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Research on the Brand Diffusion of the China Mobile Communication Industry Based on the Innovation Diffusion Theory

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Abstract

Perhaps one of the fastest growing markets in China is the mobile telecom market. The brand diffusion of China Mobile Communication Industry that has not been addressed is of great importance to the practicing brand managers. In this article, the authors forecast the potential mobile phone users of China Mobile Communication Industry with the Bass model and analyze the impact of competition on the brand diffusion of China Mobile and that of China Unicom. The study yields the good prediction and the managerial implications.

Keywords: Brand diffusion, Bass model, GMM model

1. Introduction

The diffusion of an innovation is defined as the process through which the innovation "is communicated through certain channels over time among the members of a social system". Diffusion models in marketing describe the diffusion process of an innovation in a society over time (Rogers, 1983). Researchers in management and marketing science have contributed to the development of diffusion theory by suggesting analytical models for describing and forecasting the diffusion of an innovation in a social system. The main impetus underlying these contributions is a new product growth model suggested by Bass (1969). Following the success of Bass's model, marketing researchers have been developing many different types of diffusion models to address various issues surrounding the sales growth of new durables. Applications of the model have been shown to apply to a much wider class of products and services and it has become especially significant in forecasting B2B products and services of many categories including telecom services and equipment, component products such as semiconductor chips, medical products, and many other technology-based products and services (Bass, 2004).

A careful analysis of the diffusion literature reveals that most of the diffusion models focus only on category-level diffusion and that there are only a few models that research diffusion at the brand level. More specifically, Krishnan, Bass and Kumar (2000) point out three possible reasons for the dearth in research on brand-level diffusion: (1) the belief that the theory underlying the diffusion process (i.e., the sociocontagion theory) is most applicable to a category, not to its brands; (2) the fact that the sales of a brand in a new category are affected by multiple factors (such as category-level diffusion, marketing-mix variables such as price and advertising of each brand in the market, and different entry times of the various brands); (3) the no availability of appropriate data to test the models. Instead, they have focused on specific issues that characterize a brand's diffusion. For example, Givon, Mahajan, and Muller (1995) study the impact of piracy sales on the diffusion of legal software products and treat the pirated version as another brand whose diffusion is not observed.

In this article we focus on the brand diffusion of China Mobile Communication Industry that has not been addressed so far and is of great importance to the practicing brand managers. First, we forecast the potential mobile phone users of China Mobile Communication Industry with the Bass model; second, we analyze the impact of competition on the brand diffusion of China Mobile and that of China Unicom.

2. China mobile communication industry

The Chinese mobile telecom market has a typical duopolistic structure, involving China Mobile Communications Corporation (China Mobile, in short) and China United Telecommunication Corporation (China Unicom). At present, these two firms are the only operators with licenses to provide mobile telecom services in the China market.

Before 1994, TACS (Total Access Communications System)of China mobile(originally attached to the Ministry of Posts and Telecommunications) had been monopolizing the Chinese mobile telecom market. In 1994, China Unicom was granted a basic telecom license, which dissolved the monopoly status of China Telecom, and it offered mobile telecom services based on GSM(Global System for Mobile Communications). However, China Unicom could not have a major impact on the telecom market because of the exclusive advantage of the fixed telecommunications network of China mobile. By the end of 1999, although China Unicom had had controlled only 5% of the market, the real competition began caused by a spin-off company (China Mobile) from China Telecom.

In the period of the growth and maturity of the Chinese mobile telecom market(2.5G Age), in the early 2002, China Unicom provided a CDMA(Code Division Multiple Access)network, and China mobile also offered GPRS(General Packet Radio Service) based on GSM. The two major mobile operators in China selected different technology criteria and toed the same line ready for competition After several years' development, although China Unicom was protected by national policy and its price could decrease 10%-20%, its market share was still at a rather large distance from that of China Mobile (in the later 2007, the market share of China Unicom is 29%, China Mobile is 71%).

There would encompass questions such as: (1) How about the future development of the potential mobile telecom market of China Mobile Communication Industry? (2)Does the competition within the duopolistic mobile telecom market affect the brand's diffusion and, if so, by how much? It will be much aid to probe into two questions for brand managers.

3. Diffusion model

3.1 Bass model

The Bass model constitutes a model that is used to the formulation of empirical generalizations in marketing (Bass, 1995). Mathematically, the central idea of the Bass model is that the conditioned probability of an individual adopting at time t, given that this individual has not already adopted, is a linear function of the number of previous adopters:

$$\frac{f(t)}{[1-F(t)]} = p + qF(t) \tag{1}$$

where the random variable t denotes the moment of adoption of a new product by an individual (adopter), f(t) is the probability of adoption at time t, F(t) is the cumulative distribution function and, p and q are the parameter of innovation and imitation respectively. If we define M as the potential market of adopters, n(t) as the number of adopters at time t, with n(t)=Mf(t), and N(t) the cumulative number of adopters up to time t, (N(t)=MF(t)), we can express the Bass model as:

$$\frac{dN(t)}{dt} = (p + q\frac{N(t)}{M})[M - N(t)] \tag{2}$$

The Bass model is the most parsimonious aggregated diffusion model suggested in marketing literature (Parker, 1994) and it has large acceptance in the field of innovation diffusion (Mahajan, Muller and Wind, 2000). Since its publication, several hundred articles have been written on the applications and extensions of the model (Mahajan, Muller and Bass, 1990; Sultan, Farley and Lehmann, 1990).

3.2 GMM model

Givon, Mahajan, and Muller (1995) study the impact of piracy sales on the diffusion of legal software products and treat the pirated version as another brand whose diffusion is not observed. The following differential equations represent the diffusion dynamics over time for the legal diffusion as well as the shadow diffusion:

Legal Diffusion:

$$\frac{dX(t)}{dt} = [a + \alpha\frac{b_1X(t) + b_2Y(t)}{N(t)}][N(t) - X(t) - Y(t)] \tag{3}$$

Shadow Diffusion:

$$\frac{dY(t)}{dt} = [(1-\alpha)\frac{b_1X(t) + b_2Y(t)}{N(t)}][N(t) - X(t) - Y(t)] \tag{4}$$

and X (0) = 0 and Y (0) = 0. N(t) is the cumulative number of microcomputer owners at time t, X(t) is the cumulative number of buyers of the software at time t, Y(t) is the cumulative number of pirates at time t, a is the coefficient of external influence, b_1 is the coefficient of imitation representing the word-of-mouth influence of buyers on potential software users, b_2 is the coefficient of imitation representing the word-of-mouth influence of pirates on potential software users, α is the coefficient representing proportion of individuals influenced by word of mouth who purchase the software.

Givon, Mahajan and Muller (1995) extend the Bass model and demonstrate how shadow diffusion of a software may influence its legal diffusion. Their diffusion modeling approach captures the growth of a software over time taking into consideration the influence of pirates on the software diffusion. They analyze the dominant role that pirates play in converting potential users in users of the software. Adoption data from spreadsheets and word processors in the United Kingdom are used to illustrate the application of their model (Ruiz-Conde, 2004).

3.3 Extended application of the GMM model

The authors extend the GMM Model to the Compitive Diffusion of China Mobile and China Unicom, then eqution s (3) and (4) wil be different; that is, N (t) is the potential market of mobile phone users at time t, X(t) is the cumulative phone subscribers of China Unicom at time t, Y(t) is the cumulative phone subscribers of China Mobile at time t.

4. Empirical results

4.1 Data

The yearly subscribers' data (China Mobile, China Unicom and their total) were already collected from MII (Ministry of Information Industry). These data, from 1991 through 2007, are included in Table 1.

4.2 Forecasting with the Bass model

Table 1 shows that China Unicom shares only 5% of the market to the end of 1999. For China Mobile, from 1991 through 1999, it held near-monopoly positions in its respective markets, and the category-level sales growth is of primary concern. We used the 9-year data of China Mobile subscribers. We estimated the Bass model by nonlinear least squares. Table 2 provides the parameter estimates with the Bass model on brand's diffusion of China Mobile.

M stands for 921,019,000 subscribers who are the eventual population of potential users of China Mobile and also that of China Mobile Communication Industry because China Mobile was a monopoly during 1991-1999. The number is close to 0.9 billion forcast by MII. q>>p, that is, in terms of attracting new subscribers, the internal influence(word-of-mouth communication)is much greater than the external influence(mass-media communication).That shows a brand's formation should depend on the extent to which it receives good word-of-mouth from its own previous adopters. The R^2 value is remarkably high. It shows the fit of the model to the data.

Table 3 shows the comparison of the actual and forecast data of China Mobile subscribers from 2000 to 2004. In figure 1, plots 1-9 illustrate the fitted and actual subscribers curve, and plots 10-13 illustrate the forecast and actual subscribers curve for China Mobile Communication Industry. From table 3 and figure 1, we conclude that the model well forecasts the data of the following three years, and but the forecast number increases faster form the fourth year because the time series data for the model fits was long ago from now and the initial data were small. And also, several studies of the sensitivity of the parameters of the Bass model indicate that estimates using data for first purchase adoption rates of single products are not very stable unless the period over which the estimates are formed extends past the peak of the curve.

Figure 1 shows the fit of the model to data. Clearly, there is close correspondence between the model and data. A plot of fitted versus actual subscribers data similarly shows very correspondence. The model fits well.

4.3 Impact of competition on brand's diffusion with the GMM model

Unless there is only one company in an industry (a monopoly), the Bass model is not appropriate for modeling brand growth or for examining the impact of competition on brand growth. With the GMM model, the paper used the China Unicom data of yearly new subscribers to analyze the brand competition diffusion of China Mobile Communication Industry.

Table 4 provides the parameter estimates for China Unicom. In Table 4, a, which is same to p in Table 2, is the coefficient of external influence of China Unicom. b_1 is the coefficient of imitation representing the word-of-mouth influence of China Unicom phone subscribers on potential phone users; $a<<b_1$ suggests that the growth of China Unicom was mainly driven by word-of-mouth communication. b_2 is the coefficient of imitation representing the word-of-mouth influence of China Mobile phone subscribers on potential users; $b_2> b_1$ suggests that the intensity of the word-of-mouth influence of China Mobile is more than that of China Unicom. α is 0.2998, and this value suggests that the rate of all the potential mobile phone users who were converted to China Unicom phone subscribers at any time t due to the word-of-mouth influence of the duopolistic brand is 0.3,while that of China Mobile is 0.7. That indicates more potential mobile phone users were likely to choose China Mobile on the brand selection. Figure 2 is the actual and predicted fitted-graph of the yearly new subscribers of China Unicom with the GMM model. Figure 2 and the R^2 value both prove that the model describes the growth rate behavior of two competition brands rather well.

5. Conclusion

In the paper the results presented here suggest that the Bass model can be used to forecast the eventual population of potential users of China Mobile Communication Industry, and the GMM model can be used to analyze the impact of

competition on the brand diffusion of China Mobile and that of China Unicom. The authors hope that the approach will stimulate others to develop alternative approaches and provide options for brand managers.

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Table 1. The subscribers of China Mobile, China Unicom and their total (10^4 of subscribers)

Year	1991	1992	1993	1994	1995	1996	1997	1998
Total	5	18	64	157	360	690	1320	2380
CM*	5	18	64	157	360	690	1320	2240
CU*								140
1999	2000	2001	2002	2003	2004	2005	2006	2007
4330	8530	14480	20720	26920	33490	39340	46270	54910
3800	6660	10380	13900	17710	22280	26560	31850	38660
530	1870	4100	6820	9210	11210	12780	14420	16250

*: CM is China Mobile; CU is China Unicom.

Table 2. The parameter estimates with the Bass model on brand's diffusion of China Mobile

m	P	q	R^2
92101.90	0.0001	0.6176	0.9894

Table 3. The comparison of the actual and forecast data of China Mobile subscribers

Year	2000	2001	2002	2003
Actual	8530	14480	20720	26920
Forecast	7741	13406	22121	34047

Table 4. Parameter estimates for China Unicom with the GMM model

a	b_1	b_2	α	R^2
0.0743	0.2083	0.3442	0.2998	0.9152

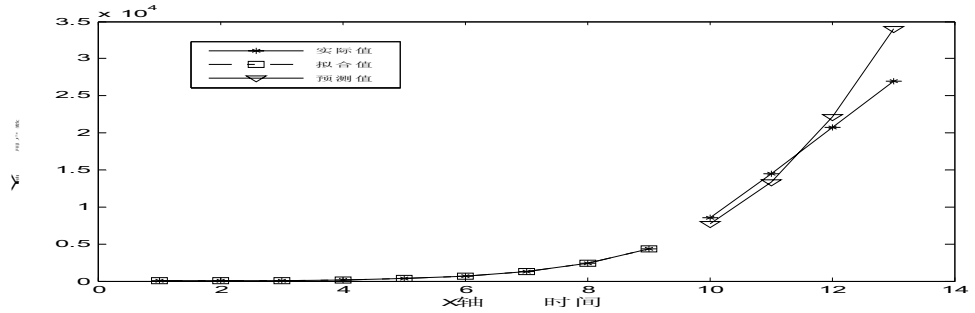

Figure 1. The Actual (*) and fitted (□) and forecast (▽) data of China Mobile

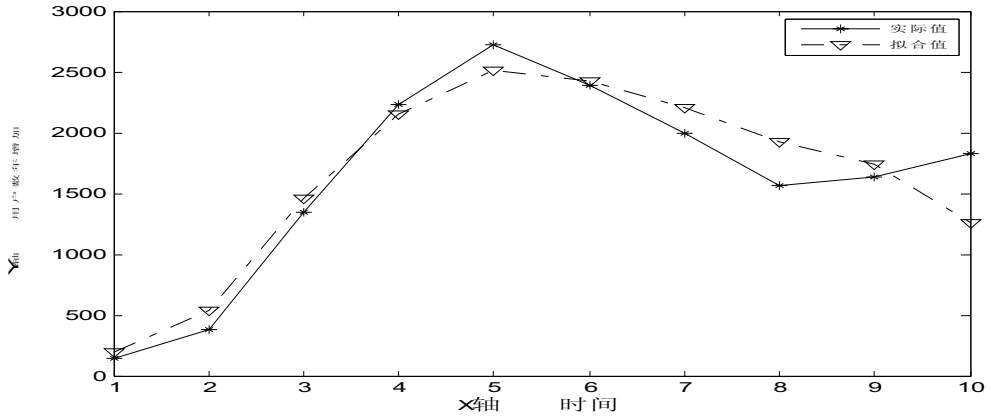

Figure 2. The Actual (*) and predicted (▽) data of the yearly new subscribers of China Unicom