ARTICLE IN PRESS

Telecommunications Policy xxx (2017) 1–11

Contents lists available at ScienceDirect

Telecommunications Policy

journal homepage: www.elsevier.com/locate/telpol

Diffusion and competitive relationship of mobile telephone service in Guatemala: An empirical analysis

Luz Angelica Pirir Avila [a], Deok-Joo Lee [b,*], Taegu Kim [c]

[a] National Secretary of Science and Technology, Guatemala, Guatemala
[b] Department of Industrial Engineering, Seoul National University, Seoul, South Korea
[c] Department of Industrial Management Engineering, Hanbat University, Daejeon, South Korea

ARTICLE INFO

Keywords:
Diffusion
Competition
Mobile telephone
Guatemala
Logistic curve
Lotka-Volterra model

ABSTRACT

The purpose of this paper is to analyze the characteristics of diffusion process of mobile telephone service and the competitive relationships between mobile and fixed-line services in Guatemalan telecommunications market. We investigated the best-suited model to explain the diffusion process of mobile telephone in Guatemala by estimating diffusion curves using empirical data. Moreover, we explored affecting factors which characterize the diffusion pattern of mobile telephony in Guatemala through statistical analysis. Finally, in order to understand the effects of competition in the diffusion process of Guatemalan mobile phone service, we attempted to clarify the competitive relationship between mobile and fixed-line services using the Lotka-Volterra model. As a result, the logistic model was found to be the best model for describing the diffusion pattern. Moreover, investment in telecommunications, the subscribers of fixed-line services, and the number of operators in mobile market were found as significant determinants of mobile diffusion process. Results from the Lotka-Volterra model showed that the relationship between mobile and fixed-line services has changed from pure competition to amensalism.

1. Introduction

Latin America is one of the most rapidly expanding areas of mobile telephony. Half of the Latin American countries shows higher growth than global average in technology access and infrastructure development of telecommunication. Guatemala is a small country at the forefront of innovative telecommunications deregulation (Gutiérrez, 2003). Intriguingly, Guatemala has one of the highest mobile penetration rates among Latin America and Caribbean countries now, although she had ranked one of the lowest penetration rates for communications services in Latin America when the mobile market was first established. Actually that fact that more than 140 subscribers per 100 Guatemalan inhabitants use mobile services, which is much higher than the regional average of 114, is quite notable considering that Guatemala is third to last in terms of mobile-cellular purchase capacity as reported by the ITU.[1]

Despite the fact that in most rural areas in Guatemala people lack basic amenities, the harnessing of technology is a priority. According to the second semester report from 2016 of the Telecommunications Superintendence of Guatemala, 88% of the current operating lines are mobile; in total, there are 18.2 million operating mobile lines. As to the structure of the mobile market, Comunicaciones Celulares S.A is the major operator possessing 52.18% of the market share followed by Telecomunicaciones de Guatemala S.A.

* Corresponding author. Department of Industrial Engineering, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul, 08826, South Korea.
E-mail address: leedj@snu.ac.kr (D.-J. Lee).

[1] The International Telecommunication Union (ITU) uses the ICT indicator to measure the mobile-cellular sub-basket as a percent of GNI per capita.

http://dx.doi.org/10.1016/j.telpol.2017.09.002
Received 29 April 2017; Received in revised form 6 August 2017; Accepted 6 September 2017
Available online xxxx
0308-5961/

with 25.76% and in the last place Telefónica Móviles Guatemala S.A. with 22.05%. All the operators offer the calling party pays (CPP) system, 94.60% of the mobile line users seem to prefer the pre-paid phone plans, relying the postpaid plans in 5.40%. Currently, Guatemala is the main importing of the Central American region holding a 37% of the total. 3.3% of this amount correspond to mobile telephony.

To understand the characteristics of Guatemala's telecommunication market, it is necessary to review some historical events. In 1881, the first telephony service was introduced in restricted areas and was promoted by the government. The market had experienced a long stagnant period due to the regulation and slow economic growth caused by political conservatism until the late 1950s. The introduction of the Central American common market in the 1960s stimulated Guatemala's economy, and the Guatemalan company of telecommunications (GUATEL) was established as a legally monopolistic telephone service provider in 1971 (Urízar, 2007). However, the penetration rate of fixed-line telephone service remained less than 3% during the following 25 years (Ibarguen, 2003). In the 1980s, the market increased due to a change in the political environment. The return of democracy after 30 years of internal armed conflict forced the government to sell state assets, such as bandwidth, to finance social activities and reduce fiscal deficit (Urízar, 2007). As a result, Millicom International Cellular S.A. (MIC) obtained the ownership of the 800 MHz bandwidth for 15 years, which led to the launch of mobile communication services in 1990.

Extensive development in the mobile telecommunications market in the 1990s was driven by policy reformation. As of 1996, the liberalization policy called '*Ley General de Telecomunicaciones*' was enacted to disincorporate the state enterprise GUATEL into Telecomunicaciones de Guatemala S.A. (TELGUA) and Servicios de Comunicaciones Personales Inalámbricas, S.A. (PCS Digital). A competitive environment also arose during this peroid. In 1999, several players emerged in the mobile market simultaneously: PCS Digital and Telefónica Móviles Guatemala S.A. (Telefónica), the first license holder, started to operate; Comunicaciones Celulares S.A. (COMCEL), launched the first prepaid service; and TEM Guatemala y Cia., S.C.A (Bellsouth) acquired the fourth nation-wide mobile services license, initiating operations in 2000. The elimination of the monopoly was followed by dramatic market growth. Competition immediately decreased the price level by almost half, and the number of mobile service subscribers increased to almost three times than the number of fixed-lines in less than a decade. The growth rate during this time was more than 50% higher than the Latin American average (Ibarguen, 2003). Some authors have attributed this growth to the allocation scheme of property rights carried out during the reform (Leighton, 2005; Spiller & Cardilli, 1997; Urízar, 2007). Conclusively, as in other Central American countries, the dynamism of the mobile telecommunications market has become a promoter of competitiveness and productivity growth in the country (Tábora, 2006). Therefore, the mobile market of Guatemala, one of the fastest developing countries in Latin America, is not only worthwhile but also intriguing to be studied in the perspectives of diffusion of innovations and the dynamics of market competition. Fig. 1 depicts the growth pattern of mobile market of Guatemala at a glance.

The diffusion of innovations has been a subject of interest since the 1960s (Meade & Islam, 2006), and a considerable body of related literature has been published in a wide range of application areas. Recently, many diffusion studies have examined the growth of mobile telephony markets (Gamboa & Otero, 2009). A remarkable argument of those studies is that the diffusion process of mobile telephony can be described by an S-shape curve and modeled using commonly known diffusion models, such as Bass, Gompertz, and logistic curve (Botelho & Pinto, 2004; Gamboa & Otero, 2009; Gruber, 2001; Gupta & Jain, 2012; Hwang, Cho, & Long, 2009; Lee & Cho, 2007; Singh, 2008; Yamakawa, Rees, Manuel Salas, & Alva, 2013). For instance, Singh (2008) applied the Gompertz and logistic models to analyze mobile telephony diffusion in India and found that the Gompertz model most adequately described the path of diffusion. Hwang et al. (2009) compared the Bass, Gompertz, and logistic models based on statistical performance and concluded that the logistic model outperformed the others in analyzing the growth patterns and determinants of the diffusion process for telecommunications in Vietnam. Chu, Wu, Kao, and Yen (2009) presented the ARMA model alongside a comparison of the Gompertz, logistic, and Bass models, and argued that the most appropriate diffusion model can be stage dependent as well as case dependent. An approach with single model is

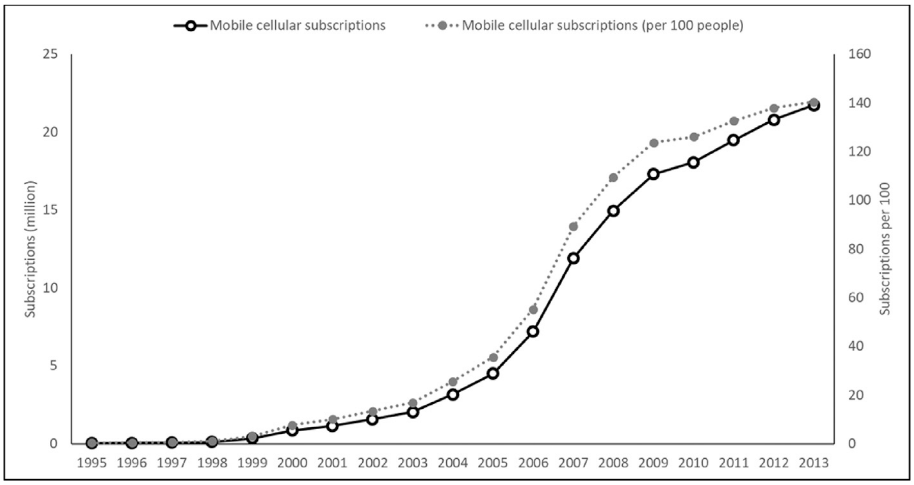

Fig. 1. Growth pattern of mobile market in Guatemala.