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Inconvenience cost of mobile communication failure: The case of South Korea

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ABSTRACT

Mobile communication failure can occur when mobile traffic exceeds the manageable level. This depends on frequency bandwidth. Mobile communication failure causes inconveniences in a user's daily life that lead to social and economic damage. To address this issue, mobile telecommunications companies deploy additional bandwidths and develop new technologies, but these are costly strategies. This study applies a spike model based on a contingent valuation method (CVM) to measure the inconvenience cost resulting from mobile communication failure. The mean monthly willingness-to-pay (WTP) to avoid communication failure per user is estimated to be KRW 898.14 (USD 0.80) over a period of five years in our study. The inconvenience cost borne by the population is estimated to be KRW 2.97 trillion (USD 2.61 billion). Users experiencing greater frequency of communication failure are found to be willing to pay more to avoid the inconvenience. When excluding respondents citing zero-WTP, the mean WTP per user was calculated to be KRW 3426.41 (USD 3.01). Data traffic usage and frequency at which communication failure is experienced are variables that exhibit statistically significant effects on WTP to avoid mobile communication failure. Overall, estimation results show that a price discrimination based on data traffic usage or quality can be considered by mobile telecommunications companies and regulators to address the issue of data traffic inducing mobile communication failure.

1. Introduction

Since the launch of Apple's iPhone in 2007, the smartphone has proliferated rapidly. The average rate of penetration of the smartphone for 50 major countries from around the world in 2016 was 69.5%. In South Korea, which shows the highest penetration rate, it reached 91% (IDC, 2016). The universalization of the smartphone has changed the basis of communication service from voice to data. The resultant data communication technology has accomplished high-speed and high-capacity communication with fourth generation (4G) technology, which is based on Long Term Evolution (LTE). The global average for speed of mobile networks is expected to be 2.4 times greater than in 2014, from 1.7 megabits to a predicted 4.0 megabits in 2019 (CISCO, 2015). However, the 2019 forecast for global mobile data traffic is projected to increase more than 16 times - up to 24.3 exabytes from 1.5 exabytes in 2013 (GSMA, 2015). This phenomenon that the traffic increases at a very fast rate is called data traffic explosion, and it is given various terms, such as traffic surge and traffic tsunami (Zander & Mähönen, 2013; Choi, Yoon, Kim, Heo, & Silvester, 2014; Naboulsi, Fiore, Ribot, & Stanica, 2016). If the frequency allocated to each local base station is not sufficient to handle the traffic explosion, communication speed and quality will deteriorate considerably, resulting in disconnection or delay. Thus, mobile communication cannot be utilized as usual. We define this

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Table 1
Evolution of mobile communication technology.

	1G	2G	3G	4G
Technology	Analog	GSM CDMA	WCDMA CDMA 1000 Wibro	LTE/LTE-Advanced WiMAX2
Transmission mode	Voice	Voice/Text	Voice/Text/Video	Voice/Text/Video
Transmission speed	–	14.4–64 Kbps	144 Kbps – 2 Mbps	100 Mbps – 1 Gbps
Download speed (800 MB video)	Impossible to download	About 6 h	About 10 min	About 85 - 6 s (theoretically)

Sources: Iqbal, Iqbal, Rasheed, & Sandhu, 2012; Tseng, Wang, Hsieh, & Guo, 2014.

situation as mobile communication failure in this study. In order to prevent communication failure, mobile service providers should continue to upgrade processes to increase the density of their mobile networks and improve their wireless communication structures. Additionally, they must deploy sufficient frequency bandwidths through the extension of additional base stations (Sen, Joe-Wong, Ha, & Chiang, 2012; Wang et al., 2015).

Mobile communication failure can cause various inconveniences in a user's daily life stemming from phenomena such as voice call and message transmission error, mobile banking error, and video streaming service interruption. Owing to the popularity and usage frequency of smartphones, the inconveniences caused by communication failure lead to social and economic damage as well as other individual inconveniences of the users. In order to avoid consumer inconvenience caused by communication failure resulting from traffic explosion, mobile service providers need to develop new technologies and make new investments. In order to analyze the economic feasibility of these solutions, both the direct costs involved and the benefits of the consumers should be considered. However, few studies have been conducted to measure the inconvenience cost resulting from communication failure, including benefits that accrue to the consumer from the prevention of communication failure, in monetary units.

The purpose of this study is twofold; (1) the estimation of the inconvenience cost from mobile communication failure caused by data traffic explosion, and (2) the interpretation of the implications of our results for the decision making processes carried out by the mobile telecommunications companies and regulators. In general, the inconvenience cost is a kind of indirect cost that quantifies the inconvenience resulting from the use of goods or services (Kaseke, 2011; Park, 1992). In this study, we define the inconvenience cost of mobile communication failure as "the monetary value of the inconvenience by disconnection or delay of mobile communication resulting from the mobile data traffic explosion". We measure this value as the willingness-to-pay (WTP) of users for avoiding inconvenience.

The rest of this paper is organized as follows: in Section 2, we explain the status of mobile data traffic in South Korea and review previous studies on the subject; Section 3 includes explanations of the models and data used in this study; in Section 4, we show the estimation results; and in Section 5, we discuss policy implications, limitations, and avenues for further research.

2. Background

2.1. The status of mobile data traffic in South Korea

Since the commercialization of LTE by TeliaSonera in 2009, most mobile service providers around the world have rapidly transitioned to the LTE standard (Yoon, Kwon, Park, Li, & Hwang, 2016). LTE possesses the advantage of being easy to interwork with the existing 3G communication network. In other words, LTE services help reduce the investment that needs to be made by the service provider, and enable easier expansion of service area than other communication systems. Another advantage of LTE is fast transmission speed, which brought about a dramatic upheaval of mobile communication by providing significantly improved real-time streaming and cloud services. Table 1 summarizes the characteristics of mobile communication technology by generation.

In South Korea, three major mobile service providers[1] began the commercialization of LTE services starting from the second half of 2011. Fig. 1 depicts LTE data traffic trends over the past three years in South Korea. An average annual increase in traffic of 61% can be observed (MSIP, 2017a).

The number of LTE subscribers in South Korea has increased by an annual average of 7% over the past three years, as shown in Fig. 2. LTE subscribers accounted for 75% of all mobile subscribers in December 2016 (MSIP, 2017b). LTE data traffic in 2016 was 253,042 terabytes, occupying about 93% of all mobile data traffic. This means that 75% of mobile subscribers owned 93% of data traffic. In addition, the Korea Communications Commission (KCC) forecasts that the mobile data traffic in South Korea will increase by up to 61 times in 2020 as compared to 2010 (KCC, 2013). By this estimate, traffic would become too much for the current frequency bandwidth to handle, causing data saturation. When the saturation level exceeds 100%, the base stations become overloaded, resulting in communication failure. In such a situation, users will not be able to utilize wireless communication services in a normal manner.

In fact, mobile communication failures frequently occur on special holidays or on weekends on busy streets. These communication failures could lead to a decline in the sales of mobile service providers, so that the expansion of additional base stations and the

[1] The three mobile service providers in South Korea are SKT, KT, and LGU+, occupying 91% of the overall telecommunication market share in 2016 (MSIP, 2017b).