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Contents

Adoption of Innovations: Comparing the Imitation and the Threshold Models

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ABSTRACT

This monograph introduces and compares the two leading frameworks for analyzing the adoption and diffusion of innovations – the imitation and threshold models. Imitation models perceive the diffusion process as being driven primarily by communication, whether initiated by the firm or between existing and potential customers, and are particularly useful when aggregate data is available, and allows the incorporation of some economic variables. By contrast, the threshold model emphasizes individual micro-economic decision making and explains the differences in the timing of adoption by heterogeneity among individuals or firms while the dynamic processes of learning affect costs as well as perceptions of value that drive the diffusion process. The threshold model provides a foundation to use cross section and panel data to estimate factors that affect differences

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in adoption patterns including size, wealth, education, and attitude towards risk.

We show how to incorporate multiple marketing tools into both models. We find that the threshold model affords a more refined consideration of risk to optimize the choice of marketing tools because the threshold model can explicitly incorporate various economic frameworks such as expected utility, loss aversion and disappointment models, the safety-rule approach, and real-option theory. We illustrate how to manage marketing risk reduction tools in this context, including money back guarantees and demonstrations. Our review suggests that the two models should be treated as complementary models rather than as substitutes for each other. Our analysis expands on the analysis and design of marketing tools in promoting diffusion and discusses how to enhance their relevance and effectiveness. It also provides a bridge between marketing tools and the economic analysis of diffusion.

1

Introduction

Imitation-based diffusion models (Bass, 1969) and the extended Bass models (Bass *et al.*, 1994, 2000) have been the major tools for predicting the diffusion patterns of innovation in the marketing field (Muller and Peres, 2019; Ofek, 2005). According to common practice, the diffusion pattern of innovations, such as the time to peak of adoption, time to takeoff (i.e., inflection point) and time to maturity, can be predicted by using the coefficients of imitation and innovation, p and q, which are derived from the Bass model. The rate of adoption of innovations is calculated by using the coefficients of imitation and innovation taken from the past diffusion of similar products. The coefficients of imitation and innovation are calculated in a simple manner by regressing the sales at time t as a function of a quadratic form of the diffusion at time $t-1$ using historic aggregate adoption records (see Ofek, 2005). Forecasting the market potential for new products is estimated independently by market survey where the parameters p and q are "borrowed" from an analogous product (Ofek *et al.*, 2016). An exception to this practice is forecasting the diffusion of disruptive innovations in which marketing research is employed in order estimate the willingness to adopt.

The strength of the predictive power of the imitation model and its fit to marketing tools that are aggregate in their nature, such as advertising, mass communication and non-targeted pricing, contributed to its widespread use in the marketing discipline. The main limitation of the imitation model, which cannot be resolved in spite of the remarkable efforts spent in doing so, results from the fact that it is a statistical model that is based on a hazard rate rather than on economic reasoning such as utility and profit maximization. The lack of economic reasoning has resulted in limited application for strategic decision making and in weaknesses in deriving normative guidelines (Mahajan *et al.*, 2000).

The Bass model is based on the implicit assumption that the cumulative outcome and individual choice are linearly related, and the connections are due to communication, network externalities and social signals. While communication does have an important role in inducing adoption, its role is prioritized in these models, giving less than desired attention to other variables that induce innovation. For example, once the expenditure on marketing mechanisms are controlled for, the importance of word-of-mouth communication among adopters is greatly reduced (Van den Bulte and Lilien, 2001). Furthermore, drawing from Granovetter (1978), the assumption that individuals are motivated by the observed collective (adoption) decision may lead to the erroneous conclusion that all individuals who adopt share the same preference and have similar sensitivity to price and risk.

In this monograph, we review the Bass model and its new generation extensions as well as the alternative approach, the threshold model, which analyzes an individual's decision whether, and to what extent, to use a new technology given economic conditions (David, 1986; Feder *et al.*, 1985; Stoneman, 2001; Sunding and Zilberman, 2001; Thirtle and Ruttan, 1987). We show that the threshold model has a notable advantage in incorporating marketing tools that are targeted and/or aim at reducing risk (Heiman *et al.*, 2020; Zilberman *et al.*, 2012). In spite of the notable theoretical advantages of the threshold model, marketing mechanisms have not been formally incorporated into the model, and therefore its potential advantages to marketing remains to be proven. This monograph first describes the two models, shows how they relate to each other, and then discusses how marketing tools, and in particular

marketing tools that are designed to reduce risk, can be incorporated into each of the two models.

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