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Broadband business by utilities infrastructure exploitation: A multistage competition model

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ABSTRACT

A promising broadband business opportunity is the exploitation of the physical resources owned by municipalities and utility-based firms. In this study, the new broadband business opportunities owned by these authorities are analyzed through the development of a decision analysis model. The proposed model analyzes the broadband business into stages, integrates real options and game theory and provides business equilibrium in terms of the time of entry in the market, quantity offer and price definition. Finally, a real world case study is discussed showing how the model can be applied.

1. Introduction

In the new era of the telecommunications business with a large number of potential investors, the Information and Communication Technologies (ICT) service providers should seek access network solutions with even more bandwidth. So far, the most viable solution for high bandwidth provision, especially in access networks, is the optical fibers technology. Particularly, the installation of the optical fibers and their commercial exploitation may be a very challenging business activity. Especially, after the telecommunication market deregulation, authorities that own physical infrastructure such as service utility companies (e.g. water, electricity, and transportation) and local municipalities experience competitive advantage, regarding building optical networks, against typical telecommunications operators. These advantages are mainly coming from the lower installation and implementation costs. In particular, existing physical infrastructure, such as sewerage pipes, can be used for installation of optical fibers inside it. The installation cost of optical fibers inside the pipes is significantly lower than the cost of the typical method along the street (Angelou & Economides, 2011).

Facility-based firms may consider a model of three basic stages, for broadband business (Iatropoulos, Economides, & Angelou, 2004). The first stage is the Dark Fiber (DF) installation and optical network implementation, operation and maintenance. The second stage is the DF activation, light the fiber, and provide bandwidth services. Finally, the third stage is the services provision such as VoD (Video on Demand) or remote surveillance (see Fig. 1). This work treats these opportunities using real option (RO) and applies game theory (GT) to model competition. Particularly, all these stages are opportunities for utility companies that can be considered as defer or growth options based on the basic business of the dark fiber exploitation. However, the options to implement these business stages experience competition threat that can

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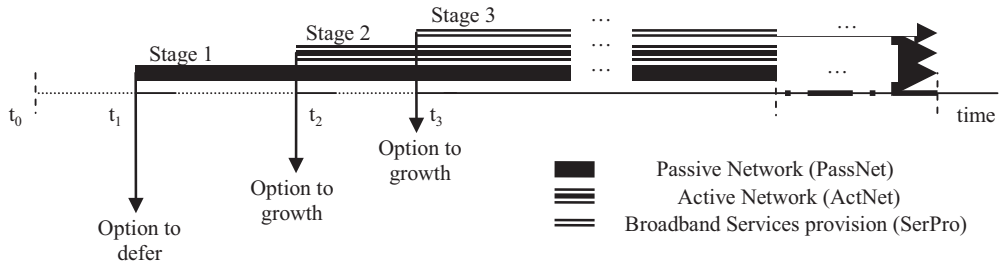

Fig. 1. Overall business in three stages and available growth options embedded.

eliminate or even more degrade them (Trigeorgis, 1996, 1999). Also, each business stage may involve different type and severity of competition.

In general, there are three dimensions in competition modeling: market structure, subject of investigation and nature of competitive actions (Trigeorgis, 1996). Analytically, depending on the number of competitors, the market structure can be either a monopoly, or an oligopoly or a perfect competition if many market participants are present. In addition, a decision maker can be interested either in the optimal decision of the single firm or in the outcome of the decisions of all market participants.

The competition is modeled as exogenous if the firm has no means to influence the other competitors' actions. This is more realistic in perfectly competitive markets with many market participants. In oligopolistic markets, actions taken by the firm may likely result in strategic reactions by its competitors. In this case competition should be modeled as endogenous and requires the combination of ROs and GT (Angelou & Economides, 2008a; Smit & Trigeorgis, 2004; Trigeorgis, 1996; Zhu, 1999;, Zhu & Weyant, 2003a, 2003b). This work focuses on the latter.

After the deregulation of the telecommunications markets their structure has changed from monopoly to oligopoly. The ICT business opportunities do not belong exclusively to only one firm but may also be shared by other competitors.

The main challenge for a potential provider (investor) is to roll out its business activity at the right time and the right scale taking in parallel into account the threat from competition that can eliminate it. Although, it is useful to take into account the traditional quantitative cost–benefit analysis, it is by no means sufficient for capturing the depth of the complexity of the problem in its entirety. Actually, traditional methods do not properly account for the flexibility inherent in most ICT investment decisions to launch them at the right time and the right scale. ROs present an alternative method since it takes into account the managerial flexibility of responding to a change or new situation in business conditions (Trigeorgis, 1996). Option thinking has been already applied to the ICT field (Angelou & Economides, 2008a, 2008b; Benaroch, 2002; Kester, 1984; Kumar, 2002). Also, options analysis in the broadband business field and especially concerning broadband technologies upgrade, from ADSL (Asymmetric Digital Subscriber Loop) to VDSL (Very High Data Rate Subscriber Loop), have been examined by Elnegaard (2002), Elnegaard and Stordahl (2002), Eurescom P-901 (2000), d'Halluin, Forsyth, and Vetzal (2002), and Kalhagen and Elnegaard (2002). In addition, Angelou and Economides (2005) provide a survey of ROs applications in the ICT field.

Furthermore, Rokkas, Katsianis, and Varoutas (2010) apply real options analysis (ROA) to perform a techno-economic study of fiber-to-the-cabinet/very high bit rate digital subscriber line (FTTC/VDSL) and fiber to the home (FTTH) deployments. Also, Verbrugge et al. (2011) present an in depth analysis of the FTTH total cost of ownership comparing different possible business models both qualitatively and quantitatively. Finally, Tahon et al. (2011) investigate business cases for 3G and WiFi operators and indicate how to model the specificities for commercial versus public players. They adopt game theory to investigate the investment options of municipal players in the specific field.

However, an ICT business opportunity is shared by several competitors (potential investors–players). Despite its importance, competition has been typically ignored in most of the ROs literature. Only a few recent papers have started to address this issue. Among others, Angelou and Economides (2009b, 2011), Grenadier (1996, 2002), Joaquin and Butler (2000), Perotti and Kulatilaka (1998), Smit and Trigeorgis (2004), Trigeorgis (1996), and Zhu and Weyant (2003a, 2003b) provided various treatments of the interplay between real options and game theory.

Viewing broadband business under the ROs perspective, this paper develops a model for evaluating such business in the joint presence of uncertainty and competition. The broadband technology industry characteristics are taken into consideration in the model. The proposed analysis aims at finding answers to the following questions:

- which stages of the broadband business are available at the utility firms and municipalities?
- what kind of competition is experienced by the potential investor at each stage?
- what are the optimum time entry into the market and the scale to implement each stage of the overall broadband business?

This paper extends the work of Zhu (1999) and Zhu and Weyant (2003a, 2003b) by considering multistage, multi-type competition modeling in a compound basis, which is related to compound ROs perspective. Particularly, Zhu focuses on