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Adoption and Diffusion of Digital Information Goods: An Empirical Analysis of the German Paid Content Market

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Abstract

The rapid growth of the Internet and electronic commerce stimulates new digital innovations. Electronic markets can influence both adoption and diffusion processes of digital innovations in significant ways. The difficulties for market transactions of information goods and the change from free to paid content on websites in the last years has led to research questions about how individuals decide whether and when to adopt paid content innovations and how this innovation diffuses throughout a population. This article presents empirical evidence about the adoption and diffusion process of paid content. It focuses on the differences of the adoption and diffusion process of different paid content product types if there exists an established, non-digital counterpart. The results in this paper help media managers to design business models for paid content by forecasting the adoption and diffusion process of the offered digital content product.

Keywords: Adoption, Diffusion, Electronic Markets, Paid Content

1. Introduction

In the field of marketing, research on new product diffusion has traditionally focused on the adoption of innovations (e.g. Mahajan, Muller 1979; Mahajan et al. 1990; Rogers 2003; Shih, Venkatesh 2004). The adoption-diffusion research examines the process by which an innovation reaches a critical mass of adopters, the diffusion is accelerated, and innovation is considered successful (Mahajan et al. 1990).

Adoption means the decision of an individual to make use of an innovation as the best course of action available. Rogers (2003:19) defines the innovation decision process as a five step process on individual level: (1) gain of initial knowledge of an innovation, (2) formation of an attitude toward innovation, (3) decision whether to adopt or reject, (4) implementation and usage of the new idea and (5) confirmation of this decision. The rate of adoption is defined as the relative speed with which members of a social system adopt an innovation. Rogers (2003:5) defines diffusion as the process by which an innovation is communicated through certain channels over time among the members of a social system.

In recent years, research on the adoption and diffusion processes of digital products has increasingly focussed on the Internet in particular because of the specific characteristics of electronic markets and digital products. The Internet stimulates the innovation of new digital products and new types of business models – paid content on websites is one example of this potential for innovation. Paid content is a special form of information good (Shapiro, Varian 1999; Varian 1998; Clarke 2000; Brandtweiner 2000) and counts as a digital product (Choi et al. 1997; Clarke 2000; Brandtweiner 2000). In this article the term paid content is used for non-free sales and distribution of information-based content products. According to this definition paid content possess special characteristics of information goods. According to Varian (1998) information goods are experience goods with economies of scale that would seem to cause difficulties for market transactions: “you must experience an information good before you know what it is” (Varian 1998).

Paid content is of particular interest for the discussion of adoption and diffusion processes on the Internet as after the consolidation of the Internet boom in 2001 and the decline of advertising revenues many firms changed their business models and moved to selling information goods which had been freely available up until then. This also required a change of consumer behaviour, because consumers are required to pay for formerly free digital content. In various articles, the adoption and diffusion of digital products in electronic markets have been analysed (Rangaswamy, Gupta 2000; Kshetri, Dholakia 2002; Bughin 2003). These analyses focus on free digital products such as free software or e-commerce of non-digital products, where the adoption decisions occur online and physical exchange take place outside digital media.

This leads to the research question whether the adoption and diffusion of paid content differs from the adoption and diffusion process of other digital products, especially if an established, non-digital counterpart (e.g. in traditional media) does not exist.

In this article we present an empirical analysis of the adoption and diffusion process of paid content using the well-established model of Bass (1968) is presented. In this context the analysis focuses on the impact of an established non-digital counterpart on the adoption and diffusion process of digital paid content.

This research will help media managers to design business models for paid content by forecasting the adoption and diffusion process.
The following section gives an overview of the adoption and diffusion literature relevant to the study. Based on these theories an approach will be derived and empirically tested. In the last section the impact of the empirical findings on the adoption and diffusion theories and the implications of theses empirical findings are discussed.

2. Adoption and Diffusion in Electronic Markets: a Literature Overview

2.1 Research on Adoption and Diffusion

The Innovation Diffusion Theory (IDT) allowed researchers to investigate how new innovations spread among groups of people. Rogers defines diffusion as 'the process by which an innovation is communicated through certain channels over time among the members of a social system. Diffusion is a special type of communication concerned with the spread of messages that are perceived as new ideas' (Rogers 2003:35). Crucial for diffusion is the innovation-decision process which results in the adoption of an innovation. 'The innovation-decision process can lead to either adoption, a decision to make full use of an innovation as the best course of action available or rejection, a decision not to adopt an innovation' (Rogers 2003:21). Users' approval of innovation and a classification of the users of an innovation is measured based on the variable 'relative time' at which an innovation is adopted. The rate of adoption is defined as 'the relative speed with which an innovation is adopted by members of a social system' (Rogers 2003:23).
Research on diffusion effects provides a paradigm, which investigates how knowledge disseminates through social networks. Historically diffusion effects have been analysed in the context of product innovations (Trade 1903, Ryan, Gross 1943). Rogers (2003) generalised diffusion of innovations "to the spread of abstract ideas and concepts, technical information, and actual practices" (Wejnert 2002) based on communication through certain channels over time among the members of a social system and the influence of marketer-controlled activities (Rogers 2003; Mahajan, Muller 1990; Mahajan, Muller, Wind 2000). Rogers (2003) categorizes customers into segments such as innovators, early adopters, early majority, late majority and laggards. In his model the diffusion process explains and predicts the time path of adoption of new products and technologies in a market.
Various models have been developed for diffusion processes. The original diffusion model provided a probabilistic approach based on the hazard function which determines the likelihood that an agent who has remained a non-adopter of knowledge through time will become an adopter in the next temporal unit (Mahajan et al. 1990) - typically related to an innovative product. This initial model focussed on effects that are supposed to be correlated with innovators, i.e. those agents that adopt and apply knowledge solely on information they receive from agents outside the social network, e.g. news and other media. Fisher and Pry (1971) adopted this probabilistic model to the group of agents that depend on information they receive from agents inside the social network (word of mouth),

which are called imitators. Bass (1968) integrated both models and provided an approximation model that can be empirically tested and used for forecasts. The latter attribute made it appealing to managers even though the parameters are derived from historical data. Therefore the reliability of forecasts decreases with the importance of external effects such as the introduction of competing products or falsification of diffusing knowledge. Hence, current diffusion models assume stability of the social network to a large extent.
The Bass model was the first which assumed different types of agents in a social network and is therefore called "behavioural". This approach was refined on individual level (Mahajan et al. 1990), which gives a richer behavioural structure including the attribute of utility to an agent in a social network. Nevertheless, these models do not focus on individual decision-making but on social networks in general. Diffusion models have been mainly applied to mature markets and the introduction of new products (e.g. Wejnert 2002) agriculture (Fliegel 1993), technologies (Burt 1987), fertility-control methods (Rogers, Kincaid 1981), policy innovations (Berry, William 1992), and political reforms (Meyer 1987). Electronic markets for paid content are a completely new market field.

2.2 Research on Electronic Markets and Information Goods

Wejnert (2002) groups diffusion variables into three major characteristics: (1) on innovations, (2) on innovators and (3) on the environmental context. The innovation is given by the content product whereas the characteristics of innovators are assumed to be constant. Offering digital paid content is influenced by the characteristics of electronic markets. Electronic markets can be interpreted as social systems that leverage global digital networks for implementations of organised economic interactions among its actors and users. Digital products and in particular information are economic objects that can be digitised and exchanged over electronic markets (Choi et al. 1997). Digital networks such as the Internet provide a means to separate information from their physical implementations (Varian 1998, Bichler, Loebbecke 2000), which gives birth to a new product type: information goods (Sarvary, Parker 1997, Bakos, Brynjolfsson 1997, Kleist et al. 1999). In fact, information goods are carried by digital representations that can be exchanged (costs for financial and product logistics) and reproduced (reproduction costs) on any computer system at marginal costs. This is due to wide-spread electronic and information technical standards and the fact that important parts of the (re-) production facility, i.e. the computation environment, are paid, installed and maintained by the customer. In other words marginal costs for production and logistics become evanescently small even for small quantities. Total costs for digital products mainly consist of design costs and fixed costs for producing the digital representation of a digital product. Because costs for reproduction are almost zero, traditional pricing theories based on marginal costs and demand are not applicable for digital goods but are replaced by "price - value" relations, i.e. the marginal costs of producing information of a certain value that is desired by customers (e.g. Choi et al. 1997). Markets for information goods exist if the functional relation between marginal costs and the willingness to pay by the customer determine a price.

Adoption and diffusion processes on Electronic Markets are most commonly explained in scientific publications using Roger's IDT. According to the IDT, the adoption of technological innovations is a function of one's innovativeness or willingness to try new products (Rogers 2003). Different publications and studies on the adoption process of new technologies find that the rate of adoption – the relative speed with which an innovation is adopted by members of a social system (Rogers 2003:221) – depends on demographic variables and perceived characteristics of innovations (Rogers 2003:222). For example, Dutton et al. (1987) shows that early adopters of computers and cable television tend to be better educated and have a higher socioeconomic status (SES). An early framework for examining the commercial development of the Web was developed by Hoffman et al. (1995). In their framework they explore the impact of the Internet as a distribution channel and as a medium for marketing communication. The study of Eastin (2002) analyses different concepts of adoption by investigating the adoption of four e-commerce applications currently available to Internet users: online shopping, online banking, online investing and electronic payment for an Internet service (i.e. access to exclusive sites) (Eastin 2002). He shows that attributes of IDT like perceived convenience and financial benefits, risk, previous use of the telephone for a similar purpose, self-efficacy and Internet use are significant variables of the adoption process. In their study Rangaswamy and Gupta (2000) analyse the adoption process of free digital products such as free software or e-commerce of non-digital products where the adoption decisions occur online and physical exchange takes place outside digital media.

3. Adoption and Diffusion on Electronic Markets: Influencing Attributes

The models of Rogers (2003) or Rangaswamy and Gupta (2000) predict that electronic markets can influence both adoption and diffusion process in significant ways through the quality and quantity of information that potential adopters use for their decision to adopt an innovation and the facility of word-of-mouth and marketer-controlled communications.

Bass (1969) developed a model for adoption and diffusion of new products. The basic assumption of the Bass model is that adopters are influenced in their timing of adoption by pressures from the social system. Pressure increases for later adopters with the number of previous adopters. The mathematical formulation of this assumption is, that "the probability that an initial purchase will be made at T given that no purchase has yet been made is a linear function of the number of previous buyers" (Bass 1969: 216):

$$P(T) = p + \left(\frac{q}{m}\right) Y(T)$$

where p and q/m are constant, Y(T) is the number of previous buyers, p the probability of initial purchases at time T=0 and q reflects the fraction of all adopters who are innovators in the sense in which Rogers defines them. Bass called the constants p and the coefficients of innovation and imitation q. These

coefficients have also respectively been termed as the coefficient of external influence and internal influence (Mahajan, Muller, Bass 1990). Bass (1969) tested his model by regression estimates on the parameters using annual time series data for eleven different consumer durables. His results indicate that his model describes the growth rate behaviour.

Rangaswamy and Gupta (2000) have some specific propositions about how the Internet will influence the parameters of the Bass model. They predict that electronic markets will become ubiquitous and propose that (1) the overall market for digital paid content is larger than for traditional paid content as firms would be able to reach more customers (for example, in foreign markets) more effectively in both the early and later stages of the life cycle of the product. (2) Imitation effects will become larger in digital media than in traditional content markets due to cheaper and faster communication, and (3) innovation effects will become larger in digital media than in traditional content markets due to richer and deeper product information.

Hence they predict that a larger market m increases total sales of digital products, whereas larger values of innovation p and imitation q increase the speed of adoption. Based on these propositions, they expect that digital products would diffuse faster online than offline. Rangaswamy and Gupta (2000) further argue that the digital medium will have some influence on consumers' adoption decisions for new products and technologies "both for products that are available only online (such as online auctions) and for products that are available primarily offline at present (such as the movie Titanic)" (Rangaswamy, Gupta 2000).

Based on the models of Rogers (2003) and Bass (1969) and the consideration of Rangaswamy and Gupta (2000) two hypotheses are derived:

> H_1: The adoption and diffusion of paid content products, measured by the parameters of the Bass model (m,p,q), does not significantly differ from the adoption and diffusion of other digital product types.

This hypothesis should help to analyse the proposition of Rangaswamy and Gupta (2000) which states that in an electronic market firms would be able to reach more customers, sell more products and in addition the speed of adoption is faster online as by traditional non-digital channels.

> H_2: The adoption and diffusion of paid content products, measured by parameters of the Bass model (m, p and q), differs significantly between different types of digital paid content and are significant larger if there exits an established, non-digital counterpart.

If this hypothesis holds, total sales of the digital product will be higher and the speed of adoption is likely to be faster if the type of content product is already established in non-digital media and its use well known.

4. Empirical Analysis

The hypotheses for adoption and diffusion of paid content on electronic markets were tested on a set of data of a leading German micropayment provider FIRSTGATE Internet AG. FIRSTGATE click&buy™ is a micropayment system where users register only once in order to be able to buy paid content or services from all suppliers, who settle their digital goods with this system. At the end of the month customers get only one bill from FIRSTGATE with a listing of all purchases. Between July 2000 and December 2003, 6,5 million purchase transactions from 1,6 million registered customers and 2500 active sellers had been handled. Each purchase transaction contains a customer and seller identification number (short "ID"), date, time and the sum of revenues. The seller' dataset contains an ID, seller's name, the websites with URL and the different prices of offered goods. Because of the dominant market position of FIRSTGATE Internet AG, this dataset provides a large coverage and is a representative sample of the German paid content market.

To test the first hypothesis the whole dataset was analysed to determine the parameters and coefficients of the Bass model (1969) by regression estimation. For the empirical analysis of the second hypothesis a sub sample of 17 paid content suppliers was drawn. The criterion of extraction was that some suppliers offer paid content that are innovations and have no correspondence in traditional "offline" markets (e.g. online software to build a website, online software to be listed on search engines or adult content in bundle with features for video-conference) and that other suppliers offer paid content with established, non-digital counterparts (e.g. printed newspaper or finance information on television). The sample of these 17 paid content suppliers and the type of information goods is listed in table 1.

4.1 Method and Results

The data analysis was conducted in three steps. First the number of adaptors by month and sellers were computed. Second the parameters and coefficients of the Bass model (1969) were analysed by regression estimation for each supplier. Finally differences of Bass model parameters and coefficients between different types of paid content were analysed .

For comparability, Bass (1969) quadratic equation of the regression estimation is also used in our analysis. In the basic Bass model the sales function at time T is defined as follows:

$$S(T) = pm + (q-p)Y(T) - q/mY^2(T)$$

Bass (1969) estimates the parameters p, q, and m from discrete time series data by using the following quadratic equation: $S_T = a + bY_{T-1} + cY^2_{T-1,}$ where S_T are the sales at T and Y_{T-1} are the cumulative sales through period T-1 ($Y_{T-1} = \sum_{t=1}^{T-1} S_t$). By using this quadratic equation for the regression estimation, the variable a estimates pm, b estimates q-p and c estimates –q/m, thus the calculation of the parameters of q, p and m is possible by transformation.

To test the first hypothesis H_1 the parameters of q, p and m were calculated for all 1.596.679 adopters in the paid content market in the period between July 2000 and December 2003, independent of the content type or seller. The run of the number of adopters – the diffusion of the digital paid content products – is illustrated in figure 1.

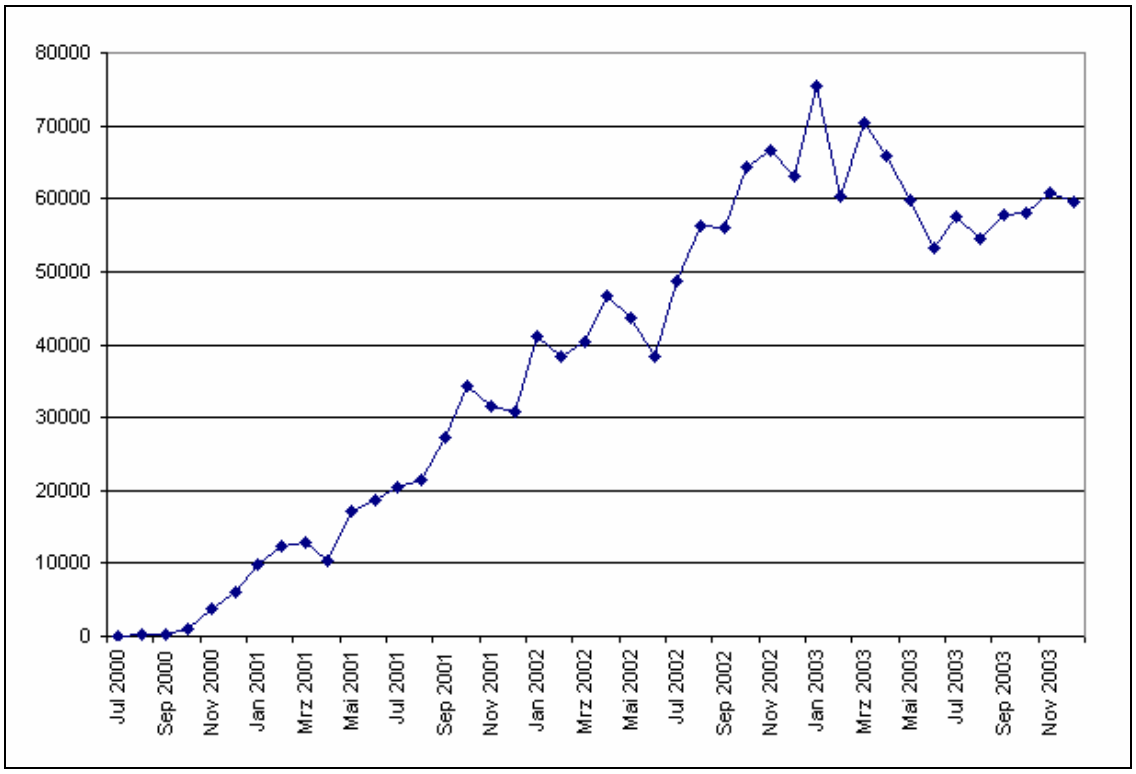

Figure 1: Number of Adopters of Paid Content Products

The results of the parameters m, q and p of the whole paid content market are listed in table 2.

Number of initial purchases during the whole life-cycle of a product	m	1039811
Probability of initial purchases at time T=0	p	0.00648811
Fraction of all adopters who are innovators	q	0.063948391

Table 2: Parameters m, q and p of the Bass (1969) model of the whole paid content market

The comparison of these results for the adoption of paid content with the results of Bughin (2003) on the diffusion of Internet Banking or with the results of Rangaswamy and Gupta (2000) on the diffusion of free software or online shopping shows that all parameters m, p, q are much smaller for digital paid content than parameters for other digital goods. Rangaswamy and Gupta (2000) show by means of adoption patterns that 2 million customers adopted the online shop of amazon.com between Dec. 1996 and Dec. 1998 and 25 million users

adopted the free Netscape software between Sep 1994 and Sep. 1998. As such, Hypothesis H1 is rejected.

To test the second hypothesis H2 the parameters of q, p and m are calculated separately for the 17 suppliers of paid content products. For validation or rejection of hypothesis 2 the average of the parameters m, p and q are calculated separately for the two supplier groups. The first supplier group (9 suppliers) offers digital paid content with established non-digital counterparts, such as printed newspapers or finance and stock information. These products are available primarily offline and their use is well known. The second supplier group (8 suppliers) offers digital paid content without a non-digital counterpart. Hence, these digital products are only available online and their use and consumption are novel and were unknown before the Internet era.

The values for the two supplier groups and paid content (digital) product types are listed in table 3.

Paid Content Product Type	**m: Number of initial purchases during the whole life-cycle of a product**	**p: Probability of initial purchases at time T=0**	**q: Fraction of all adopters who are innovators**
Existence of a non-digital counterpart. The use of the paid content product is established	30543	0.0209	0.0757
Product only available online and the use and consumption is novel	9189	0.0783	0.1870

Table 3: Parameters m, q and p of the Bass (1969) model for different paid content product types

The results in table 3 show that the number of initial purchases during the whole product life cycle is more than three times larger if there exist a non-digital counterpart. But the probability of initial purchases at time T=0 (coefficient p) and the fraction of all adopters who are innovators (coefficient q) and thus influence the speed of adoption, are more than twice as fast if the digital product has no established offline counterpart.

In the following section results are discussed in the context of existing theories and implications are drawn.

5. Discussion and Implications

Rangaswamy and Gupta (2000) empirically argue for differences in online shopping in their paper by charting adoption patterns for Netscape and Amazon.com. Netscape created an entirely new product category (browser software), whereas Amazon.com shook up an existing industry (books). The data for Netscape shows the rapid frequency with which the company introduced new products (a new version almost every six months) and encouraged rapid diffusion by allowing the product to be downloaded. This online channel constituted an innovative alternative for delivering products to customers. Amazon.com data shows the rapid adoption of a business model in a category where customers make choices and purchases online but products are delivered by traditional non-digital channels. Based on their empirical findings Rangaswamy and Gupta (2000) argue that in the digital economy a larger market m increases total sales of a product, whereas larger values of innovation p and imitation q increase the speed of diffusion.

The empirical results in the previous section show that the adoption and diffusion of digital paid content products significantly differ from other digital products. In comparison to the results of Bughin (2003) and Rangaswamy and Gupta (2000) these results now show that the number of initial purchases of digital paid content products are significantly smaller than the number of initial purchases of other digital products. Furthermore, on average the speed of diffusion is significantly slower for paid content products as the speed of diffusion for other digital products. Thus the results for paid content show a significant difference to for the adoption and diffusion process of other digital products.

As mentioned, information goods like digital paid content have special economic characteristics pertaining to the experience of the good and the economies of scale, which would seem to cause difficulties for market transactions. These difficulties for market transactions are a possible explanation for the slower adoption and diffusion process of paid content products (see table 2) in comparison to other digital products (eBanking, free software, online shopping).

Therefore hypothesis H1 must be rejected, because the parameters of the Bass (1969) model for the adoption and diffusion - m, p, and q - are smaller for digital paid content in comparison with other digital products.

The analysis of different types of paid content products shows, that the existence of an established, non-digital counterpart plays an important role for the adoption and diffusion process. Hypothesis H2 was, that the parameters m, p, and q of the Bass (1969) model are larger for paid content if an established, non-digital counterpart were existent. The results in table 3 show that this hypothesis cannot be rejected completely. The number of initial purchases during the whole life cycle of a paid content product is several times higher if established, non-digital counterparts existed. But the parameters p and q, the coefficients of innovation and imitation, are twice as big if the digital product is not available in the "offline" world. This part of hypothesis 2 can be rejected.

These results show empirical evidence for the expectations of Rangaswamy and Gupta (2000) that the digital medium will have some influence on consumer's adoption decisions for new products and technologies both for products that are

available only online and for products that are available primarily offline at present. The results in table 3 also show that the influence on consumer's adoption decisions differs significantly if the product is available only online or primarily offline. The number of initial purchases is several times higher if the product type is primarily available and established offline. But the speed of diffusion is faster if the product type is primarily available online. These results shall help media managers to design business models for paid content by forecasting the adoption and diffusion process of the offered digital product type. Insofar as the model of Bass (1969) contributes to an understanding of the process of paid content product adoption, the results presented in this paper may be useful in providing long-range forecasting.

6. Conclusions

This paper has shown that the adoption and diffusion of digital paid content products significantly differ from the adoption and diffusion process of other digital products and are significantly slower. It is also shown that the adoption and diffusion of digital paid content products differ if an established, non-digital counterpart exists. Regarding online adoption behavior, the results show that customer adoption processes of paid content could differ systematically from decision process of other digital products. These findings are correlated with the difficulties of market transactions of information goods.

A goal of further research is the development of a research design which enables higher significances of regression estimations. Furthermore, in future research the assumption must be changed that suppliers keep their products or business models unchanged during the time period of observation simply by the assumption of dynamic behaviour. Of course further research has to be done in this area in order to analyse the adoption and diffusion process of digital paid content products in comparison with the simultaneous adoption and diffusion process of non-digital counterparts. A correlation of these adoption and diffusion processes is conceivable and predictable.

Paid content is still an innovation in its early stage (Zerdick et al. 2001). In fact, paid content was assumed being almost impossible at the early days of electronic commerce when content generally had to be for free and subsidised by online advertisements (Devan et al. 2003). But high search costs and heterogeneous quality levels of free content nurture the market for high-quality paid content markets for particular needs and on particular topics (Davenport, Beck 2001).

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