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THE ROLE OF CULTURAL DIVERSITY IN NEW PRODUCT SALES FORECASTING*

Summary: There are currently three basic models, which can be modified, extended and successfully used in forecasting future sales of a new product. But when we apply these models of new product sales forecasting in real market conditions, we must face the fact, that neither of these methods takes into account the diversity of consumer behavior across cultures. In this paper we try to identify relevant cultural factors, significantly influencing the diffusion process, to determine which product categories are culturally-bound from this point of view and to identify the range of this impact.

Keywords: innovation, new product, sales, forecasting, consumer behavior, individualism, uncertainty avoidance.

Introduction

Marketing theorists and practitioners focus largely on the general problem of demand assessment and sales forecasting for established products. But when products or entire markets are new, the challenges differ. There are little or no

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historical data and limited experience on which to base the forecasts. New products can be classified into four categories, depending on whether the product is new to the company, new to the world or both. The following exhibit summarizes the forecasting techniques, that are most useful in each of these four categories.

Some people working in science and technology domains are reasonably good at predicting what technologies will emerge in the future, but are rarely good at predicting how such technologies will affect people, how customers would react to those technologies, and whether and when customers will embrace products based on those technologies. In these situations, the past provides imperfect, or even poor, indicator of the future.

There are currently three basic models, which can be modified, extended and successfully used in forecasting future sales of a new product: (1) the F.M. Bass' [1969] model, applicable for new technologies and infrequently purchased durables, when the focus is customer trial as the form of adoption; (2) the ASSESSOR model [Lilien, Rangaswamy, van den Bulte 1999], appropriate for more frequently purchased products, for which trial is just a step on the path to loyalty; and (3) popular marketing technique called Conjoint analysis [Rao, 2014], that provides another option for new product forecasting.

But when we try to apply these models and methods of new product sales forecasting in real market conditions, we must face the fact that neither of these methods takes into account the diversity of consumer behavior across cultures. The question remains: how does the culture affect the diffusion process? And how can we reflect this fact in our calculations?

1. The Bass forecasting model extension

Managers need forecasts for likely adoptions (first-time purchases) and sales of new offerings, that may take several years to realize, because critical early funding and production planning decisions depend on such forecasts. For these purposes can be used innovation diffusion models. There are predictive models of accepting a new product by consumers, placing emphasis on the product demand saturation level [Grisáková, 2013]. Several definitions of diffusion exist. We prefer definition outlined by P. Storeman [1981], according to expert diffusion can be described as the spreading of new item through different social groups in time. In marketing we call these groups reference groups [Štetka, Majtán, 2014] and these items products or services. In the following text we will use the term “product”, although all principles we mention are fully applicable in services segment too.

Current scientific development in this field was largely influenced by D. Chandrasekaran and G.J. Tellis [2007], who contributed to the present development of this specific problem, mainly by identifying the parallels of marketing diffusion and epidemiological studies, what enabled the application of progressive network analysis [see also: Brezina, Čičková, Gežík, 2012]. Although the most commonly used diffusion model (primarily due to its versatility) continues to be the predictive Bass model. This model offers a good starting point for forecasting the long-term adoption patterns of new technologies and new durable products, if the firm has either: (1) recently introduced the product or technology and observed its sales for a few time periods or (2) not yet introduced the product or technology, but recognizes some similarities between the product and existing products or technologies, whose sales history is known [Lilien, Rangaswamy, De Bruin, 2013]. Model attempts to predict how many customers eventually will adopt the new product and when they will do so. This question of timing is crucial, because the answer guides the firm in terms of how to deploy its resources to market the new product.

The predictive Bass model is constructed on the basis of a single differential equation, operating with (1) the saturation level of demand (M) [see also: Grisáková, Mit'ková, 2011] representing a group of potential consumers; (2) coefficient of innovation (p), as a measure of the spontaneous acquisition of new products by consumers; and (3) coefficient of imitation (q) as an acceptance rate of consumer preferences. The Bass model integrates both internal factors [Mansfield, 1961] (q), as well as external factors [Fourt, Woodlock, 1960] (p) in time (t). The output of the Bass model is the dynamic of new product consumption in time $x(t)$.

The Bass model makes following assumptions [Lilien, Rangaswamy, De Bruin, 2013]: (1) a customer either adopts in a specific period or waits to adopt, and all potential customers eventually adopt; (2) there's fixed maximum potential number of buyers; (3) no repeat or replacement purchases occur, only first time purchases; and (4) the impact of word-of-mouth communication of product adoption is the same, regardless of when a customer adopts the product.

According to M. Rogers [2003], model assumes that potential adopters of an innovation are influenced by two types of communication channels: mass media and interpersonal channels. Individuals adopting a new product, because of a mass media message occur continually throughout the diffusion process, but are concentrated in the relatively earlier time periods. Individuals adopting as a result of interpersonal messages about the new product expand in numbers, during the first half of the diffusion process and thereafter decline in numbers per ensuing time periods, creating a bell-shaped diffusion curve (which is the

familiar S-shaped curve when plotted on a cumulative basis). The Bass model assumes, that the rate of adoption during the first half of the diffusion process is symmetrical with that in the second half, as would necessarily occur for an S-shaped curve.

Some of above mentioned presumptions are considerably simplifying the real innovation diffusion process. But fortunately, it's possible to modify the basic version of the Bass model through expanding its parameters, ergo by adding: (ad1) the marketing mix effect [Bass, Kirshnan, Jain, 1994] $Z(t)$, ergo considering changes in the product price $P(t)$ (see also: Kufelová, Kintler, 2007) and in advertising expenditures $A(t)$ [see also: Grančičová, 2011]. The model might be further developed by accounting for (ad2) the competitive effect [Mahajan, Sharma, Buzzell, 1993] addressing the issue of substitutes existence [see also: Fendeková, Strieška, 2005], considering (a) the positive effect from increased promotion of the given product category [see also: Hrušovská, 2010] as well as (b) the negative effect from reallocation of market potential [see also: Majtán, 2013]; or the so-called (ad3) "takeoff" effect [Golder, Tellis, 1997], characterizing changes over the time – product life cycle, especially the transition from the state of introduction to the phase of growth. It is possible to expand the model also by considering (ad4) the impact of price elasticity (η) on the demand saturation level (M) [Lilien, Rangaswamy, den Bulte van, 1999].

The most crucial part in the forecasting process based on using the Bass model is the parameters estimation. Nowadays, exist several methods of doing so and we classify them according to whether they rely on (1) historical sales data or (2) judgment for calibration.

If historical sales data are available for the new product for at least a few periods, we can use linear and nonlinear regression. W. Dodds [1973] and J. Nevers [1972] have devoted their research to these algorithms of parameters estimation. D.C. Schmittlein and V. Mahajan [1982], V. Srinivasan and Ch. Mason [1986], W.P. Putsis [1996], Ch. van den Bulte and G.L. Lilien [1997] all defined in details the approximation limits relating to the resolution of estimate by using the least squares methods. Therefore, N. Grisáková [2013] recommends applying a non-linear algorithm or the method of maximum credibility. These are, however, iterative methods, therefore, the resulting estimate of parameters depends primarily on selected starting values.

If we require judgmental methods, we can use analogs or surveys to determine customer purchase intentions. The analog approach has proved very useful in practice. By identifying previous innovations, that are analogous to the current product, the firm can determine p and q from the sales trajectories of those previous innovations. Combining these determinations with the M estimate for

the current product (through customer surveys, managerial judgement or the chain ratio method), the firm forecasts the sales pattern for the new product. Instead of simply guessing at the adoption and sales levels of a new product, this approach only requires marketing managers to fill the inputs to well-established model, and the model takes care of the structure by which the inputs get incorporated into the forecasts.

The Bass model has seen extensive use because of its ability to indicate, how successful innovations diffuse through the target population. However, when applying the Bass model, especially in forecasting contexts, it is important to recognize its limitations. Past data from analogs may describe how successful innovations previously have diffused, but they cannot account for the chances of a new product's success. Analog data of past successful product will predict favorable forecasts for any new product, which results in a clearly untenable success bias. To minimize such bias, the model must also include failure probabilities, but inherently, much less information about the sales patterns of failed innovations is available.

2. Cultural impact of individualism dimension

One of the most distinct cultural influences on peoples' willingness to embrace new technologies is the difference between individualism and collectivism [Chandrasekaran, Tellis, 2008; Steenkamp, Jan-Benedict, Hofstede, Wedel, 1999; Triandis, 1995]. Individualism (collectivism) refers to the degree to which people follow their personal beliefs in making decisions relative to reliance on the beliefs of others around them [Koch, Tremain Koch, 2007]. G. Hofstede [2001] dealt with the mutual relationship of the interests of individuals and society, as well as the variability of this ratio across cultures, in a study of cultural dimensions between elements. R. Bond R. and P.B. Smith [1996] subsequently verified the existence of the relationship between the conforming behavior of individuals and the measure of individualism. Consumer conformity is a reflection of social conformity in consumer behavior [Štetka, Majtán, 2014]. Social conformity is understood as a non-critical acceptance of opinions, attitudes and behavior of the reference group majority, in consequence of its social impact [Hewstone, Stroebe, 2006]. We consider consumer conformity to be the opposite of consumer innovation.

Relative advantage refers to the degree in which a potential adopter will gain or benefit from the adoption of a new innovation. This dimension, commonly found in the adoption literature, is often cited as the most significant in terms of

influencing the rate of adoption [Holak, Lehman, 1990]. Relative social advantage refers to an individual's motivation to seek status through using or owning the innovation, leading to enhanced prestige, social reward, approval, acceptance and personal visibility. For certain innovations, such as new clothing fashions, the social prestige, that the innovation conveys to its adopter is almost the sole benefit the adopter receives. Ironically, when other members of the social system adopt the same items, such as clothing, the prestige once held by the initial users may become lost [Rogers, 2003]. In collectivist cultures, the notion of standing out or rising above the crowd is less emphasized [Koch, Tremain Koch, 2007]. Therefore, it is expected that at both early and late diffusion stages, perception of relative social advantage associated with ownership of a new innovation will be greater in socially independent cultures than in socially joined cultures. This hypothesis was proved by R.L. Flight and others [2011]. They also proved, that the perception of relative social advantage decreases over time between early and late diffusion stages in both kinds of culture. This is based on an assumption that new products are sought after with greater desire than old ones. In essence, being first to own a product provides a "first-mover" social advantage to those who take early possession of a new technology [Rogers, 2003].

The most used approach to the identification and quantification of individualism and its variability across cultures is approach founded by G. Hofstede [2001]. Aside from Hofstede, F. Trompenaars and Ch. Hampden-Turner [1998], who created their own model of cultural dimensions, have dealt complexly with this issue. These two approaches do not differ in their basic philosophy; however, their methodologies of compiling indexes quantifying the measure of individualism across cultures do differ. In order to synthesize these two approaches, we created Objectified Comparative Individualism Index (*OCII*), published in *The referential framework of consumers across cultures* (in original: *Referenčný rámec spotrebiteľa naprieč kultúrami*) [Štetka, Majtán, 2014].

We emphasize and verify the relevance of differentiating individualism and collectivism as a normative mechanism influencing the diffusion of product innovations, also through the results of correlation and regression analysis of *OCII* index and individual household consumption by purpose in PPS [Eurostat, 2015]. According to these results, it is possible to differentiate product categories, which are dependent and product categories which are independent of this cultural dimension. The typology of normatively dependent product categories emphasizes the mentioned influence of a normative mechanism on the diffusion of product innovations. These are namely those categories which are characterized by the increased occurrence of product innovations. Specifically, we arrived

to the conclusion, that in individualistic cultures consumers [Štetka, Vrtíková, Šlosár, 2015a; 2015b]:

- prefer a healthy lifestyle and consume a minimum amount of fats and oils ($r^2 = -0,436$; if $\alpha = 0,05$, p-value $\rightarrow 0$);
- live a fast lifestyle and buy an increased measure of processed foods – pre-prepared meals ($r^2 = -0,406$; if $\alpha = 0,05$, p-value $\rightarrow 0$);
- in an increased measure they buy groceries, which also bring them individual and shared gratification, i.e. chocolates and other sweets ($r^2 = 0,356$; if $\alpha = 0,1$, p-value $\rightarrow 0$);
- buy an increased measure of non-alcoholic beverages ($r^2 = 0,397$; if $\alpha = 0,5$, p-value $\rightarrow 0$), spirits ($r^2 = 0,393$; if $\alpha = 0,5$, p-value $\rightarrow 0$) and wine ($r^2 = 0,512$; if $\alpha = 0,01$, p-value $\rightarrow 0$);
- are mindful of external appearance and in an increased measure buy shoes ($r^2 = 0,366$; if $\alpha = 0,1$, p-value $\rightarrow 0$), clothing ($r^2 = 0,312$; if $\alpha = 0,1$, p-value $\rightarrow 0$), clothing accessories ($r^2 = 0,298$; if $\alpha = 0,1$, p-value $\rightarrow 0$), but primarily fashion (non-textile) accessories ($r^2 = 0,535$; if $\alpha = 0,01$, p-value $\rightarrow 0$); and
- use personal care services ($r^2 = 0,356$; if $\alpha = 0,05$, p-value $\rightarrow 0$)
- in a notably increased measure they secure housing in a transitional way – in the form of rentals ($r^2 = 0,599$; if $\alpha = 0,01$, p-value $\rightarrow 0$);
- are mindful of the furniture and furnishings of their own households ($r^2 = 0,398$; if $\alpha = 0,05$, p-value $\rightarrow 0$), as well as its equipping with consumer goods, instruments and aids ($r^2 = 0,668$; if $\alpha = 0,01$, p-value $\rightarrow 0$), and in the case of need of repairs and maintenance of households they predominately prefer external services to their own work ($r^2 = 0,297$; if $\alpha = 0,1$, p-value $\rightarrow 0$);
- they travel significantly more ($r^2 = 0,486$; if $\alpha = 0,01$, p-value $\rightarrow 0$), primarily by train ($r^2 = 0,647$; if $\alpha = 0,01$, p-value $\rightarrow 0$), but also by airplane ($r^2 = 0,306$; if $\alpha = 0,05$, p-value $\rightarrow 0$);
- purchase more bicycles ($r^2 = 0,375$; if $\alpha = 0,05$, p-value $\rightarrow 0$) but also new cars ($r^2 = 0,298$; if $\alpha = 0,05$, p-value $\rightarrow 0$), and they spend significantly more on their operation ($r^2 = 0,418$; if $\alpha = 0,01$, p-value $\rightarrow 0$);
- significantly procure information and communication services ($r^2 = 0,814$; if $\alpha = 0,01$, p-value $\rightarrow 0$), including purchases of new information and communication technologies ($r^2 = 0,666$; if $\alpha = 0,01$, p-value $\rightarrow 0$);
- are more educated ($r^2 = 0,429$; if $\alpha = 0,01$, p-value $\rightarrow 0$), they read books ($r^2 = 0,318$; if $\alpha = 0,1$, p-value $\rightarrow 0$), newspapers, magazines and other periodicals ($r^2 = 0,543$; if $\alpha = 0,01$, p-value $\rightarrow 0$);
- spend their free time more actively, in an increased measure they utilize cultural and sports services ($r^2 = 0,588$; if $\alpha = 0,01$, p-value $\rightarrow 0$), they purchase

sports and other free-time devices and aids ($r^2 = 0,536$; if $\alpha = 0,01$, p-value $\rightarrow 0$), and they spend more on holiday packages ($r^2 = 0,486$; if $\alpha = 0,01$, p-value $\rightarrow 0$).

On contrary, in the collectivistic segment important consumer barriers are contained, notably reducing the potential market realization of presented products and services categories on markets included in this segment.

3. Cultural impact of risk aversion

Social psychology theory is in this research field mainly focused on two experiments, resolving social conformity issues, conducted by M. Sherif and S.E. Asch [Hewstone, Stroebe, 2006]. The crucial difference between these two experiments is mainly in circumstances in which they happened [Štetka, Majtán, 2014]. While experiment conducted by M. Sherif [1935] was taken under uncertainty conditions, S.E. Asch [1956] conducted an experiment in terms of clear perception of reality. Despite the certainty of decision-making situation in Asch' experiment, there was a certain degree of conformity in respondents behavior duly noted. But the recognized rate was significantly lower than in Sherif' case. We substantiate this difference precisely by the different degree of uncertainty perceived by experiment participants [Štetka, Rybárová, 2014]. This fact was proven also by R.S. Baron, B.A Vandello and J. Brunzman [1996], who confirmed that the difficulty or ambiguity of stimulus is very important variable, significantly influencing conformity through informational mechanism.

Perceived risk is a well-established concept in decision-making theory [Rybárová, Grisáková, 2010]. Risk has been shown in a number of studies to be highly (negatively) related to the rate of diffusion [Ostlund, 1974]. Product risk is based on two elements: (1) uncertainty and (2) consequence [Bauer, 1960]. Thus, perceptions of both the uncertainty of an unknown future outcome and the potential loss associated with a failed product (financial loss, opportunity costs, social impairment etc.) lead to product performance risk and slower diffusion [Flight et al., 2011].

Most commonly used cultural model is G. Hofstede [2001] model of five cultural dimensions. One of these dimensions is so called Uncertainty Avoidance. Our application of this dimension is based on the premise that perceived uncertainty is culturally bound subjective category [Hofstede, Hofstede, 2006]. Uncertainty Avoidance variability across cultures may be measured by Uncertainty Avoidance Index (*UAI*). Because of the regular update, data we used are taken from the Hofstede center online database instead of available book edition.

This index range is from 0 to 100 and measures degree in which the members of a given culture feel threatened by uncertainty or unknown situations [Hofstede, Hofstede, 2006]. In the context of consumer behavior it is a measure of severity assigned by consumers to various risks in their shopping situations [Štetka, Majtán, 2014]. The index quantification is based on questionnaire survey – significantly correlated answers to questions about (1) stress in work; (2) compliance; and (3) employment expectancy [Hofstede, 2001].

We emphasize and verify the relevance of differentiating uncertainty avoidance as an informational mechanism influencing the diffusion of product innovations, also through the results of correlation and regression analysis of *UAI* index [Hofstede, 2015] and individual household consumption by purpose in PPS [Eurostat, 2015]. In the meaning of these results, it is possible to differentiate product categories, which are dependent of this cultural dimension. The typology of culturally bound product categories emphasizes the mentioned influence of an informational mechanism on the diffusion of product innovations. These are namely those categories, which are characterized by the increased occurrence of product innovations. Specifically, we arrived to the conclusion, that in cultures characterized by high degree of uncertainty avoidance consumers [Štetka, Šlosár, Vrtíková, 2015]:

- do not prefer a healthy lifestyle and consume maximum amount of fats and oils ($r^2 = -0,594$; if $\alpha = 0,01$, p-value $\rightarrow 0$), meat ($r^2 = -0,382$; if $\alpha = 0,05$, p-value $\rightarrow 0$) and livestock products ($r^2 = -0,341$; if $\alpha = 0,05$, p-value $\rightarrow 0$);
- spend their leisure time passively, cultural and sporting services are being used only rarely ($r^2 = -0,534$; if $\alpha = 0,01$, p-value $\rightarrow 0$), they buy sports and other leisure tools and equipment very little ($r^2 = -0,673$; if $\alpha = 0,01$, p-value $\rightarrow 0$), including bicycles as a transport equipment ($r^2 = -0,542$; if $\alpha = 0,01$, p-value $\rightarrow 0$);
- as a result, they have a high consumption of pharmaceuticals ($r^2 = 0,385$; if $\alpha = 0,05$, p-value $\rightarrow 0$) and health services ($r^2 = 0,456$; if $\alpha = 0,01$, p-value $\rightarrow 0$);
- buy processed foods – pre-prepared meals in very small amount ($r^2 = -0,441$; if $\alpha = 0,05$, p-value $\rightarrow 0$);
- the same case is with food products which give them individual or shared enjoyment, i.e. chocolates or other sweets ($r^2 = -0,363$; if $\alpha = 0,1$, p-value $\rightarrow 0$), nonalcoholic beverages ($r^2 = -0,516$; if $\alpha = 0,01$, p-value $\rightarrow 0$), spirits ($r^2 = -0,511$; if $\alpha = 0,01$, p-value $\rightarrow 0$), wine ($r^2 = -0,462$; if $\alpha = 0,01$, p-value $\rightarrow 0$), and beer ($r^2 = -0,44$; if $\alpha = 0,01$, p-value $\rightarrow 0$);
- don't purchase information and communication technologies very often ($r^2 = -0,569$; if $\alpha = 0,01$, p-value $\rightarrow 0$);
- read less newspapers and journals ($r^2 = -0,467$; if $\alpha = 0,05$, p-value $\rightarrow 0$);

- are avoiding rentals as a housing solution ($r^2 = -0,547$; if $\alpha = 0,01$, p-value $\rightarrow 0$), and purchase household equipment and tools very modestly ($r^2 = -0,599$; if $\alpha = 0,01$, p-value $\rightarrow 0$);
- do not participate in games of chance ($r^2 = -0,396$; if $\alpha = 0,05$, p-value $\rightarrow 0$).

On the contrary, in segment characterized by a tendency to undertake the risk (low *UAI*) important consumer incentives are contained, notably increasing the potential market realization of presented products and services categories on markets included in this segment.

Conclusion

In this paper, we defined essential approaches to modeling the diffusion of product innovations and pointed out the possibility of extending these models by taking into account the cross-cultural factors. We analyzed the impact of two cultural dimensions: (1) individualism vs. collectivism as the fundamental factor of normative mechanism and (2) uncertainty avoidance (risk aversion) as a relevant factor of informational mechanism. We substantiated the relevancy of these two factors with the results and findings of already conducted researches, but also with the correlation and regression analysis, regarding key product categories' consumption and mentioned factors distribution.

For identification and quantification of the degree and impact direction of these two diffusion factors we took into consideration well established cultural models and its dimensions. In the process of resolving risk aversion vs. tendency to risk, we applied Hofstede's *UAI* index. And in the case of individualism vs. collectivism, we applied synthesis and integration of two independent approaches to the identification and quantification of individualism across cultures. It resulted in the compilation of an Objectified Comparative Individualism Index (*OCII*) as the key indicator for measuring the degree and variability of individualism across European markets.

Based on these results, we suggest marketers operating on global markets to take these two measurable cultural factors into account in the process of forecasting future sales of product innovation.

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ROLA RÓŻNORODNOŚCI KULTUROWEJ W PRZEWIDYWANIU SPRZEDAŻY NOWYCH PRODUKTÓW

Streszczenie: Obecnie wyróżnia się trzy podstawowe modele, które mogą być modyfikowane, rozszerzane i z powodzeniem wykorzystywane w przewidywaniu przyszłych poziomów sprzedaży nowych produktów. Niemniej, gdy zastosuje się te modele przewidywania przyszłych poziomów sprzedaży nowych produktów, w warunkach rynkowych trzeba zmierzyć się z faktem, iż żadna z tych metod nie bierze pod uwagę zróżnicowania zachowań konsumentów w różnych typach kultur. W artykule identyfikujemy właściwe czynniki kulturowe istotnie wpływające na proces dyfuzji nowych produktów, by określić, które kategorie produktu są zależne od kultury oraz aby zidentyfikować zakres wpływu tych kategorii produktu na proces dyfuzji.

Słowa kluczowe: innowacyjność, nowe produkty, sprzedaż, przewidywanie, zachowania konsumentów, indywidualizm, unikanie niepewności.