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The diffusion of mobile telephony in Kazakhstan: An empirical analysis

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ABSTRACT

Recently, the mobile telephony market of Kazakhstan has experienced rapid growth to the extent that the number of subscriptions exceeded the total population since 2009. In order to understand this phenomenon, this paper analyzes the diffusion of mobile telephony in Kazakhstan. Estimating the penetration rate of mobile telephony with the three most popular diffusion models, Logistic, Gompertz and Bass, it was found that the best fit model of the diffusion process for mobile telephony in Kazakhstan is Gompertz. Furthermore, we performed an empirical analysis to determine the significant factors that affect the fast diffusion speed and found that population and fixed line subscriptions are significant factors. Finally, we attempted to predict the demand of mobile telephony in Kazakhstan over the next ten years using a modified Gompertz model in which affecting factors are incorporated.

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1. Introduction

Diffusion is the process by which an innovation is communicated among the members of a social system over time (Rogers, 2003). Diffusion models are used as a simple analytical tool, not only to explain the complexities of the underlying diffusion process but also to predict the penetration rate of some innovations in a market. From a practical standpoint, diffusion models are of particular interest to both researchers and practitioners because of their ability to forecast the diffusion of new technologies or products in a market. Further, it is widely understood that the diffusion of innovation is likely to follow an S-shaped curve regardless of the time it takes, while the diffusion speed of innovation could be affected by various environmental factors. Thus, S-shaped diffusion curves in which diffusion speed can be formulated by multiple explanatory variables in mathematical form have been frequently adopted in the analysis of diffusion.

Recently, the literature regarding applications of diffusion models to mobile telecommunication markets on the country scale has been extensively studied (Botelho and Pinto, 2004; Chu et al., 2009; Frank, 2004; Gamboa and Otero, 2009; Gupta and Jain, 2012; Hwang et al., 2009; Lee and Cho, 2007; Michalakelis et al., 2008; Singh, 2008; Yamakawa et al., 2013). These studies cover the various kinds of nations in terms of size, region, the status of economic development and technological level. Some researchers have even tried to examine and compare the diffusion of mobile telephony on an international scope (Dekimpe et al., 1998; Gruber, 2001; Gruber and Verboven, 2001; Liikanen et al., 2004; Sundqvist et al., 2005).

Throughout the aforementioned works, three kinds of diffusion models were commonly utilized to choose the best one by comparing the statistical estimation results using real data from each country: the Gompertz, logistic, and Bass models (Wu and Chu, 2010). Further, it is known that the best fit model will be different for different countries. Table 1 summarized the previous studies about the diffusion of mobile telephony.

Compared to the countries analyzed by the previous studies, the mobile market of Kazakhstan, one of the fastest developing countries in middle Asia, could be an intriguing case if we consider the fact that the speed of diffusion has been very fast in spite of the fact that mobile communication in this country appeared somewhat later than for other developed countries. Specifically, the mobile penetration per 100 inhabitants in Kazakhstan is 180.5%, whereas it is 125% on average in Europe. Therefore, it is not only interesting but also worthwhile to investigate the factors which have influenced this surprising diffusion speed and to forecast the further diffusion of mobile telephony in Kazakhstan beyond the seemingly saturated current penetration level.

The purpose of this paper is to investigate the characteristics of the diffusion process of mobile telephony in Kazakhstan. We apply diffusion models to estimate diffusion curves using actual data relevant to the mobile telecommunication market of Kazakhstan and then select the best-fit diffusion curve, i.e., the model possessing the highest amount of explanatory power regarding Kazakhstan's situation. Furthermore, we identify the significant factors which would affect the diffusion speed of mobile telephony in Kazakhstan through statistical analysis. Finally, using the selected diffusion model and the discovered influencing factors, we attempt to forecast the subscription demand of mobile telephony in Kazakhstan for the future. Fig. 1 illustrates the procedure of analysis to be performed in this paper.

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Table 1
The summary of previous literature regarding the diffusion of mobile telephony.

Paper	Country	Models	Independent variables	Explanation
Gruber and Verbonen (2001)	15 member states of the EU		CMPA	At least three distinct operators for the analogue technology.
			CMPD	At least three distinct operators for the digital technology.
			GDP	GDP per capita.
			MNLINE	The # of mainlines per capita.
Lee and Cho (2007)	Korea	Logistic	GDP	GDP per capita.
		ARMA	DIG	The dummy variable, its value being zero before the introduction of digital technology and one after it.
			TEL	# of main telephone lines in operation.
Chu et al. (2009)	Taiwan	Logistic	GDP	GDP per capita.
		Bass	DIG	Digital technology/technology innovation.
			CMP	Deregulation/market competition.
			OPR	Number of operators.
			FIX	Fixed line telephony penetration.
			PPR	Pre-paid access restriction.
Hwang et al. (2009)	Vietnam	Gompertz	FIX	The total cumulative annual fixed line subscribers.
		Logistic	DATA	The cumulative annual revenue of data/IP based data services.
		Bass	HERFIN	The yearly Herfindahl index of market concentration.
			DAHL	
			PRICECON	The price control dummy of the regulator.
Gupta and Jain (2012)	India	Gompertz	CPP	The Calling Party Pays system and is taken as a proxy to study the effect of government intervention. It is dummy variable which is 0 till year 2002 and 1 from year 2003 to year 2009.
		Logistic		
		Bass		
			TAR	The effective tariff to study the effect to competition between service providers.
			FIXSUBS	Fixed line subscribers to study the effect of competition with the existing technology.
Yamakawa et al. (2013)	Peru	Gompertz	MKTCONC	Market concentration.
		Logistic	INTER	Regulated interconnection tariff.
			CONN	
			GDP	GDP per capita.
			POP	# of population.

The structure of this paper is as follows. Section 2 provides a brief history of the telecommunications market in Kazakhstan to help readers understand the current status of mobile telecommunication market of Kazakhstan. Section 3 describes the analysis including the introduction of models, the selection of the best diffusion model, the determination of the significant factors affecting the speed of diffusion, and the forecasting result of the demand for mobile telephony in Kazakhstan. Finally, Section 4 concludes this paper.

2. Brief overview of the history of the telecommunications market in Kazakhstan

The needs for telecommunications of Kazakhstan's people are due to its enormous territory and geographical position. The history of telecommunications in Kazakhstan began with a telegraph line from Almaty to Bishkek, the current capital, in 1862. At the same time, the telephone line was developed as well but was affordable only to a minority. The Russian Revolution of 1917 and the economic problems that followed made the development of telecommunications in Kazakhstan stop for a long time. Only in 1934 did Almaty finish the construction of a Telecommunication Center that contained a general post office, telegraph, and long-distance and local telephone exchanges.

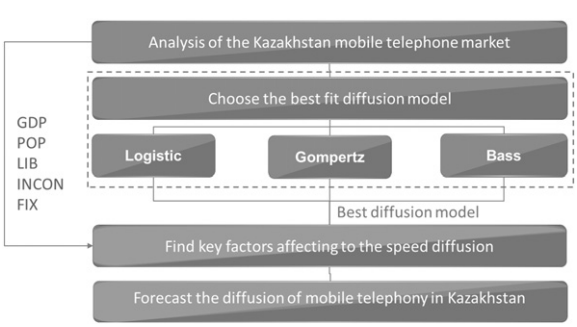

Fig. 1. The procedure of analysis.

In the 1980s, the active construction of underground backbones began. In 1990, the republic contained 1.25 million home telephones, which resulted in 28 fixed telephone subscribers per 100 inhabitants. In 1994, the Kazakhstan government established a nation-owned telecommunications operator, Kazakhtelecom, as an organization of the Ministry of Communications of the Republic of Kazakhstan through the merger of 36 regional telecommunications companies. Ten years later, the government began an effort to modernize the country's telecommunications network through liberalization. As a result, several private companies started to offer telephone services along with Kazakhtelecom.

In countries where access to fixed telephony has been limited or the service has been poor, consumers have found a good substitute in mobile services despite its relatively high price (Gamboa and Otero, 2009). For many years, Kazakhstan had a long queue for the installation of a fixed phone. A large area, settlements remote from the big cities, and the need for huge capital investment did not allow the entire population to have fixed telephony.

In 1994, mobile telephony services were first introduced by Altel, one of nation-owned telecommunications operators, in Kazakhstan. At that time, the frequency bandwidth spectrum was defined between 800 and 900 MHz under the advanced mobile phone service (AMPS) technology. The first GSM 900 licenses were awarded to the Kar-Tel company in 1998, and the right to provide mobile services was received by the Tolkyn Corporation (the predecessor of Mobile Telecom-Service) in 1999. Also at this time, the K-cell company was established by the joint venture of Scandinavian TeliaSonera and the Turkish Turkcell, becoming the second company to launch services over a GSM 900 network in Kazakhstan. This led to a sharp increase in the number of mobile subscribers, from 88.7 thousand in 2000 to 834.5 thousand in 2001 (Committee on Statistics of the Republic of Kazakhstan, 2014).

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