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BULLETIN
of the Szent István University

SPECIAL ISSUE

PART II.

Gödöllő
2008

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ISSN 1586-4502

Megjelent 380 példányban

Foreword

Tradition and Innovation – International Scientific Conference of (Agricultural) Economists
Szent István University, Gödöllő, 3-4 December, 2007

Tradition and Innovation – International Scientific Conference was held on December 3-6, 2007, in the frames of the anniversary programme series organized by the School of Economics and Social Sciences of the Szent István University. The aim of the conference was to celebrate the 50th anniversary of introduction of agricultural economist training in Gödöllő, and the 20th anniversary of the School of Economics and Social Sciences, which was founded in 1987.

The articles published in the special edition of Bulletin 2008 of the Szent István University were selected from the 143 presentations held in 17 sections of the conference and 30 presentations held at the poster section. The presentations give a very good review of questions of national and international agricultural economics, rural development, sustainability and competitiveness, as well as the main fields of sales, innovation, knowledge management and finance. The chairmen of the sections were Hungarian and foreign researchers of high reputation. The conference was a worthy sequel of conference series started at the School of Economics and Social Sciences in the 1990s.

Előszó

Tradíció és Innováció – Nemzetközi Tudományos (Agrár)közgazdász Konferencia
Szent István Egyetem, Gödöllő, 2007. december 3-4.

2007. december 3-6. között a Szent István Egyetem Gazdaság- és Társadalomtudományi Kara (SZIE GTK) által szervezett jubileumi rendezvénysorozat keretében került megrendezésre a Tradíció és Innováció – Nemzetközi Tudományos Konferencia, amelynek célja volt, hogy méltón megünnepelje a gödöllői agrárközgazdász képzés fél évszázada történt elindítását, s ugyanakkor a Gazdaság- és Társadalomtudományi Kar 1987-ben történt megalapításának 20. évfordulóját.

A Szent István Egyetem által kiadott Bulletin 2008 évi különszámában megjelentetett cikkek a konferencián 17 szekcióban elhangzott 143 előadásból, illetve a poszter szekcióban bemutatott 30 előadásból kerültek kiválasztásra. Az előadások jó áttekintést adtak a hazai és nemzetközi agrárközgazdaság, vidékfejlesztés, a fenntarthatóság és versenyképesség kérdései mellett az értékesítés, innováció, tudásmenedzsment, pénzügy fontosabb területeiről is. Az egyes szekciók elnöki tisztjét elismert hazai és külföldi kutatók töltötték be. A konferencia a Gazdaság- és Társadalomtudományi Karon az 1990-es években elkezdett konferencia sorozat méltó folytatása volt.

Dr. László Villányi
Dean / dékán

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MODEL APPLICATIONS FOR THE SPREAD OF NEW PRODUCTS IN HUNGARIAN MARKET CIRCUMSTANCES

OROVA, IRMA – KOMÁROMI, NÁNDOR

Abstract

Getting a new product adopted - even if it has obvious advantages - is difficult. Many innovations require a long period from the time they become available to the time they are widely adopted.
This study was conducted to determine some characteristics of new product diffusion processes in Hungarian market circumstances and compare them with the international findings.
Having studied a wide variety of diffusion models applied in marketing, the Bass (1969) model seems to be internationally adopted. The parameter values of this model for different products in several countries are available in relative studies.
The diffusion of different products were investigated on Hungarian statistical data (e.g. automobile, camcorder, subscription of cellular phone) and on own paper as well as WEB based surveys (e.g. pen drive, organic bread).
I found my results close to Christophe Van den Blute's in the case of the innovation coefficient (0,016). The values of the imitation coefficient are very variant for the Hungarian data series, it is only the camcorder that is similar to the reference value (0.40), but the imitation effect proved extremely high in the case of the pen drive and cellular phone.
The Bass model is sensitive for the long, slowly rising data series. Nonlinear regression is an effective way in some cases. This work led comparison between subway methods as well.

Keywords: forecasting, diffusion models, regression analyses

Introduction

Participants of the market retain their good position on the market by developing new and modern products. Getting a new product adopted – even if it has obvious advantages – is difficult. Many innovations require a long period from the time when they become available to the time they are widely adopted. Valid estimation of the demand can help manufacturers to develop the output strategy and dealers to find the proper product selection policy.

The original diffusion research was done as early as 1903 by the French sociologist Gabriel Tarde who plotted the original S-shaped diffusion curve. Tardes' 1903 S-shaped curve is of current importance because "most innovations have an S-shaped rate of adoption" [Rogers, 2003]. There are Hungarian scientists among the first researchers of the spread of innovation. Baron Eötvös Lóránd discusses the problem of the technological development from the viewpoint of natural science in 1919. [Letenyei, 2006]

Research on the diffusion of innovation started in a series of independent intellectual enclaves during the 1940s and 1950s in the USA. Rogers describes a general diffusion model and defines the innovation and the diffusion of innovation [Rogers, 2003]:

- Innovation is an idea, a practice, or an object that is perceived as new by an individual or other unit of adoption.

- Diffusion process of innovation is the spread of innovation in witch an innovation is communicated through certain channels over time among the members of a social system. [Rogers, 2003]

When graphed, the rate of adoption formed what came to typify the diffusion of innovation model, an "s shaped curve." The graph essentially shows a cumulative percentage of adopters over time – slow at the start, more rapid as adoption increases, then levelling off until only a small percentage of laggards have not adopted.

Rogers' model of the innovation-decision process consists of five stages: knowledge, persuasion, decision, implementation, confirmation. Rogers finds 5 variables determining the relative speed with which an innovation is adopted by members of a social system: perceived attributes of innovation, type of innovation-decision, communication channels, nature of social system, extent of change agents'. As individuals in a social system do not all adopt an innovation at the same time Rogers categorizes adopters on the basis of innovativeness. Adopter categories and their main characteristics: innovators – venturesome, early adopters – respect, early majority – deliberate, late majority – sceptical, and the laggards – traditional.

The marketing diffusion tradition dates back to the beginning of the 1960s. The typical innovation is the new product e.g. a coffee brand, the touch-tone telephone, clothing fashions, new communication technologies. [Rogers, 2003] The method of data gathering is mostly survey interviews. Data process is statistical analysis by that time. Major findings are the characteristics of adopter categories and the opinion leadership in the diffusion.

Diffusion models of new product acceptance

The objective of a diffusion model is to represent the level of spreading of a new product or service among adopters in terms of a simple mathematical function of the life-time on the market. [Bass, 1969] The simplest diffusion models are first purchase models. There are no repeat buyers and purchase volume per buyer is one unit in these models. These models consider the market of one country usually and suppose the potential market size to be constant. (In spite of the fact that population is not constant in a country and the life style changes as well.). There are more complex models without these simplifications but this study applies to the first-time purchase model.

First-time purchase models describe the empirical S-shaped diffusion curve by different mathematical functions considering different root causes of adoption e.g. the innovation effect Fourt-Woodlock (1960), the imitation effect Mansfield model (1961) or both (Bass, 1969). [Mahasjan et al. 2000]

Bass model

Bass(1969) model consider innovation and imitation effect as well. The basic assumption is that an initial purchase will be made at t - given that no purchase has been made - is a linear function of the number of previous buyers. The new adopter is somebody from the potential market. The probability of the new adoption is a conditional likelihood this way and it can be determined by Bayes theorem:

$$P(t) = \frac{f(t)}{1 - F(t)} = p + qF(t),$$

where

t	time
P(t)	the conditional likelihood, the probability of the new adoption in time t
f(t)	density function, unconditional likelihood of the adoption in time t

F(t) distribution function, the probability of the cumulative adoption till time t
p coefficient of innovation (the probability of the first adoption in t=0; external influence or advertising effect)
q coefficient of imitation (internal influence or word-of-mouth effect)

As $F(T) = \int_0^T f(t)d(t)$ and $F(0) = 0$, regarding there is no adoption at t=0, the probability of new adoption in time t is:

$$f(t) = (1 - F(t)) * (p + qF(t))$$

If the potential market is *m* during the total life-time of the product the cumulative adoptions by time t are $N(t) = mF(t)$ and the number of adoptions at time t: $n(t) = mf(t)$, thus

$$n(t) = \frac{dN(t)}{d(t)} = (m - N(t)) * \left[p + q\frac{N(t)}{m} \right] = mp + (q - p)N(t) - \frac{q}{m}N(t)^2$$

Bass model is the union of two previous models:

- Fourt-Woodlock model (1960) based only on innovative effect (q=0)
- Mansfield model (1961) based only on imitative effect (p=0)

Bass(1994) model incorporates the effects of marketing-mix variables (e.g., advertising, price) and there is other extensions of the model incorporating e.g.- or other country variables [Kumar 2002]:

$$P(t) = \frac{f(t)}{1 - F(t)} = \left[p + qF(t) \right] * x(t)$$

Where x(t) marketing mix effect

The Bass (1969) model is widely used in forecasting, especially product forecasting and technology forecasting. This model is influential in marketing and management science. In 2004 it was selected as one of the ten most frequently cited papers in the 50-year history of Management Science

The average value of Bass-parameters of several product categories in the USA from 1921 to 1996 are p=0.037, q=0.327 on long data series and p=0.040, q=0.398 on short series. Data length in short data series is at least 10 observations.

Bass (1969) model is the base of several international investigations of the diffusion of new products.
Talkudar analyze the Bass parameters and the potential market size across countries by assembling a novel dataset that captures the diffusion of 6 products in 31 developed and developing countries from Europe, Asia, and North and South America. The average parameters for coefficients for external and internal influence are as follows: for *p*: 0.0010 (developed) and 0.00027 (developing) and for *q*: 0.509 0(developed) and 0.556 (developing). [Talkudar et al. 2002]

Christophe Van den Bulte made a meta-analysis of diffusion speed across countries building *a* database containing 1586 sets of p and q parameters, from 113 papers published between January 1969 and May 2000. [Van den Blute, 2002] He finds:

- The innovation and imitation coefficients for the products launched in the USA are: p=0,016, q=0,409.
- There are systematic regional differences in diffusion patterns.
- The average coefficient of innovation p (speed of take-off) in Europe and Asia is roughly half of that in the U.S.

Estimation of Bass parameters

The empirical data series are discrete series but the Bass(1969) model is a continuous model. Bass recommends ordinary least squares (OLS) regression on the discrete analogue model of the basic Bass model

$$Y(T) = mp + (q-p)N(T-1) - \frac{q}{m}N(T-1)^2 + \varepsilon_T = a + bN(T-1) + cN(t-1)^2 + \varepsilon_T$$

where:

Y(T)	number of new adoptions in interval T
N (T-1)	cumulative number of adoptions through *t <T-1*
ε_T	additive error term, the mean of it is supposed 0.

The above equation for Y(T) assumes that the time intervals are equal.

Regression results *a, b, c* and the innovation and imitation parameters and the potential market offer itself.

Empirical regularities

There are empirical regularities during the estimation in the case of models with an unknown ceiling (market size). Van den Blute and Lilien estimated the Bass parameters of diffusion processes on time series of different length. They find in the empirical analysis of twelve innovations: 10% increase in the observed cumulative market penetration (Y(T)) is associated with 5% increase in estimated market size (m), 10% decrease in the estimated coefficient of imitation (q) and 15% increase in the estimated coefficient of innovation (p). They used nonlinear least squares (NLS) estimation. [Blute et al. 1997]

Online surveys

New survey methods appear in the last decade of the 20th century by the spread of Internet access. The consumer satisfaction surveys are made by e-mail and on Web based by the 51% of the small shops in the USA. Using online questionnaires enables the researcher to collect large volumes of data quickly and at low cost. The 31% of the scientific researches about the market is Internet based in 2005. [Terhanian, 2005]

Material and methods

The data processed in this study are from secondary and primary data sources.

Secondary data sources

Secondary data are time series of annual data from Hungarian Central Statistical Office (HCSO) and monthly data from National Communications Authority (NCA).

Automobile. Time series in the tables of "Consumer durable goods stock per hundred households" of HCSO contain data about automobiles in the years of 1960, 1970-83, 1985, 1989, 1991, 1993-2005. Different categorization systems of consumers are found in the tables

but the average values for the whole households of the country were taken into consideration in my investigations.

Video-recorder is a product of the last decades of the 20th century. The time series of HCSO are from 1993 to 2005 for this product.

Cellular phones, ISDN. NCA provides different type of data about the Hungarian telecommunications. Quarterly data of mobile phones and ISDN subscriptions (from 1999) were the base of my investigations.

Primary data sources

Primary data were collected by paper based questionnaires and via Internet (e-mail, Web based questionnaire).

Pen drive. This comfortable storage unit has great capacity as well. I investigated the spread of pen drive among the students of Szent István University of Gödöllő in Hungary by paper based questionnaires in June of 2005. I asked if they have already a pen drive, where do they use it (in learning, entertainment, work, etc.), who has recommended this product them (friend, parent, boss, etc.). Do they plan to buy pen drive, if they do not have yet.

MP3 Player. This small device with great capacity is on the market from some years. Especially, young people find pleasure in it especially. I made a WEB based survey among my students at Szent István University of Gödöllő from 24 to 30 of November in 2005. The questionnaire was available from the labs of the department of Informatics only. The main question was since when did they have MP3 player - if they have had already one. I asked other questions to understand the diffusion process e.g.: Who has suggested this article? This was a study about the WEB based questionnaires as well for me because I lost much time by data recording at the paper based pen drive survey previously.

Organic bread. There is a trend in Europe to eat more and more organic food. Hungary grows a great amount of organic corn. I was interested in how much the Hungarians consume organic bread. I made two surveys one of the heads of the organic shops all over the country in 2005, I asked the heads of the shops two ways:

- by paper based questionnaires within a framework of a project of Marketing Institute of Szent István University about the situations of organic shops in Hungary.
- by e-mail

Both cases the questions were: “Do you sell organic bread?”, if yes: “How many years ago did you start selling organic bread? How many kg could you sell in a week at that time? How many kg can you sell now per a week?” The shops were selected from two databases, from a printed and an electronic according to the field location and the size of the settlement.

Methods

I determined the innovation and imitation parameters of the Bass model by regression. I carried out some basic statistics to examine the circumstances of the diffusion process on the primary data. I investigated the effect of the length of time series on the Bass parameters.

To achieve the Bass parameters of the diffusion processes in Hungarian circumstances the classical approach (Bass 1969) was utilised on my discrete time series. It means I made the regression by Ordinary Least Squares method on the discrete analogue model of the basic Bass model

Remarks: There are no yearly data available for automobiles in the tables of HCSO between 1960 and 1970. I supposed an exponential growth in the years of missing data. The model was set on time period 1964-1980, supposing that the lifetime of a automobile was 15 years that time in Hungary. This way assuring the assumption of the Bass model: there is no repeat purchase. Talkudar does the same way in their study. [Talkudar, 2002]
Data from the organic shops did not compose a conventional time series. The amount of the new adoptions was derived from the new organic bread selling shops plus the yearly increase of the amount of sold organic bread (supposing linear increase in time) by the old shops.
I carried out some basic statistics on the circumstances of the diffusion process on the primary data.

Results

Diffusion process

To characterize the diffusion process of some new products in Hungarian circumstances I determined the innovation (p) and imitation (q) parameters of Bass (1969) model and took some other remarks in the case of the primary data.

Secondary data

Automobile. The model fits on the source data and predicts well in short term (...picture) There was a decline between 1993 and 1997 (there were only 35-37 automobiles in 100 households) because of the bad economic situation of Hungary but more and more families have automobiles from 2001. The long term prediction is satisfactory this way.

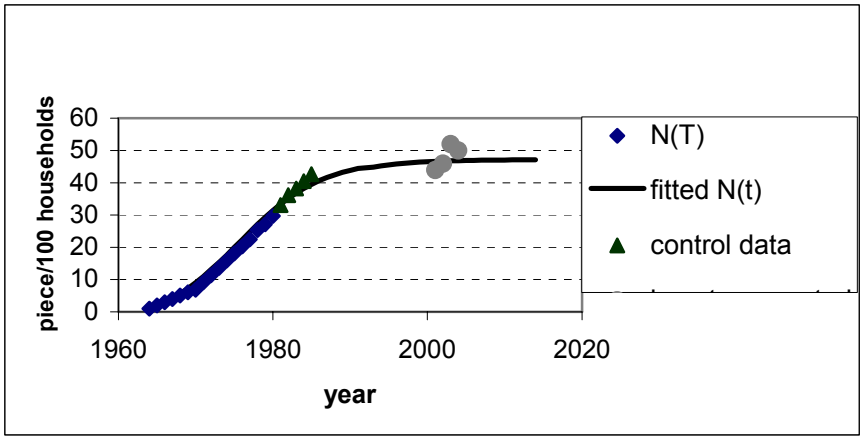

Figure 1 Spread of Automobiles in Hungary
Data Source: Hungarian Central Statistical Office

The parameter of innovation is 0.0150 (p) and of the imitation is 0.1714 (q). The innovation parameter is nearly the same as the results of *Christophe Van den Blute* (2002) but the imitation effect is only the half of his findings. The cause can be the high price of the automobiles in Hungary.

Video-recorder. The innovation parameter is 0,0157 and the imitation parameter 0,3639 for video-recorder both is very close to the average value in the USA. Bass model prognoses maximum 9-10 (exactly 9,77) video recorder is expected in 100 households for about 2023 but the control data of the year 2005 shows that there is no development.

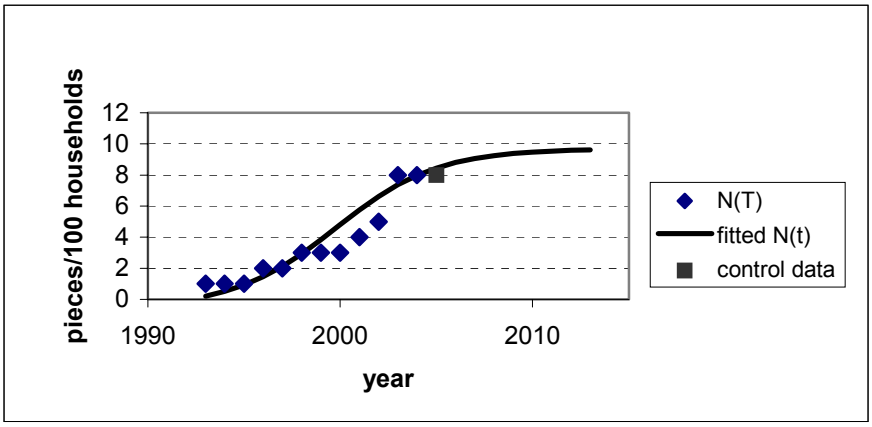

Figure 2 Spread of Video-Recorders in Hungary Data Source: Hungarian Central Statistical Office

Cellular phones. Implementing the Bass model on the quarterly data of three years I got the next results: innovation parameter 0.0166 and the imitation parameter are 0.27. The maximal amount of the subscription for cellular phones will be about 7550 and is expected in 2018.

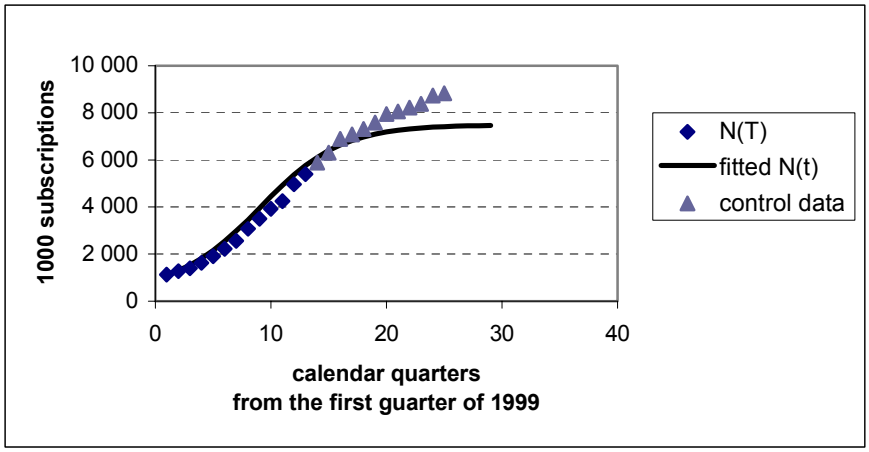

Figure 3 Spread of Cellular Phone Subscriptions in Hungary
Data source: Hungarian National Communications Authority

Bass model overestimates at the beginning and underestimates later according to the Figure 3 and this is the experience of Srinivasan.[Srinivasan et. al. 1986]
Time series of quarterly data gives smaller differences than the modeling on yearly data *Putsis* (1996). Other advantage is the shorter time period for the recommended 10 data points.

ISDN subscriptions. Bass parameters were determined by the time series from the first quarter of 1999 to the second quarter of 2003. This is a long period in the product life because it contains the inflexion point as well where the growth rate begins to sink. The innovation and imitation parameters are p=0.0240, q=0.3960 and they describe the diffusion process well ... figure.

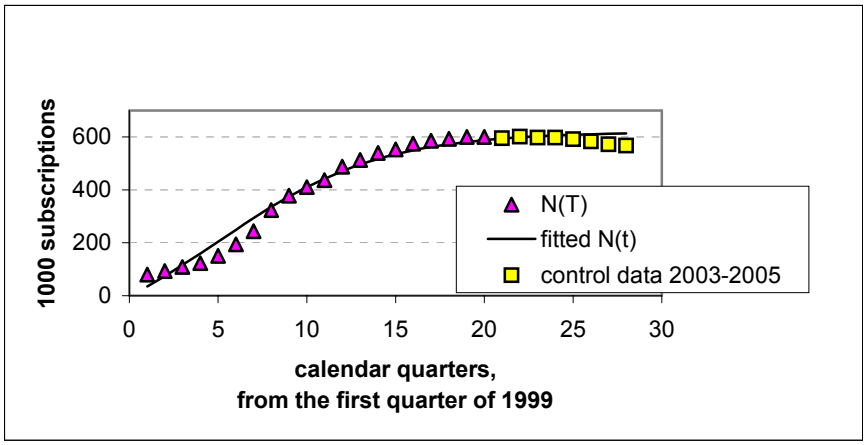

Figure 4 Spread of ISDN Subscriptions in Hungary Data source: Hungarian National Communications Authority

The spread of ISDN is more intensive than that of the cellular phones according to the Bass parameters, but it is less in volume. The model predicts more subscriptions then really took place what is unusual. It could happen because the time series represent the actual number of the subscription. It contains the new contracting and the termination of contract as well. The model is valid till there are more contracting than terminations but useful information can be retrieved for the future with the knowledge of termination numbers

Primary data

Pen drive. There were 349 students - mainly men (78%) - who answered the questions. Almost the half of the answerer (47.6%) had already a pen drive and another 33% intended to buy one. It is important to emphasize that 68% of the students were interested in techniques as they were students of the Department of Mechanical Engineering. 22.6% of the owners bought pen drive on the advice of their near friends, relatives and 13.8% on the advice of the educational institute.

Implementing the Bass model I found 0.0045 for the innovation parameter and 0.2036 for the imitation parameter on this sample. The diffusion process is fast basing this model on monthly data. The maximum penetration forecast was 72.2% by the Bass model. It was a less then expected according to the answers (80.6%).

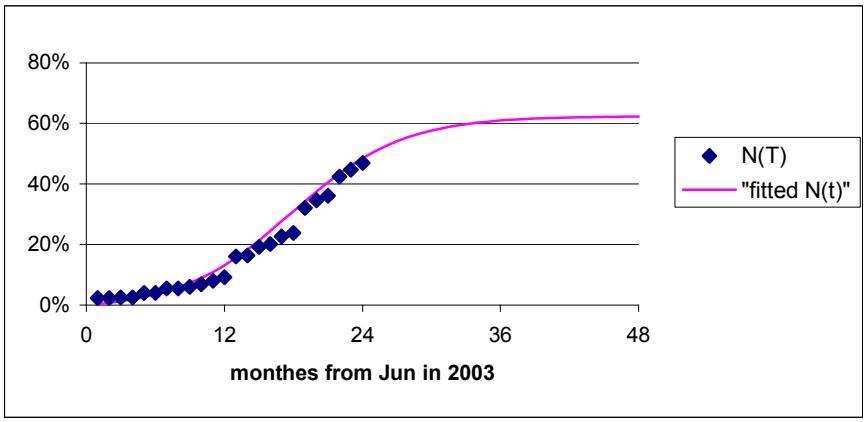

Figure 5 Spread of Pen drive among SZIU Students in Gödöllő, Hungary
Data source: Own Survey in June of 2005

MP3 player. The questionnaire was filled by 204 students, mainly men (65%) but there is no difference in having MP3 player by sex. 34% of men and 31% of women had already one. 37% of the owners of MP3 player got it as a present other 25% bought them at a friend's, near relation's recommendation. Only the 10% bought it on the effect of advertisements on TV, Internet or other media. Parameters of the Bass model were: p=0.0038, q=0.3163. The imitation effect is stronger here than at the pen drive. The different use of the two products can cause this deviation.

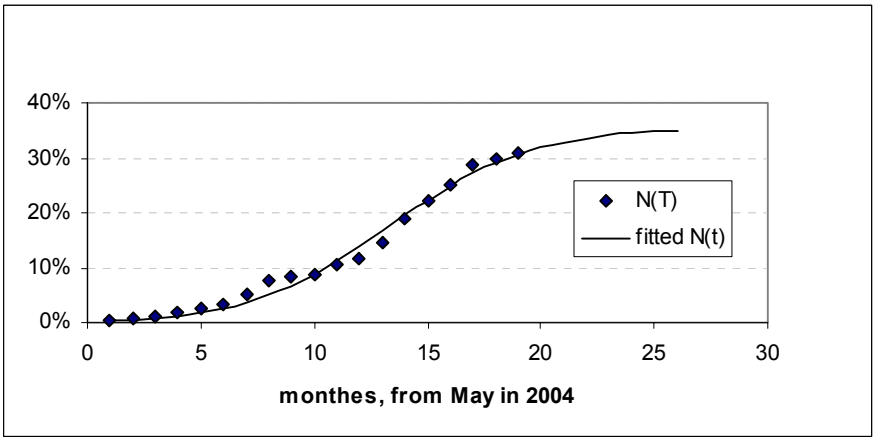

Figure 6 Spread of MP3 Players among SZIU Students in Gödöllő, Hungary
Data source: Own Survey from 24 to 30 of November in 2005

Organic bread. 54% of the shops sold organic bread from 1-4 years at that time but a great part (31%) already from 5-8 years. The organic bread retail augmented in each shop. Data are from the capital or several towns in the country (42-42%) and from the agglomeration of Budapest. There are no answers from other settlements. The sale of organic bread started at about the same time in the capital and in the towns, but there was double amount sold in a town than in the capital at the beginning and at the time of the survey as well. The Bass parameters are p=*0.013*, *q=0.213*. Both parameter values are rather low. Neither the external nor the internal influence is strong. The price may be high for the consumers. The consumption increases continually the rate of the parameters show this as well.

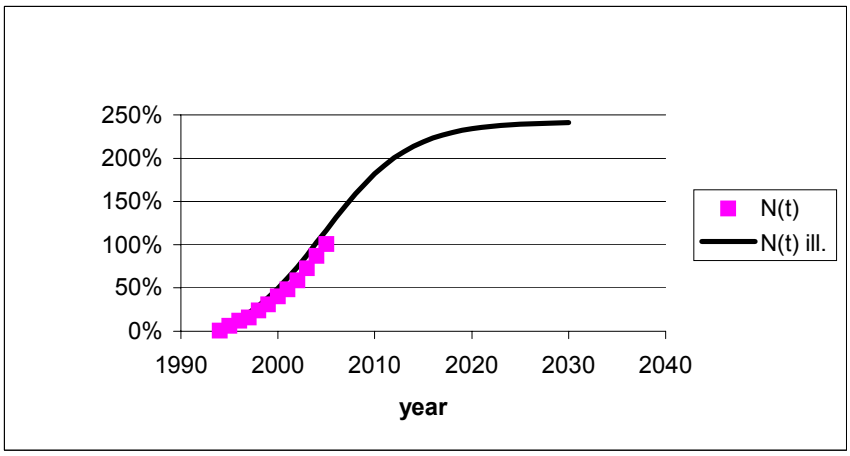

Figure 7 Sold rate of Organic Bread to the year of 2005 in Hungary
Data source: Survey in 2005

Table 1 Summary

Comparison of the Bass parameters					
Product	Country	potential market [%]	Innovation parameter p	Imitation parameter q	Time series
Automobile	Hungary	47.57	0.015	0.1714	yearly
Vudeo Recorder	Hungary	9.77	0.0157	0.3639	yearly
Cellular Phone Subscriptions	Hungary	80.85	0.0166	0.2709	quarterly
ISDN subscription	Hungary	57.65	0.024	0.396	quarterly
Pen Drive	Hungary	62.46	0.0045	0.2036	monthly
MP3 Player	Hungary	35.75	0.0038	0.3163	monthly
Organic Bread	Hungary	-	0.013	0.213	yearly
Átlagos [MAHAJAN et. Al. 2000]	USA	-	0.04	0.398	yearly
Átlagos [Van den Bulte 2002]	USA	-	0.016	0.409	yearly

Experiences in data collecting

Paper and Web based questionnaire. Web based questionnaire (MP3 survey) was faster and easier than the paper based (pen drive survey) during the filling in and during the data processing as well. The paper based questionnaire had linear structure the questions were after each other. The web based had branches and the new question appeared according to the previous answer: there was less to read during the filling in process. Data recording was automatic and therefore without mistyping this way.

Paper based and e-mail questionnaire Organic bread: I found great difference in the effectiveness of the two types of survey methods. There were only 17% the response rate in the case of the comfortable e-mail questionnaire and 43% at the conventional paper based survey - but I got the e-mail answers mainly in some hours. E-mail questionnaires are usually fast

Empirical regularities

I investigated how the parameters depend on the length of the time series at the ISDN subscriptions. I started the regression on 14 points and I added the 8 next points one by one. Change of Bass parameters are on the Figure 8. Increasing the cumulative adoption by 10%changed the estimated parameters as follows: market potential increased by 8%, imitation parameter by 15% and the innovation parameter decreased by 18%.

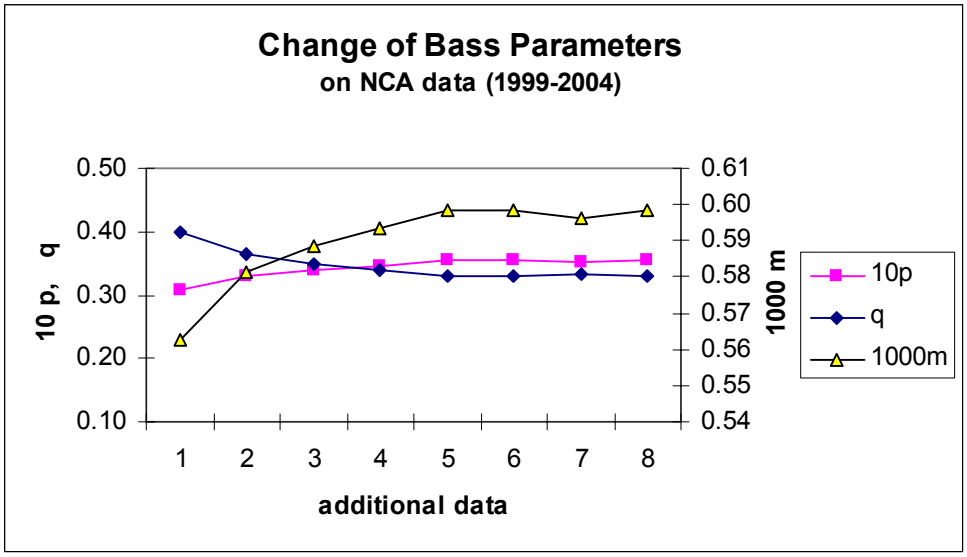

Figure 8 Changes of Bass parameters from the length of time series Hungarian National Communications Authority

Conclusions

Implementing the Bass model on the products launched in Hungary I found that the coefficients of innovation are close to Van den Blute's findings in the USA of and conflict with his experience in European circumstances [Van den Blute 2002]. The imitation coefficient is only the fraction of the average value in the USA regarding several products. The diffusion rate is very high of the pen drive and the MP3 player as the data were monthly. The great difference in the imitation effect reflects the difference in the life style of the two countries. It inspires further research of the new product diffusion process in Hungary.

Surveys resulted interesting findings: students bought new product on the advice of their near friends, relatives (25% at MP3 and 22.6% at pen drive survey) and only a few students bought it on the effect of advertisements (10% at MP3 and less at pen-drive).

I found empirical regularities during the estimation of Bass model like Van den Blute and Lilien. [BLUTE et. Al. 1997]. Increasing the cumulative adoption by 10% changed the estimated parameters as follows: market potential increased by 8% (5% Blute and Lilien), imitation parameter by 15% (15% Blute and Lilien) and the innovation parameter decreased by 18% (10%). Van den Blute and Lilien used NLS regression and I used OLS. The found regularity depends on the model with an unknown ceiling and not on the regression method.

I experienced the advantages of the Web based surveys. My Web based questionnaire (MP3 survey) was faster and easier than the paper based (pen drive) survey. The nonlinear structure helped the filling in. I got the e-mail answers mainly in some hours at the organic bread survey. I think it is unavoidable to use Internet in surveying [Terhanian, 2005].

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