Strategic investments under competition for access provision

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\textbf{ABSTRACT}

We examine competition for access provision when symmetric vertically integrated firms invest in infrastructure upgrades. Spillovers through access have two effects (a \textit{wholesale-profit effect} and a \textit{retail-production effect}) on infrastructure investment made by vertically integrated firms. When the vertically integrated firms freely set access charges, due to the dominance of the wholesale-profit effect, quality differentials endogenously occur between these firms (asymmetric equilibria). When access charges are regulated, symmetric equilibria occur with multiple equilibrium investments due to the retail-production effect. Because competition for access provision induces a strong incentive for infrastructure investment, it also achieves a higher social welfare than does access regulation.

\textbf{1. Introduction}

In this paper, we examine wholesale competition in industries where vertically integrated firms (or facility-based firms) and unintegrated downstream firms (or service-based firms) coexist. Wholesale competition in industries with two-tier structures abounds in the business world. A typical example is found in the telecommunications industry. In broadband markets, facility-based firms, such as regional telephone companies or cable TV companies, have their own infrastructures to provide Internet services to customers, while service-based firms, such as independent Internet service providers, need to borrow infrastructure to offer the services to their customers. In the retail market (i.e., the Internet market), there exists competition that includes not only facility-based firms but also service-based firms. In mobile communications markets, mobile virtual network operators (MVNO, service-based firms) need to purchase wholesale mobile services from mobile network operators (MNO, facility-based firms) to offer mobile services to their end users. All these firms, including MVNOs and MNOs, compete with each other in the retail market.\textsuperscript{1} In addition, further investments for 5G network deployment are also required in mobile markets.

There are two approaches in the existing studies that examine two-tier competition with several vertically integrated firms (facility-based firms) and unintegrated downstream firms (service-based firms). The first approach focuses on vertically integrated firms’ incentive to grant access to their infrastructures to unintegrated firms. Ordover and Shaffer (2007) find that unintegrated firms are likely to obtain access when inputs are homogeneous (i.e., their products are not horizontally differentiated). Höfler and Schmidt (2008) ask

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\item The licensing of intellectual property provides another example of competition within two-tier structures. In licensing markets, firms that own their IP-protected technologies can be considered vertically integrated firms (facility-based firms). They decide whether to license their technologies to potential rival firms, and if they license their technologies, they compete with potential rivals (service-based firms) in product markets.
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whether granting access to unintegrated downstream firms always enhances social welfare. They find that if final products supplied in a downstream market are horizontally product-differentiated, resale (i.e., granting access to unintegrated downstream firms) can be harmful to consumers. Brito and Pereira (2009, 2010) examine the endogenous determination of horizontal product differentiation and show the possibility of high retail prices and the realization of asymmetric product differentiation in the sense that both an entrant and an access provider prefer a closer substitute of products between them to a substitute of products between the entrant and other vertically integrated firms.

The second approach examines the (non-)necessity of regulatory intervention under the wholesale competition among vertically integrated firms. Bourreau, Hombert, Pouyet, and Schutz (2011) find that competition between vertically integrated firms can induce the input to be priced above marginal costs even when the firms offer a homogeneous input. They discuss the impacts of several regulatory tools such as a wholesale price cap and vertical separation. Bourreau, Cambini, and Hoernig (2015) compare the effect of uniform access pricing on investment in rolling out infrastructure with that of deregulating access price in a geographical setting.

This paper proposes a different model that relates to the second approach by shedding light on the following three aspects. First, in our model, two vertically integrated firms have an opportunity to invest in the upgrades of inputs, called infrastructure upgrades. Second, through the infrastructure upgrades, the quality of services supplied downstream is endogenously determined, which means that the relative magnitude of vertical product differentiation among the services provided by all firms is endogenously determined. Third, we introduce various degrees of spillovers generated from infrastructure upgrades through access, and the benefits of the upgrades to an unintegrated downstream firm depends on the degree of spillovers through access. In an open access environment, the degree of spillovers through access is interpreted as the relative inferiority or superiority of an unintegrated firm's retail production technology compared with that of a vertically integrated firm that it accesses.

Featuring these three aspects gives new insight on wholesale competition for access provision. In fact, when vertically integrated firms compete for access provision in the wholesale market and have an opportunity to invest in infrastructure upgrades, the likelihood that a vertically integrated firm is accessed by an unintegrated downstream firm depends on the investment level of its rival vertically integrated firm. This is because an unintegrated downstream firm wants to access a firm that generates the greatest benefits generated from infrastructure upgrades among vertically integrated firms. Then, because of the existence of access profits, the profit obtained by a vertically integrated firm can change discontinuously according to the investment level of its rival. This in turn implies that the investment of the vertically integrated firm cannot change smoothly according to the investment level of its rival (i.e., the non-smoothness of a vertically integrated firm's reaction function).

We show that the non-smoothness of a vertically integrated firm's reaction function emerges from the two opposite effects generated from spillovers of infrastructure upgrades when the firm is accessed by an unintegrated downstream firm. The first effect is the wholesale-profit effect, and the second is the retail-production effect. The wholesale-profit effect means that one vertically integrated firm can obtain access profit in the wholesale market by giving an unintegrated downstream firm a more favorable term than its rival on the benefit of spillovers. This wholesale-profit effect has a positive impact on a vertically integrated firm's incentive to invest in infrastructure upgrades. The retail-production effect means that an unintegrated downstream firm can obtain the benefit of enhancing its retail production without investment, which has a negative impact on the incentive to invest in infrastructure upgrades. The relative magnitudes of these two effects determine whether a vertically integrated firm is willing to invest more when it is accessed than when it is not accessed.

In particular, in the free competition regime in which access charges are not regulated, each of the vertically integrated firms has a stronger incentive to invest in infrastructure upgrades when it is accessed than when it is not accessed: the wholesale-profit effect dominates the retail-production effect when a vertically integrated firm is accessed by an unintegrated downstream firm. In this case, an analytical result similar to that in a preemption game is derived. That is, asymmetric equilibria occur, where a vertically integrated firm that is accessed by an unintegrated downstream firm invests more than does a vertically integrated firm that is not accessed. This means that vertical quality differentials occur in equilibrium between vertically integrated firms that have the same technologies ex ante.

In contrast, in the access regulation regime with regulatory non-commitment, an access charge is set equal to the access cost (a cost-based access charge) by a regulator. In that case, the wholesale-profit effect does not appear, whereas the retail-production effect remains. Then, a vertically integrated firm has a stronger incentive to invest in infrastructure upgrades when it is not accessed by an unintegrated downstream firm than when it is accessed. In that case, each vertically integrated firm is unwilling to invest in infrastructure upgrades or to be accessed by an unintegrated downstream firm. As a result, symmetric investments emerge in equilibrium in the access regulation regime.

Furthermore, the difference in the relative magnitudes of the wholesale-profit effect and the retail-production effect in the two regimes generates the difference in total investment levels in equilibrium. In fact, comparing the total investment between the two regimes, we show that the free competition regime achieves a larger total investment in infrastructure upgrades than the access regulation regime does. This result in turn indicates a higher social welfare in the free competition regime than in the access regulation regime. Therefore, building a simple but solid model, we provide a theoretical justification for the policy recommendation that when there is effective competition in the wholesale broadband market, access regulation should be removed (see Ofcom (2013)). Furthermore, based on a sample of OECD countries, Bouckaert, van Dijk, and Verboven (2010) show that inter-platform competition contributes to broadband penetration. Our analytical results are also consistent with their empirical evidence. Similarly, in the mobile communications market, the wholesale access regulation should not be introduced for the deployment of 5G networks.

2 Although Bourreau et al. (2015) address an integrated firm’s investment incentive, they implicitly assume that an unintegrated downstream firm can obtain the same level of benefits generated from infrastructure upgrades as an integrated firm does.

3 See also Williamson, Lewin, and Wood (2016).
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