Footprint of New Product in Mobile Market Using Diffusion Models

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Abstract. Facing any new product or new technology, a diffusion method, which can suggest exponential growth to some asymptote is important for both technical innovation and business decision. This paper produces the new study to examine and evaluate the diffusion models on mobile market. In order to evaluate two classic diffusion models, this paper chooses to use the existing 3G cellular mobile product data in UK as the sample data. This paper yields which diffusion model has the good prediction and good description features on different stage of product growth.

Keywords: Diffusion model, 3G, UK Mobile Market.

Mobile technology now becomes one of mainly methods to assist people access information, media and to generate their social life along with other communication methods. Although mobile telecommunication technology has been applied for public since 1960s, last two decades, the widespread diffusion of mobile technology has been at all speed. Interestingly, such speed appeared different level in different counts. According to the statistics at 2001, Luxembourg already has 96 mobile telecommunication services, whilst the US only has 44% on the same rates (Jang et al., 2005). As worldwide market generally share the same innovation of new technology, such difference of diffusion has been explained as government policy and regulation factors (Gruber and Verboven, 2001). Gruber and Verboven (2001) have pointed that governments' "regulatory delay in issuing first licenses, yet persisting initial cross-country differences also contribute to a lack of convergence". On the contrary, Jang et al.(2005) claimed that the network externality affecting the rate of diffusion of mobile telephones, such as market competition, the choice of fee payment. In their study, the diffusion of mobile telephone has been lead to the marketing relevant factors. Thanks to the convergence of diverse functionalities, mobile network has already shown great potential in terms of providing customized services to users regarding to their affordance, their demands and their preferences. Customers' preference and habits has been concerned as a significant factor to contribute the difference of diffusion of mobile telecommunications across countries (Park et al., 2010; Michalakelis et al., 2008; Karacuka et al., 2012). From previous researches, the common statement is that the pattern of diffusion of mobile telecommunications is characterized by countries based on various factors. So, what is the patter of diffusion of mobile telecommunications in UK?

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The UK has been one of the technological leaders over the last two centuries. The US and UK have been contributed the majority technology inventing over the last two centuries. Interestingly, UK has been identified as consistency of low uptake country on the diffusion of new technologies in the health area (Packer C et al., 2006). However, regarding to the Ofcom report, U.K. is the fast growth in subscribers to high-value smartphones such as the iPhone than any other nation in Europe. Specifically, the UK stands in the front of adoption of smartphone and uptake of mobile internet. The report also pointed out such high level adoption maybe caused by new generation. It is debate about how good UK performance on the adapting new technology from previous studies. Therefore, it is high interesting to understanding the diffusion of new mobile telecommunication in UK.

Facing a new product or new technology, a diffusion model, which can suggest exponential growth to some asymptote, is important for both technical innovation and business decision to understand the factors influencing further development of technology. As the methodological approach used to estimation, the diffusion model has been widely used to determine the adoption of technology or production innovations, by drawing the product's expected life cycle. It generally shows as the S-shaped growth pattern, which is the cumulative diffusion shape of innovation on sigmoid pattern.

In order to examine the diffusion of new mobile telecommunications in UK, this paper uses 3G mobile subscriber data as the example to display the diffusion model. 3G technology has been brought to UK mass commercial market at 2003 by O2. UK 3G mobile market is one of developed market in the world with the mature product and fully competitive marketing environment, which can help us to avoid any skew from unrealistic and monopolism influence. Also, after 4G launched in UK mobile market, 3G become the mature product in both business and technical perspective, which provides the authors more freedom to define different segments on their market data analysis. The data covered the period from 2003 to 2014, 15 years observation.

This paper produces the new study to examine and evaluate the diffusion models on UK 3G mobile subscribers by using two classic diffusion models: Logistic and Bass. The logistic model is a refinement of the demographic model published by Pierre Francois Verhulst in 1838. It has long been used to project cumulative output of new product (Mansfield, 1961). Bass model is produced 1969 by Frank Bass, specifically for sale forecasting in marketing.

- Logistics Model

The equation of Logistic model is shown as follows, where N is the number of individual adopters, K is the number of adopters in equilibrium in the diffusion study, and r is the intrinsic growth rate:

$$\frac{dN}{dt} = rN\left(1-\frac{N}{K}\right) \quad \text{or} \quad \frac{\frac{dN}{dt}}{N} = r\left(1-\frac{N}{K}\right) \tag{1}$$

In first order solution in terms of time t is shown as follows:

$$N(t) = \frac{K}{1 + e^{-r(t-m)}} \tag{2}$$

Where m is the system age of maximum changes in time period;

- Bass Model

In 1969, Bass suggested the diffusional equation for represent the time-dependent diffusion process, the distribution function is expressed as follows:

$$N(t) = K\left(\frac{1 - e^{-(p+q)t}}{1 + \frac{q}{p}e^{-(p+q)t}}\right) \tag{3}$$

Where N(t) is the number of individual adopters governed by time (t), K is the number of adopters in equilibrium in the diffusion study, p is the coefficient of innovation, and q is the coefficient of imitation;

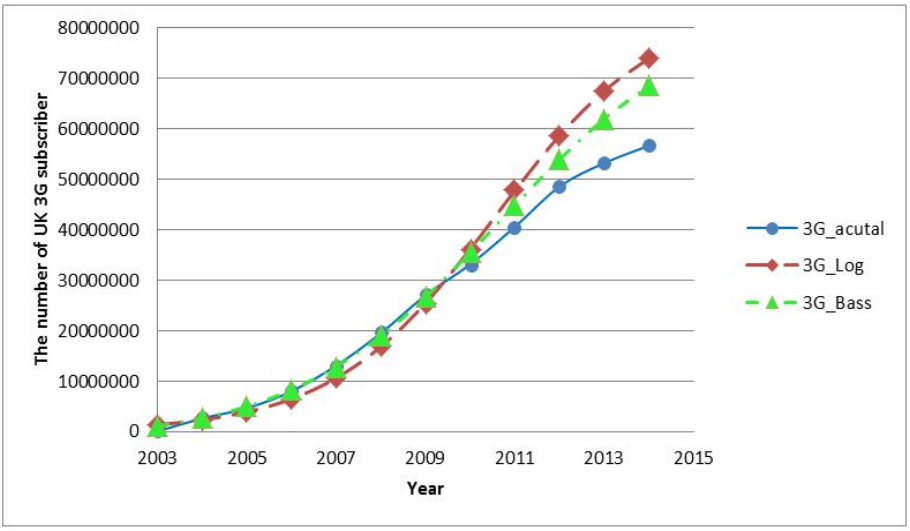

Fig. 1. The number of UK 3G subscribers from different models

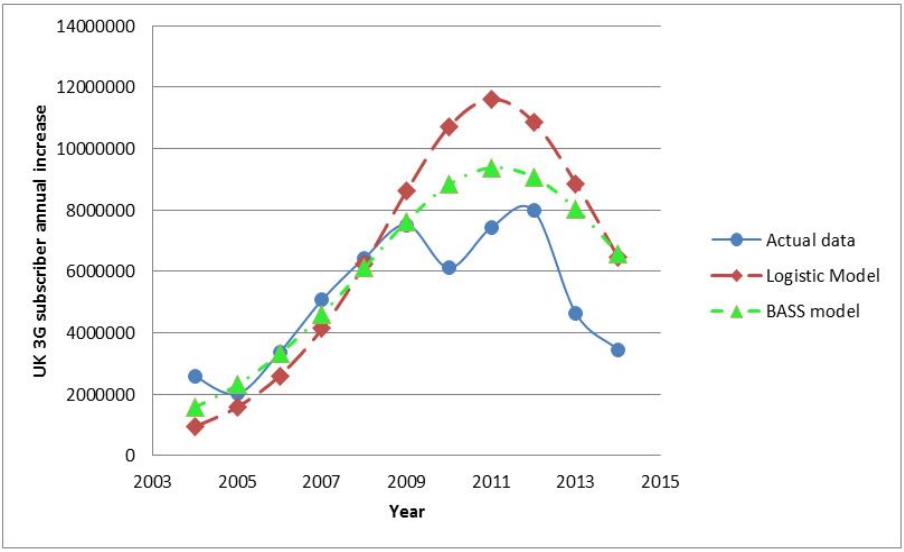

Fig. 2. The annual increase of UK 3G subscribers from different models

Applying Equation (2) and Equation (3) separately, the Logistic model and Bass model are used to estimate the number of UK 3G subscribers from 2003 to 2014. By using the least square method, the relevant parameters of each model are trained and generated (shown in Table 1). In Figure 1, it shows both Logistic model and Bass model shows small difference for estimation between 2003 to 2010, comparing with the actual data [1,2]. After 2010, although both models' estimation is positive than actual data, the increase peak of actual data is still near the Logistic model's estimation in 2012, around 8 million increase. In general, Bass model shows better performance on the data fitting with the actual data rather than the Logistic model.

Table 1. List of coefficients for Logistics model and Bass model

	Parameter estimation	**Logistic model**	**Bass model**
Adopters in equilibrium	K	0.85e+08	0.85e+08
Growth Rate	r	0.55	q=0.423 p=0.01
System age of maximum annual changes	m	8.55	9

[1] Analysis Mason 2014 Country report data annex: UK
[2] IDC: EMEA Telecom Services Database, 2Q13.

This paper uses two diffusion models—Logistic and Bass model on the UK 3G market data from 2003 to 2014. This paper yields which diffusion model has the good prediction and good description features on different stage of product growth. Additionally, this paper concludes that BASS model should be the better choice when applied to historical data based on the examination of veracity and accuracy through comparing the predictive results and actual marketing subscribe.

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