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Access pricing, competition, and incentives to migrate from "old" to "new" technology ☆

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ABSTRACT

In this paper, we analyze the incentives of an incumbent and an entrant to migrate from an "old" technology to a "new" technology, and discuss how the terms of wholesale access affect this migration. We show that the coverage of the new technology varies non-monotonically with the access price of the old technology: a higher access charge on the legacy network pushes the entrant firm to invest more, but has an ambiguous effect on the incumbent's investments, due to two conflicting effects: the wholesale revenue effect, and the retail-level migration effect. When the new technology is also subject to access provision, we find that migration from the old to the new generation network at the wholesale level can be incentivized if a positive correlation between the access prices (to the two old and new generation networks) is maintained.

1. Introduction

In network industries, and in particular telecommunications, the typical regulatory instrument used to limit market power and sustain competition at the retail level mandates access to existing (essential) infrastructures that are mainly operated and maintained by incumbent firms. While access regulation plays a fundamental role in promoting competition in the short-run, it can also have a significant impact on the incumbent firms' incentives to upgrade their infrastructure. Furthermore, terms of access to the legacy networks can impact both the incumbent and the entrant firms' incentives to invest in new alternative infrastructures,[1] and hence, shape the transition from old technology infrastructures to new ones.

The transition from "old" to "new" infrastructures often does not happen instantaneously. In the broadband telecoms industry, the evidence suggests a rather slow transition from the old generation (copper) to the new generation (fiber) networks (EC-DGInfo, 2011). The transition phase is then characterized by the coexistence of different generation infrastructures, where the investment incentives are shaped by the terms of access to the existing infrastructure, and possibly by those to the new infrastructure. The analysis of how the terms of access to the old technology affect investments in the new technology, as well as the interplay between the access terms to both networks, has been largely ignored in the recent literature, where the main focus has been on the impact of access regulation of either old or of new infrastructures on the investments by either the incumbent or the entrant firms. While the settings with this focus are most appropriate for the industries where the new technologies replace the old technology instantaneously, they are not suitable for addressing interesting research questions in industries where different generations of technologies coexist—at least during the transition phase. The main question we address in this

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[1] See Valletti (2003) for the review of the theoretical literature, and see Cambini and Jiang (2009) for a more recent and comprehensive survey.

paper is as follows: How do access requirements of an old generation network affect both the incumbent and the entrant firms' incentives to invest in the new generation network? We extend the same question to the context where access to the new generation network is also possible.

In the stream of literature to which we aim to contribute, the majority of papers fall into either one of two groups.[2] One set of papers consider only the entrant firm as a potential investor, and therefore, study the impact of access regulation (of the incumbent's network) only on the entrant's incentives to invest.[3] Another set of papers considers both the entrant and the incumbent firms' incentives to invest, but nevertheless ignores the migration issue.[4] This latter set of papers mainly explores the optimal access scheme in terms of the timing of investments in a setting where the investment decisions are "zero–one" in nature. Various recent studies, namely, Klumpp and Su (2010), Nitsche and Wiethaus (2011), and Brito et al. (2010), address the problem of investment and access regulation in a different vein, and yet, neglect the effect of migration from old to new infrastructures and how access regulation affects the decision to enter into one segment of the market. Brito et al. (forthcoming), which is the most similar paper to ours, focuses on the nature of innovation (which can be either drastic or non-drastic) and considers a new technology that is not subject to access.

While overlooked in the theoretical literature, the migration issue has recently received considerable attention in the policy arena and is a hotly debated topic at the EU level.[5] Existing proposals made by market specialists appear to be in sharp contrast to one another. For example, in a recent report prepared by WIK (2011) for the European Competitive Telecommunication Association (ECTA), WIK proposes to decrease the access price to legacy (copper) networks to encourage entrants to invest in new (fiber) networks, and to allow a rapid switch-off of the copper networks where the fiber is already installed. In contrast to WIK (2011), the report prepared by Plum (2011) for the European (incumbent) Telecommunications Network Operators (ETNO) states that a lower copper price would discourage investments to next-generation access networks because it would encourage customers to remain on copper networks, thereby negatively impacting the fiber business case. Moreover, Plum proposes to set a direct link between the regulated access price of the legacy network and the regulated access price of the new network. Both documents show that not only do the access prices of the high-tech infrastructure have an impact on the incentive to invest in the new network, but also the access price to the old (legacy) network has a major influence on the transition to the new networks. However, the direction of this link is still unclear and not theoretically based.

In this paper we consider a setting where access to an existing old generation network (OGN) is available everywhere within a country, and an incumbent and an entrant compete for providing retail broadband services to consumers. In our setting, the country is composed of a continuum of areas, in which the fixed cost of rolling-out the new generation network (NGN) varies. In this setting we analyze both the incumbent and the entrant firms' incentives to invest in a new technology in different areas of the country, as a function of the access price of the existing network.

Three conflicting effects emerge in this setting: when the access price for the existing infrastructure is low (i) the so-called replacement effect[6] kicks in, and hinders infrastructure investment by alternative operators; (ii) the incumbent's opportunity cost of investment due to the wholesale revenue effect is also low (if the incumbent invests in a higher quality network, the entrant may invest in reaction, and the incumbent will then lose some wholesale profits); and finally (iii) the prices of the services which rely on the OGN are low. Therefore, in order to encourage customers to switch from the OGN to the NGN, operators should also offer low prices for the new infrastructure based services. This effect, which we refer to as the retail-level migration effect, reduces the profitability of the new technology infrastructure, and hence, the incentives to invest in it. We show that the coexistence of these multiple effects creates a non-monotonic relationship between the access price and investments in the NGN.

Then, we extend our analysis to the case in which access to the NGN (whether owned by the incumbent or the entrant) is also available, possibly with different terms. We show that the provision of access to the NGN reduces the areas in which there is infrastructure competition (i.e., in which both firms invest in the NGN) when the incumbent dominates the NGN market. Furthermore, the access price of the OGN "caps" the access price to the NGN, and the migration from the OGN to the NGN at the wholesale level can be incentivized only if a positive correlation between the access prices (to the OGN and NGN) is maintained.

The rest of the paper is organized as follows. In Section 2, we describe our benchmark model. We solve the model in Section 3 and provide an example in Section 4. We extend our analysis to consider spillovers and access to the NGN in Section 5. Finally, we conclude.

2. The setting

There are two firms, an incumbent (firm 1) and an entrant (firm 2), competing to provide broadband services. At the beginning of the game, both firms rely on the incumbent's old generation network (OGN), i.e., the copper network, to provide their services. The entrant's access to the OGN is regulated with the per-unit access price a.[7] Then, both firms sequentially[8] decide on their investments in the next generation network (NGN). We consider the case where the incumbent moves first. This assumption reflects the fact that the incumbent firm typically faces an advantage due to its control over the existing infrastructure and ducts that facilitate the deployment of the new infrastructure.[9] In a given area, when a firm invests in the NGN, that firm no longer employs the OGN to provide its services in that area.

[2] Our paper is also a supply-side complement to the literature on the demand side "excess inertia" in technology transition. For example, Kretschmer (2008) develops a model with two new technologies trying to replace an old one in presence of network effects. Differently, in our paper we analyse how regulation on an old technology might affect the investment in a new one.

[3] See for example, Bourreau and Doğan (2005, 2006) and Avenali et al. (2010). The latter two papers suggest that an access price that increases over time would give the entrants the proper incentives to invest in alternative technologies in a timely manner.

[4] See Gans and Williams (1999), Gans (2001, 2007), Hori and Mizuno (2006) and Vareda and Hoernig (2010) for the impact of access prices in a dynamic investment race between two operators. These studies show that the regulator's capacity to make credible commitments is important for firms' investment decisions. When the regulator lacks credibility, Foros (2004) shows that the difference in firms' abilities to provide value added services can be the major determinant in investment incentives. When there is no credibility issue, Kotakorpi (2006) shows that the presence of spillovers reduces the incumbent's incentives, which leads to a level of investment, which is not only below the socially optimal level, but also less than the amount in the absence of regulation.

[5] For example, the recent EU Recommendation C(2010) 6223 on "Regulated Access to NGANs" (September 2010) states that the regulatory policies during the migration phase can be fundamental in determining the incentives to invest in new infrastructures. To this aim, the EU is going to adopt a new recommentation on "Cost methodologies for key wholesale access prices" to define the pricing structure of wholesale resources in the transition from copper to fiber networks.

[6] This effect implies that, everything else constant, a monopoly firm is argued to have lower incentives to invest in drastic innovations than a competitive firm, as it involves "replacing itself." See Bourreau et al. (2010) for a general description of this effect in the telecom industry.

[7] Access to the incumbent's OGN can take place at either the resale level, or through a local loop unbundling offer.

[8] See Bourreau et al. (2012), for a "coverage game," where the investment decisions are made simultaneously.

[9] Note that, the incumbent moves first in terms of deciding which areas of the country it invests in the NGN. The entrant may end up investing "first" in the NGN in a given geographical area if the incumbent decides not to invest in that area. We also verified that the qualitative nature of our results remain unchanged when the entrant moves first (the computations for this extension are available upon request).