DIFFUSION OF MOBILE COMMUNICATIONS: A TAIWANESE CASE STUDY

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ABSTRACT

Previous empirical studies about the diffusion of mobile communications have subjectively selected a diffusion model, and adopted it to identify the main driving forces of the diffusion. Additionally, some results of these investigations are worth reexamining, since the diffusion processes on which they are based are still in early stages. Based on data for Taiwan's cellular mobile telephone subscribers for 1988–2006, this study, by simultaneous model comparing, indicate that the Logistic model is best for fitting historical data, while the autoregressive moving average (ARMA) model excels at forecasting during the rapid take-off period. Moreover, deregulation is the only factor that significantly facilitates the diffusion speed.

INTRODUCTION AND LITERATURE REVIEW

The rapid diffusion of mobile communications has attracted significant attention. For instance, Gruber and Verboven [1] adopted the Logistic model to study mobile diffusion in 15 EU countries. They indicated that while technology and competition are both significant determinants of mobile diffusion, technology has a stronger effect than competition. Sundqvist, Frank and Puumalainen [2] analyzed years in which mobile communication was adopted in 25 countries with the Bass model. They noted that a country's wealth positively influences the early adoption of mobile communications, and that uncertainty-avoiding adopters have a large coefficient of imitation. Rouvinen [2] compared the speed of diffusion between developed and developing countries by the Gompertz model. They found that late entrants experienced faster diffusion, promoting cross-country convergence, but that the differences in speed of diffusion were not significant. Lee and Cho [4] compared the Logistic and the time series autoregressive moving average (ARMA) models using Korean data. They found that the Logistic model fitted the data better than did the ARMA model, and that fixed communications were a substitute, rather than a complement, for mobile communications.

These empirical works clearly show that applying a diffusion model analogy is the first step in analyzing the diffusion of mobile communications. The Logistic, Gompertz, Bass or ARMA models have unique advantages. For instance, Griliches [5] indicated that the Logistic model successfully explained the new technology adoption of hybrid corn in the US. Chow [6] studied computer demand in the US, demonstrating that the Gompertz model explained demand better than Logistic model. Bass [7] presented a novel diffusion model and successfully predicted peak color TV sales in 1968. Gujarati [8] asserted that the forecasts obtained by autoregressive moving average (ARMA) are often more reliable than those obtained from the traditional econometric modeling, especially for short-term forecasts. Hence, no strong arguments or principles have yet been conceived to guide the choice of a diffusion model.

Furthermore, the mobile communication sector has evolved and reached a stage close to maturity. Some empirical studies conducted in early or immature stages might be too early to draw reliable conclusions [9]. Hence, mature cases are worth reexamining to search new findings beyond the previous empirical results.

To mitigate the randomness when selecting a diffusion model and look for new findings from mature cases, this study adopts Taiwan, which is a mature case, to compare the effects of the Gompertz, Logistic, Bass and ARMA models on fitting the historical data. Besides identifying the fitness of the four models using the same mobile phone sample at the same time, their forecasting ability was also tested using input data for periods of varying lengths. Moreover, the determinants of the diffusion process were also checked and clarified based on the fittest model.

METHODOLOGY

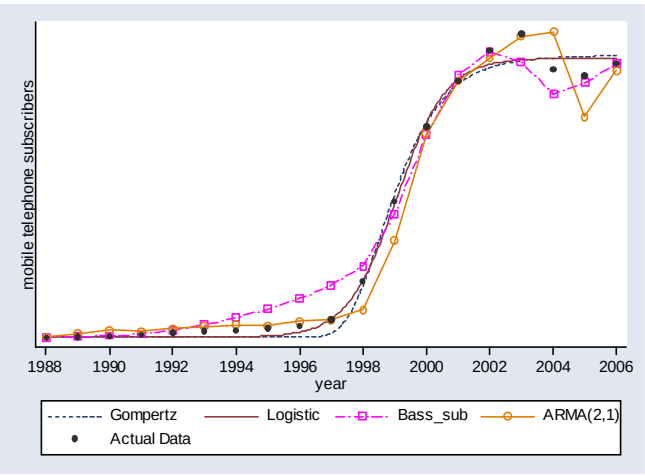
The data for the number of cellular telephone subscribers in this study were obtained mainly from the *World Telecommunication Indicators 2004* of the International Telecommunication Union (ITU). Some data for Taiwan were obtained from the website of the National Communications Commission, Taiwan.
The Gompertz, Logistic, Bass and ARMA(2,1) models were tested for fitting historical data. The forecasting ability of each model was tested by applying varying durations of input data, as described by Heeler and Hustad [10].
As estimating of the determinants of the speed of the diffusion, the growth rate of the model, modified from Frank[11], is given by

$$r_T = \beta_0 + \beta_g \mathrm{GDP}_T + \beta_d \mathrm{DIG}_T + \beta_r \mathrm{DER}_T + \beta_c \mathrm{CMP}_T + \beta_f \mathrm{FIX}_T \qquad (1)$$

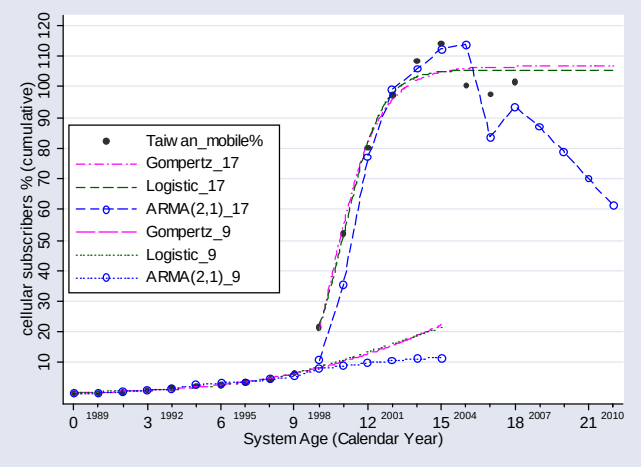
where *r* represents the speed of the diffusion and is the growth rate of the model; GDP, CMP and FIX stands for national wealth, competition and fixed-line subscribers, respectively; DIG (digitization) and DER(deregulation) are dummy variables.

RESULTS

Model Comparison Estimated coefficients and standard errors in parentheses



Model Fitting



Forecasting

MAIN CONTRIBUTION AND FUTURE RESEARCH

This study mainly demonstrates that the fittest model is not necessarily the one with the best forecasting power for the diffusion of mobile communications. Furthermore, market opening (deregulation) is the most important facilitating driver for the diffusion of mobile communications in Taiwan, while the

economic situation and technological innovation are insignificant. This result is from a case that is mature and a late follower, but has caught up quickly with others.

Since different countries are at different diffusion stages, studies of mature cases in time are useful to those with a diffusion time lag. A concrete diffusion formula or model can be developed as additional mature cases are explored, and the driving forces can be estimated accordingly; this will be the direction of future research.

Variable	Model			
	Unrestricted	Restricted (1)	Restricted (2)	Fixed
β_0	2.057 (1.157)	2.515** (0.668)	2.515** (0.668)	1.290** (0.124)
GDP β_g	4.03e-5 (7.99e-5)	2.91e-5 (7.37e-5)	–	
DIG β_d	-0.140 (0.283)	–	–	
DER β_r	1.215** (0.508)	1.380** (0.368)	1.368** (0.352)	
CMP β_c	-0.108 (0.079)	-0.131* (0.062)	-0.140** (0.054)	
FIX β_f	-0.036 (0.029)	-0.044* (0.022)	-0.038** (0.014)	
Adjusted R^2	0.4660	0.5063	0.5442	

Two asterisks (**) and one asterisk (*) mark statistical significant at 5% and 10% level, respectively.

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