2 + Nr + F_I M - C_I$$

is either monotone increasing or U-shaped. The entrant's payoff:

$$\Pi_E = N(1/2 - (b^C(1 - s_E^*) + \delta)/(2t))(t - (b^C(1 - s_M^*) + \delta) - r) + F_E M s_E^* - c_E$$

is also either monotone decreasing or hump-shaped, depending on parameters. Let $r_E^*$ be the value of $r$ that makes $\Pi_E$ zero.

If $b^M - 2t < 0$, assuming that the incumbent has bargaining power and that $c_E$ is sufficiently low, a profitable entry is possible. However, the value of $r_E^*$ does not exceed $b^C s_E^* (t + b^C + \delta - b^C s_E^*)/(2t)$, which is the value of the rent that enables the incumbent to earn the monopoly profit, derived from setting $s_E^* = 0$ and $r = 0$.[18] That is, the incumbent does not wish to voluntarily provide its back-end service to the entrant, or allow the entrant to access to its infrastructure, which

18) It is intractable to derive $r_E^*$ directly from $\Pi_E = 0$, but we can see that the rent $r = b^C s_E^* (t + b^C + \delta - b^C s_E^*)/(2t)$ makes the value of $\Pi_E$ negative.

may raise an issue of the need for regulation of the rent.

If $b^M - 2t > 0$, assuming that the incumbent has bargaining power, it sets $r$ up so that the entrant is indifferent between the entries as an end-to-end provider and as a front-end provider. Each payment platforms' market share of consumers and the merchants' payoffs, which are zero, is not affected by the type of entry. That is, the entrant takes the entire enhanced surplus as well as some revenue from the incumbent. Regulatory agencies may regard this situation undesirable and require adjustments of merchant fees to redistribute the increased surplus. No-surcharge rule assumed in the previous section can be an example of regulation to address this issue.

In all, without any regulatory obligation, if $b^M - 2t < 0$, the incumbent does not provide its back-end services to the entrant. On the other hand, if $b^M - 2t > 0$, the incumbent voluntarily provides its back-end services so that the entrant is indifferent between entry as an end-to-end provider and as a front-end one.

## 6. Concluding Remarks

We investigate the effects of non-financial firms' entry into the retail payments market, the existing firms' response, and the equilibrium from the perspectives of vertical restraints and duopolistic competition. With cross-platform externalities in transaction processing, horizontal preference for payment services, and unit purchases of homogenous good by consumers, we have the following results. First, in the case when only the entry of an end-to-end provider is possible, either all merchants multi-home or no entry occurs, with or without the mandatory provision of the back-end infrastructure. In the case of the entry of a front-end service provider, on the other hand, a partial multi-homing equilibrium result can emerge under proper exogenous conditions. In the absence of regulation, however, a vertically integrated incumbent wishes to fore closure the entry if the entrant has no alternative way of accesing the infrastructure for back-end service.

The Case of low merchant benefit may reflect the necessity of payments service in offline transactions, where face-to-face situations reduce the value of payments

service. The case of high merchant benefit may, on the other hand, reflect the different situation of online and mobile transactions, where the service from payment platforms is a must for the completion of transactions.

Due to its proximity to end-users, existing financial firms in the retail payments market often regard new entries of non-financial firms as more of threats and target of competition than cooperation, and vice versa. The results, however, shows that cooperation and partial integration between financial and non-financial firms can be beneficial for the overall welfare.

The results also imply that mandatory back-end infrastructure provision may be necessary, if other conditions such as security issues are met. in the sense that the consumer's benefit increases when an entry occurs, and overall welfare grows due to the reduced costs of investment by the entrant. Note that when the merchants' benefit from payment services is sufficiently high (i.e., $b^M - 2t > 0$), the market shares of consumers and the merchants' payoffs are not affected by the type of entry. That is, payment platforms take the entire enhanced surplus. Regulatory agencies may find this situation unsatisfactory and consider regulatory measures such as no-surcharge rule and adjustments of merchant fees in order to redistribute the increased surplus.

We admit that there are some caveats concerning our model. There is a couple of less-realistic assumptions which simplify the settings and provide consistency in modeling, which in turn help us to focus on the competition between platforms. One is the unit demand and exogenous price assumptions, which eliminate the need for considering any changes in the demand and supply. Another one is that merchants' differentiated preference for consumers. In practice, it may come mostly from geographical causes, such as delivery costs, which may be a tiny factor for offline merchants. We also want to note that our results are drawn under several assumptions and should thus be interpreted with caution. For example, the overall welfare implications are derived from the assumption of a lower entry cost of the front-end only provider. At this point, we leave these drawbacks as topics for future research.

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## <Abstract in Korean>

# 비금융기업의 진입이 소액결제시장에 미치는 영향

**전주용***

본 연구는 비금융기업의 진입에 따른 소액결제 시장에서의 경쟁구도 변화 및 시장 영향에 대하여 이론 모형을 수립 및 분석하고 시사점을 도출한다. 결제 관련 인프라를 보유한 기존의 소액결제 사업자와 신규로 시장에 진입하고자 하는 비금융 핀테크 기업 간 복점(duopoly)경쟁을 중심으로 양면 시장 및 수직 제약(vertical restraints) 특성을 반영하는 이론 모형을 수립하여, 다음과 같은 분석 결과를 얻었다.

우선, 수직결합 형태(end-to-end)의 신규 진입은 지급결제 서비스로부터 얻는 판매자 효용이 일정 수준 이상일 경우만 발생하게 되며, 이 때 모든 판매자는 기존 및 신규 지급 플랫폼에 대한 동시 가입(multi-home)을 택하게 된다. 반면, 기존 사업자가 보유하고 있는 인프라를 임차하고 신규 진입자는 직접적인 대고객(front-end) 서비스만 제공하는 형태의 진입은 수직결합 형태의 진입이 발생하기 어려운 판매자 효용 수준에서도 일어날 수 있다. 이 경우 일부 판매자들은 양쪽 서비스를 동시에 가입하고, 그 외의 판매자들은 기존 플랫폼만 가입하게 되는 부분 동시가입(partial multi-home)이 나타날 수 있음을 보인다. 신규 지급결제 사업자가 대고객 서비스 형태와 수직결합 형태의 진입이 모두 가능한 상황에서는 대고객 서비스 형태 진입 시 후생이 더 높게 나타나며, 이는 수직결합 형태 진입 시 요구되는 투자비용의 절감이 가능해진다는 점에 기인한다.

끝으로, 결제서비스로부터 얻는 판매자 효용이 일정 수준 이하일 경우, 기존 사업자는 신규 사업자가 자신의 인프라를 임차하는 것을 거부할 동기를 갖게 될 수 있다. 이는 수직 봉쇄(vertical foreclosure) 시도에 대한 규제 필요성이 존재할 수 있음을 시사한다.

핵심주제어: 핀테크, 진입, 소액결제, 대고객 서비스, 수직 제약
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