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Learning How to Consume and Returns to Product Promotion

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Abstract

This paper presents the computational model of consumer behaviour. We consider two sources of product specific consumer skill acquisition, termed here as learning how to consume: learning by consuming and consumer socialization. Consumers utilize these two sources in order to derive higher valuations for products they are consuming. In this framework we discuss the behavior of returns to product promotion relative to the changes in product characteristics, such as quality and user-friendliness, as well as in case of varying intensity of consumer socialization. The main finding is that in case of duopoly the dependence of returns to advertising on product quality is not monotonic as it has been claimed by earlier studies. Additional important finding indicating the importance of the models with interacting agents is that returns to advertising exhibit qualitatively different behavior in case of zero intensity of consumer socialization.

Key Words: *Consumer skills, learning by consuming, consumer socialization, product promotion, returns to advertising.*

JEL codes: *D11, M37, C63.*

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Introduction

The process of consumer decision making is complex. It is influenced by numerous forces, some of them more important than others. Our everyday decisions about which products to purchase are largely influenced by our own consumption history, by information coming from our social network, as well as by information received from media.

At the same time, in today's world of advanced technologies, many products need specific consumption skills in order to be utilized to their maximum capacity. These skills are acquired by consumers through consumption, as well as through a socialization process.

This paper looks at the influence of the consumer skill acquisition process on consumers' decisions on product choice in case of substitutes. We discuss two sources of consumer skill acquisition: learning by consuming and consumer socialization process. Learning by consuming means that consumers acquire skills along the consumption process, while consumer socialization implies that consumers get the skill spillovers from their social network.

In this framework, as new product enters the market it will be met with some initial skill distribution over the population of consumers. Consumers who purchase new product will acquire more skills through the consumption process, and these skills will be further diffused through a socialization process. Thus, consumer purchasing decisions have temporal effects on average skill levels over the population. High rates of initial market penetration of a new product will ensure the fast acquisition and diffusion of skills across the population, which implies that new product will be able to grab higher market shares in process of transition to its equilibrium market share. Thus, in this framework there is the scope for studying product promotion policies, which are bound to have temporal effects on market shares. We discuss effects of policies that can influence the probability of consumers purchasing certain products.

The products that we have in mind are the products which are relatively durable in order to ensure some time spent on using them. They are repeatedly purchased by households and are technologically sophisticated to some extent. This description fits well the group of products called "consumer electronics." This class of products has one more characteristic which makes it particularly interesting for us: the products in this category are widely advertised. According to AdvertisingAge, in year 2007 producers of consumer electronics in the USA spent 50% of their profits on advertising.¹ This indicates that producers of this class of products rely heavily on advertising as the way of promoting their products.

The paper is organized as follows. The first section shortly reviews the existing related literature in economics, business and sociology. Section two formulates the model, section three discusses the effects of product promotion under different market structures. The last section summarizes the paper and concludes.

1 Related literature

In terms of methodology, the current paper is related to two growing bodies of literature about heterogeneous agents and about non-market interaction among them. Heterogeneous agent models present an

¹Source: 2007 advertising to sales ratios for 200 largest ad spending industries, www.adage.com.

alternative to models employing the representative agent. In the late 1980's and early 1990's a criticism of the representative agent emerged, concerned with its ability to correctly describe the behavior of an economy populated with heterogeneous agents and its inability to address distributional issues (Kirman 1992). Although in a recent paper Caselli and Ventura (2000) give directions how to construct representative agent models where one can discuss distributional issues, additional restrictions on model construction in these cases remain. The model presented in this paper does not have a representative agent. Along with the heterogeneous agents, we have heterogeneity product characteristics.

Modeling non-market interaction among economic agents has a long tradition, but it has become more important in last two decades. There are models about non-market interactions between consumers and producers (e.g. Scheinkman and Woodford 1994; Weisbuch and Battiston 2007) as well as interactions among the consumers (e.g. Eshel et al. 1996; Cowan et al. 1997). In general, interactions generate some kind of feedback loops that affect the decisions of the economic agents. As noted by Glaeser and Scheinkman (2000) the structure of those interactions does matter for the outcome we obtain at the end. In particular, they show that in case of local interactions systems generate more interesting dynamics, having multiple equilibria and possibility of moving from one equilibrium to another. More contextualized works show that interaction can explain certain interesting phenomena in economics and other social sciences, like standardization process (e.g. Arthur 1989; Cowan 1991; Eshel et al. 1998), waves in consumption across the population classes (Cowan et al. 2004) or contagious justice (Alexander and Skyrms 1999).

As far as processes involved in our model are concerned, the paper relates to four other strands of literature: about consumer socialization and communities of practice, about learning to consume and about temporal effects of advertising. Consumer socialization and consumer skill sharing have been identified as being important for various social processes first in sociology in 1950's and 1960's (e.g. Roszak 1969) and then in the business literature in 1970's (e.g. Moschis and Churchill 1978). Sociologists have been concerned with consumer skill acquisition by adolescents through interaction with peers as well as parents, but aspects of life-time-long learning have been also discussed (Ward 1974). Marketing academics have also studied the consumption skill acquisition of young people, as learning processes and more pronounced in this age-group (Moschis and Churchill 1978). Although some aspects of consumer socialization processes have been discussed in economics, to the best of our knowledge, consumer skill sharing through social processes has not been studied. This paper contributes to filling this gap.

Economics has shown some interest in communication among creative individuals. Literature about communities of practice is concerned with the effects of task-related communication among people in organizational context (Brown and Duguid 1991). Interaction in context of communities of practice is regarded as a very efficient tool of sharing knowledge within social networks (Leve and Wenger 1991).

The idea of skill acquisition through consumption has been introduced to economics by Ulrich Witt (2001) under the notion of "learning to consume." The author differentiates among the two aspects of learning through consumption: cognitive and non-cognitive. Witt discusses the subject through the lens of changing preferences and argues that both types of learning (cognitive, as well as non-cognitive) change the consumer preferences and, as a result, the future pattern of consumption of an individual. In this paper I formalize part of Witt's learning to consume ideas. In line with Witt (2001), I claim that

consuming certain products gives incentives to consume this product again. The mathematical modeling of learning forces in this paper takes quite general form which can accommodate cognitive, purposeful learning, as well as non-cognitive learning, which in our context might be an accidental discovery of new (unknown to a consumer) features of the product in the process of consumption. The latter part is profoundly different from the definition of non-cognitive learning by Witt (2001), who looks at the matter from the angle of associative learning. There are also other distinctions between forces modeled in this paper and forces considered by Witt (2001). Here we only discuss learning in a single product context, rather than learning to (in general) consume. We concentrate on consumers acquiring skills to better utilize separate products. To stress these similarities and distinctions, learning process discussed in this paper is named “learning how to consume.”

In contrast to the literature about non-market interactions, the literature about the temporal effects of advertising is quite rich in economics. The topic was especially important in the 1970s and 1980s, while in business and marketing literature advertising is still a popular topic. The ground for theoretical work on advertising was laid by Phillip Nelson (1974; 1978). Nelson considered advertising as a signal of product quality and speculated about the effects of advertising and its differences across types of products. He split the product space in two: “experience goods,” goods whose characteristics can be learned only through experience, and “search goods,” whose characteristics are observable prior to purchase. Nelson claimed the advertising would have a higher impact on “experience goods,” thus expected experience goods to be advertised more. He obtained empirical support for his expectations (Nelson 1974). Some time later, Nelson’s speculative ideas were formalized by Milgrom and Roberts (1986). They discussed only experience goods and concentrated on the impact of advertising across the product quality. They found that high quality brands would advertise more than low quality brands. Empirical support for this finding was provided by Nichols (1998). Milgrom and Roberts (1986) also added one more option for quality signaling, through prices, and found that if signaling through prices was an available option, producers would prefer it over signaling through advertising. In this model the high quality brands would still have higher incentive to send signals (be it through prices or advertising).

Another big part of literature is concerned with the welfare impact of advertising. In the early stages of the development of this literature, it was believed that advertising resulted in a loss of social welfare and economists advanced arguments against it (e.g. Kaldor 1950). In the 1990s economists took on this subject and presented models showing that (some forms of) advertising could lead to improvements in social welfare (e.g. Stegeman 1991; LeBlanc 1998). Becker and Murphy (1993) present the most elaborate model concerned with welfare implications of advertising and show that whether advertising has positive or negative welfare effects depends on several factors (e.g. the degree of competition on the markets for advertised goods).

Works on the effects of advertising in business and marketing are mostly empirical. In series of papers Comanor and Wilson (1967; 1969; 1979) provided extensive empirical support to the idea that advertising had a significant positive effect on firms profits and this effect was positively correlated with firm size. Thus, they concluded advertising can be used by incumbent firms to create entry barriers. Recent literature puts emphasis on the search for the optimal temporal advertising policies. It has been identified that pulsation advertising policies are more efficient than uniform advertising policies on wide

range of markets (Vande Kamp and Kaiser 2000). Mesak and Zhang (2001) provide the theoretical support for this finding on monopolistic markets. But in general search for the optimal temporal policy has not yielded any clear recommendation for businesses. More theoretical work has to be done in this direction. One more direction of empirical research tries to measure the returns on advertising (Mariel and Orbe 2005) and asks the question whether these returns can generate long-run comparative advantage for the advertisers. Erickson and Jacobson (1992) find that once one controls for the unobserved firm-specific factors advertising returns are not enough to create long-run advantages. This contradicts to Comanor and Wilson (1969) who claim that advertising can be used for creating barriers for extended periods.

In the next section we present the model that uses heterogeneous agents (Kirman 1991), who locally interact outside the market (Cowan et. al. 1997). Consumer skills, that are acquired through consumption (Witt 2001), are diffused among agents through those non-market, social interactions (Ward 1974). We use this model to study the returns on advertising (Mariel and Orbe 2005) and its impact on market shares of advertisers, which are the indication of market power (Comanor and Wilson 1967). I show, that in case of duopoly, result of Nelson (1974) and Milgrom and Roberts (1986), that higher quality implies higher returns, does not hold.

2 The model

Consider an economy with many heterogeneous agents, who have to choose one product every period from an available product set. Each consumer (s) has an idiosyncratic valuation (v) for every product (n) at every time period (t). Valuation of a product for a consumer is the maximum price this consumer is willing to pay for this product.

On the supply side, assume there are many (substitute) products with different qualities (λ) offered on the market. We assume that λ can be measured in monetary units. We abstract from the differences in prices as well as from the possibility of their temporal change and fix the prices of all the products to be equal to a constant over time.

Consumers are myopic: they make decisions by maximizing one-shot utility. We follow a standard discrete choice literature and model consumers' choices probabilistically. The probability that the consumer s will choose product n at time t is a function of the vector of valuations (\mathbf{V}_t^s) that a given consumer holds for a given time period.

Assume that valuation is multiplicative in two parts: one is the quality of the product (λ), the other is the consumer skill level ($k \in [0, 1]$), which we assume to be product-specific. If a consumer's skill level is 1, she can utilize the given product to its maximum capacity, thus her valuation of the product will be equal to the product quality.

Skill levels change over time: consumers learn through consumption and through socialization. We assume that learning by consuming happens at a decreasing rate and specify the learning function:

$$k_m^s = 1 - (1 - k_0^s)e^{-\delta m}, \quad (1)$$

where δ is the speed of learning, k_0^s is the initial skill level of agent s for the product under discussion and m is the number of consumptions prior to (and including) the current one.

From equation (1) we can derive the change in skill levels between two subsequent consumptions of the same product

$$k_{m+1}^s - k_m^s = \gamma(1 - k_m^s), \quad (2)$$

where $\gamma = 1 - e^{-\delta}$.

Using equation (2) one can write the law of motion for the valuations of a product, while abstracting from the consumer skill sharing process. Recall that $v_t^s = k_t^s \lambda$, thus multiplying both sides of the equation (2) by λ will yield:

$$v_{m+1}^s - v_m^s = \gamma(\lambda - v_m^s). \quad (3)$$

Every time period t agent s chooses the product n for purchase with the probability $p_{n;t}^s(V_t^s)$. This implies that

$$E_t(v_{n;t+1}^s) = v_{n;t}^s + \gamma_n(\lambda_n - v_{n;t}^s)p_{n;t}^s. \quad (4)$$

An important thing to note with the equation (4) is that besides the product-specific quality level, expected dynamics of valuations also depends on a product specific speed of learning (γ_n). This parameter can be interpreted as user-friendliness. If γ_n is high, skill acquisition for the product is fast, while in case of low γ_n it takes lot of time before skill level of a consumer converges to its maximum.

As about the socialization process, we assume that every consumer is interacting with the small and constant group of people. Through this interaction she can acquire product specific consumer skills at some rate if any of her friends has higher consumer skills for this product than she does. For the sake of tractability, assume that consumers are aligned on a unidimensional lattice (circle) and that each of the interacts with only two neighbours (one on each side). She can learn from only one neighbour in any period and we assume that she is choosing the most skillful neighbour in this certain product and if her skills are lower then those of her that neighbour, she learns from neighbour at rate μ . So, ignoring the learning through consuming for a moment, the effect of consumer socialization on valuation can be written as

$$k_{n;t+1}^s = k_{n;t}^s + \mu (\max(k_{n;t}^{s-1}; k_{n;t}^s; k_{n;t}^{s+1}) - k_{n;t}^s). \quad (5)$$

It is important to note that μ is neither product, not consumer specific. In principle μ can well be consumer specific, which would reflect the differences in absorptive capacity of consumers. But that would further increase the already large parameter space of the model, so one can think of μ as the interaction intensity, which can be thought of as a characteristic of the society.

To combine two forces of consumer learning assume that despite of product choices, socialization affects the valuations of all the products every time period. This means that consumers acquire some skills for every product at every time period (given that they have not reached the highest skill level and they are not the highest skilled consumers in their neighbourhood). Multiplying both sides of equation (5) by λ_n and combining it with the equation (4) gives the full specification of the model

$$E_t(v_{n;t+1}^s) = v_{n;t}^s + \gamma_n(\lambda_n - v_{n;t}^s)p_{n;t}^s + \mu(\max(v_{n;t}^{s-1}; v_{n;t}^s; v_{n;t}^{s+1}) - v_{n;t}^s) \quad (6)$$

It is important to note that the expected law of motion of product valuations is product-specific, as well as consumer-specific. Thus we have $N \times S$ of these equations (where N is the number of products, and S is the number of consumers in the economy). For any reasonable shape of the probability function, it is impossible to obtain an analytic solution for this large system. Due to this complication we use numerical simulations to address research questions.

3 Returns to product promotion

The model specified in section 2 can describe the dynamics of purchasing probabilities of every product for every consumer in the economy. This property seems to be particularly appealing for studying market share dynamics of products on markets with fixed sizes. An important aspect of competing for market share is product promotion. Producers can promote their product and affect the purchase probabilities of consumers. One widespread tool for product promotion is advertising. From the review of literature in the section 1 of this paper, it is obvious that academics have regarded advertising as a tool for signaling the product quality. Early speculations on the topic resulted in intuitions that high quality brands should have higher incentive to advertise (Nelson 1974). The following theoretical work (e.g. Landes and Rosenfield 1994) has been built on this intuition and empirical research has provided the support from real-world data (e.g. Nichols 1998).

In this section we discuss the effects of product promotion implied by the model presented in section 2.² We show that if one allows for the product with sufficiently higher quality than that of its rivals, the producer of that product will not have higher incentive to advertise. For plausible variation in qualities, this finding can be only supported under the condition of sufficiently small number of products available on the market (e.g. case of duopoly). Once number of product increases, the difference in quality becomes not plausible for supporting the finding above. Thus, if we would look at markets with many goods, we would see the returns for higher quality brands being higher (in line with Nichols 1998). This finding suggests that dependence of advertising returns on quality is influenced by the market structure, measured by the number of competitors, a variable that has been completely omitted from previous analysis.

In order to discuss the returns to product promotion we have to introduce couple of notions and specify the ways we measure important variables. We do this in the following section.

3.1 Measurement

Measuring a market share. As we are studying markets with constant size, we can, without a loss of generality, normalize their size to unity. Then, market share of product n will simply be the average of probabilities of purchasing product n across the agents:

²Although in some places throughout the paper we refer to this phenomena as advertising, the modeling takes a general form so the intuitions can be applied to any other type of product promotion.

$$h_{n;t} = \frac{1}{S} \sum_{s=1}^S p_{n;t}^s. \quad (7)$$

Following discrete choice literature (Anderson et al. 1992), we assume that probability of the product n to be chosen by agent s at time t is described by the multinomial logit function

$$p_{n;t}^s = \frac{e^{v_{n;t}^s}}{\sum_{i=1}^N e^{v_{i;t}^s}}. \quad (8)$$

Thus, ultimately, market share dynamics depends on the dynamics of valuations. It is easy to verify that as, $\forall s$ and $\forall n$, $k_n^s \rightarrow 1$ market share distribution becomes time-invariant:

$$\bar{h}_n = \frac{e^{\lambda_n}}{\sum_{i=1}^N e^{\lambda_i}}. \quad (9)$$

Equation (9) implies that $\bar{h}_n \propto e^{\lambda_n}$, which effectively means that products with higher quality are guaranteed with higher equilibrium market shares.³ Equilibrium market share distribution does not depend on any other parameter of the model. The rest of the parameters influence only the transition path to the time invariant distribution.

The measure of returns to product promotion. Stemming from the discussion in section 1, an interesting question about advertising is the optimal temporal advertising strategy. Intuitively one can see that in this model the effects of product promotion are anchored to skill acquisition. If the average consumer skill level in the population has not reached its maximum for product n advertising will influence not only the probability of purchase of product n at time when there is advertising, but also during the next periods as higher purchase probability today ensures higher rate of skill acquisition, which influences the purchase probability for the next period. Thus, as long as advertising is undertaken before the average skill level reaches unity, it has a long-lasting effect (Landes and Rosenfield, 1994), influences the transitional dynamics to the time invariant market share distribution and can create barriers to entry (Comanor and Wilson 1974). On the other hand if advertising takes place after everybody has learned how to utilize product to its maximum capacity, it will not have any effect on purchasing probability in subsequent periods.

Thorough discussion of this topic is beyond the scope of current paper, and due to the lack of the theoretical work on the subject we are confronted with the choice of the advertising strategy in order for the discussion on returns that we want to undertake. Thus, we consider the choice, whether to advertise or not to advertise, rather than how much to advertise, or how to advertise. We assume that for some fixed cost, which is constant across producers, the producer of the product n can influence every consumer's probability of buying the product n at time zero, in a following manner: if without advertising, given \mathbf{V}_0^s , consumer s would buy product n with the probability given by equation (8), with advertising of product n the probability would be

³The model with similar outcome has been analyzed by Kihlstrom and Riordan (1984), while Schmalensee (1978) has presented the model where products with lower qualities can have higher equilibrium market shares.

$$\hat{p}_{n;0}^s = \frac{A + e^{v_{n;0}^s}}{A + \sum_{i=1}^N e^{v_{i;0}^s}}, \quad (10)$$

where A is the effect of advertising, which is constant.

It takes simple algebra to notice that $\hat{p}_{n;0}^s > p_{n;0}^s$ as long as $A > 0$, which we assume is the case. From here we can deduce, that $\hat{h}_{n;0} > h_{n;0}$. Following the temporal effect argument earlier, we can argue, that as long as $(1/S) \sum_{s=1}^S k_{n;0}^s < 1$, $\hat{h}_{n;1} > h_{n;1}$. And in general, $(1/S) \sum_{s=1}^S k_{n;t-1}^s < 1 \Rightarrow \hat{h}_{n;t} > h_{n;t}$. So, advertising results in market share gain over the extended period of time if producer advertises during the first period when its product was put on the market.⁴ Then we can measure the return to advertising as

$$r_n = \sum_{t=0}^{\infty} (\hat{h}_{n;t} - h_{n;t}), \quad (11)$$

where r_n is the return on advertising for the product n .

3.2 Examples

As we argued earlier, advertising will have temporal effects through its influence on skill level. This effect depends on parameter γ - the user-friendliness of a product. If γ is high the the probability gain of the same size will result in higher average skill level and thus in (on average) higher valuation of the product during the next period, compared to when γ is low. But at the same time higher γ would also directly imply the higher skills and the valuation of the product next period compared to lower γ . Thus the size of an additional market share that advertising brings in case of lower or higher γ is not clear right away.

Returns to advertising also depend on product quality (λ). Higher the quality, the more time it takes to reach the equilibrium market share for given initial valuation and γ . Thus there is potential for higher return on advertising. But at the same time, consider the situation when only two products are competing on the market. Assume their qualities and user-friendliness measures being the same, in this case without advertising both products will have half of the market share, if we also assume they start from equal average initial valuations. For this situation advertising of one of the products will gain extra market share to it, which is the measure of return to advertising. Now consider one of the products having much higher quality, *ceteris paribus*. Consider the case when the difference between λ ' is so high, that the equilibrium share of the better product is 95%. Will this better product have higher return to advertising? It is not clear as product would quickly acquire its market share even without advertising, so returns to advertising for this scenario would be marginal.

Returns also depend on μ , which we interpret as socialization intensity. Socialization helps the diffusion of consumer skills in society. In part, advertising does the same, through increasing the probability of purchase and, consequently, skill levels. Thus, socialization can be viewed as the substitute to advertising. From this intuition higher socialization rate should result in lower returns to advertising. But, advertising does something that socialization does not, which is increasing the maximum skill level in the economy. Recall that learning through socialization only takes place if consumer's neighbours have higher

⁴The only case when this statement is not true is when $\forall s v_{n;0}^s = \lambda_n$, which we rule out as it does not involve any learning, thus is not interesting.

skills than she does, thus the person with maximum skill level in the economy will never learn anything through socialization. But she can accumulate skills through consumption though, which is affected by advertising. So, socialization can be also viewed as complement to advertising as it supports the diffusion of skills created through advertising. Thus causal relation between γ and r is not clear either.

As a result, none of the interesting parameters in our model has monotonic relationship to returns to advertising, thus none of them could be excluded from the analysis of returns. Next we use the r measure to analyze the effects of product promotion in different scenarios. Although we are mostly interested in the case of duopolistic market (the second scenario), we present the first scenario as a benchmark in order to fix certain intuitions, and the third one as the attempt to shed some light on the effect of number of products on returns to advertising.

3.2.1 A product entering a mature market

The simplest way to understand the intuitions of the model for the returns to product promotion is to discuss it in context of a new product entering a mature market. We define a mature market as market which consists of goods that have been on the market for long enough for all the agents to acquire maximum possible skills. In this case, if one puts a new product on this market, its returns to advertising will depend only on characteristics of itself (besides consumer socialization intensity). Assume that there are $N - 1$ products on the mature market indexed by $j = 1, 2, \dots, N - 1$ and we put new product n on this market. Then, n 's market shares can be tracked by

$$h_{n;t} = \frac{1}{S} \sum_{i=1}^S \frac{e^{v_{n;t}^i}}{b + e^{v_{n;t}^i}} \quad (12)$$

where $b = \sum_{j=1}^{N-1} e^{\lambda_j}$ is constant. In this case valuations of the all incumbent products do not change as, by definition, all the consumers have skills for these products equal to unity. As one can see from equation (12) expected law of motion of valuations for the product n will be altered with products user-friendliness: higher γ will mean that every agent will acquire consumer skills faster, thus starting from any arbitrary $v_{n,0}^s$ valuations will converge to λ_n faster and our new market share distribution will also converge to the new time-invariant distribution faster. Thus higher user-friendliness will mean that products can penetrate markets and obtain their long-term market share faster.

For understanding the relationship between γ and r as well as μ and r we simulate the model specified in section 2. Consider a mature market where the qualities of incumbent products are distributed in such a way that $b = 500$. We restrict all the incumbent products from advertising. As we argued before, advertising will be inefficient for incumbent products, thus in general they will not have an incentive to advertise. Even if any (or all) of them advertise the results reported in this section would change slightly quantitatively, while they would stay the same qualitatively. Assume that we have 100 agents consuming and interacting in a way defined in the section 2.

Consider a new product with quality $\lambda = 5$ entering the market. If $b = 500$ and $\lambda = 5$ we know, that the equilibrium share of the product will be around 23% of the market. The initial skills for consuming the new entrant are distributed uniformly on interval $[0, 0.4]$ over the consumer space, thus the average skill level is equal to 20%.

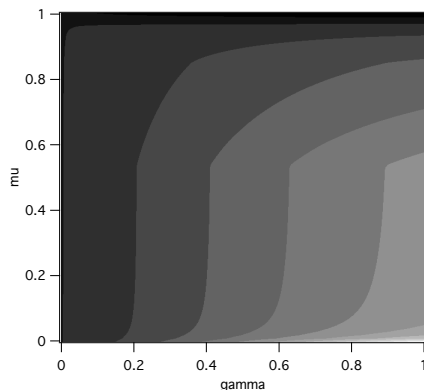


Figure 1: Dependence of returns to advertising on product user-friendliness and consumer interaction intensity on mature market.

The new entrant can advertise. As we noted before, we discuss only the advertising-not advertising decisions, thus we can fix the parameter A . As we do not have a clear idea how to calibrate the parameter, we choose its value arbitrary, to be equal to 1. We use $A = 1$ in whole paper, thus when I discuss the returns to advertising, we talk about the difference in outcomes of two scenarios: when $A = 1$ and when $A = 0$.

Besides the quality of a new product, its user-friendliness and the consumers' socialization intensity will affect the returns to advertising. In figure 1 we plot the averages of 40 simulations. During each of them we randomly assign skill levels to our consumers from the distribution we specified above, and then look at advertising and no advertising scenarios for each μ - γ constellation. Lighter shades of grey in figure 1 correspond to higher returns to advertising.

Recall the higher γ implies more user-friendly product and higher μ implies the consumer population which interacts more intensively. From figure 1 one can infer that returns to advertising rise along with the user-friendliness of the product as long as product is not extremely user-friendly. This phenomenon is more pronounced in economies where interaction among consumers is less intensive. At the same time one can also notice, that in this situation the substitutability effect of socialization for advertising dominates complementarity effect as for the whole range of μ returns fall with increase in socialization intensity. As long as the given product is not extremely user-friendly, this relation becomes more pronounced as user-friendliness of the product increases.

The relationship between the quality level and returns to advertising is better suited for discussion in section 3.2.2, thus we do not discuss it extensively here, but we note that increase in quality level increases the returns to advertising for the new product quality levels which are realistic (even up to products who's equilibrium share is 95%). For extremely high values of λ returns start to decrease, in line with the intuition provided earlier. One more important thing is that as long as returns are rising with λ the $r - \gamma - \mu$ schedule maintains the same shape as in figure 1.

3.2.2 Case of new duopolistic market

More important and challenging task is to investigate the behavior of returns to advertising on young markets. In contrast to the discussion in section 3.2.1, where we had some incumbent products, it is much

more convenient to concentrate on completely new markets (with no incumbents) in this case. Here we discuss the case of duopoly, when two products are simultaneously entering the market which does not have any incumbent firms. Section 3.2.3 presents some insights in cases when there are more products on the market.

Consider a new industry arising, having two firms, who enter simultaneously. Two firms produce substitute products, but the characteristics of the products (λ and γ) might differ. One of the problems in discussing the effects of advertising in this setup is that both of the firms can advertise simultaneously. Thus, if we choose one of the firms and discuss returns to its advertising we will have virtually two regimes to analyze: one when the competitor does not advertise and the other when competitor advertises. These two regimes might produce not only quantitatively, but also qualitatively different responses to advertising. Yet, numerous simulations show that this is not the case in our model: although these two regimes produce quantitatively different results, qualitative behavior of the returns to advertising never changes depending on the advertising decision of the competitor. Plus, the quantitative differences between two regimes are extremely small and often negligible. The reason for this is following. Consider these two products having the same characteristics (λ and γ). In this case if none of the producers advertise, both of the products will have half of a market share from the start (assuming that the averages of initial skill levels are equal for both products) till the end. If one of the producers advertises, she takes additional market share from the competitor at that period, then skills for that product are accumulating faster, and this will give temporal advantage to the advertiser's product. This will last for some period until the average skill levels converge to 1. Now consider what happens if the other producer also advertises? Of course both of them stay with 50% market share, thus we get the same dynamics of market shares as when none of the producers was advertising. In this situation gains from advertising when the competitor advertises and when competitor does not advertise (in terms of gained market share due to advertising) are exactly equal. The situation gets asymmetric (quantitatively) as characteristics of the products start to differ from each-other, but as asserted earlier, these differences are small thus in what follows we discuss only one scenario out of this two, and due to simulation simplicity we choose it to be the scenario when the competitor does not advertise.

If we have two new products on the market we have pairs of λ s and γ s to work with (in contrast to section 3.2.1). But as these products are competing with each other, intuitively important parameters would be the ratio of λ s and the ratio of γ s and not the values of single parameters themselves. Thus when discussing the duopoly situation we work with these ratios. This brings complication in presentation of results. To solve this problem we work with peculiar scales for presentation of simulation results. The axes for the parameter ratios are constructed in a way, that they reach 1 in the center, which means that two parameters under discussion have equal values. This splits the axes in two. Right half goes in equal steps to the maximum value of ratio defined (e.g. 5, which would mean that the value of the parameter under discussion of the product that we are looking at is 5 times that of the value of the equivalent parameter of the competitor), while the left half goes symmetrically with the right half and takes values of 1 over the corresponding value from the right half (thus in this case the left half of the axes would go to 1/5, which would mean that the value of the parameter under discussion of the product that we are looking at is 5 times lower compared to the value of the equivalent parameter of the competitor).

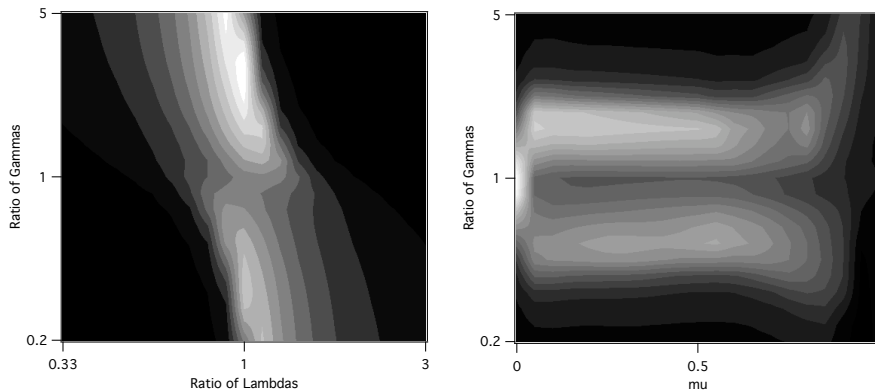


Figure 2: The case of duopoly: dependence of returns to advertising on quality and user-friendliness (left) and on user-friendliness and communication intensity (right).

To eliminate the differences in results due to the differences in absolute values of the parameter, the parameter ratios are created by holding constant the average of the parameter values all across the axes. This means that if ratio of x s being equal to one is created by $x_1 = 2$ and $x_2 = 2$, then ratio of x being 3 is created by $x_1 = 3$ and $x_2 = 1$ and ratio of $1/3$ is created by $x_1 = 1$ and $x_2 = 3$.

The left panel of figure 2 reports the returns to advertising for the different values of ratios of gamma and lambda. In these simulations we fix the number of consumers to be 100 and the intensity of communication to be $\mu = 0.3$. These are the averages of 40 runs, standard deviations are very small. Every run covers the whole spectrum of γ and λ ratios. In the beginning of every run we generate consumers and the initial skill distribution for each of the products, average of which are equal to each other. After that we run the economy as long as it takes advertising returns to become negligible for each γ ratio - λ ratio pair. The next run starts by generating the new skill level distribution for the consumers (of course means of every run's skill distributions are equal).

There are couple of observations one can make from the left panel of figure 2. First is that, no matter what the user-friendliness of the product is, if the quality of the product is sufficiently higher or lower than the quality of the competitor, the returns for advertising are low, compared to the situation when qualities are equal. The reason for this is that in both of these cases advertising can not affect the skill level development in the economy: if the product is doomed for the 0.5% of the market share, there is little product promotion can do to affect the transitional dynamics to the equilibrium. The same reasoning applies to the symmetric situation: if the product's equilibrium market share is 99.5% it can not gain much more by advertising during the transition.

The second observation is that, if the difference in the product quality is not large, returns to advertising of poor products⁵ drop as they become less user-friendly and the returns for the better products drop as they become more user-friendly. The third observation is that if product qualities are sufficiently close, the relation between the returns to product promotion and user-friendliness of the product have double-hump shape: starting from the relatively non-user-friendly product, as user-friendliness increases initially so do returns to advertising, which fall after some time, reaching local minimum when user-friendliness

⁵By poor product we mean the product which has lower equilibrium market share, lower λ , the notion does not concern the value of γ .

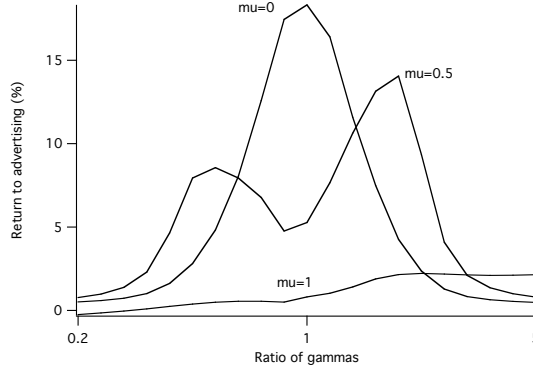


Figure 3: Cross-sectional cuts into the right panel of figure 2.

parameters of two products are equal, then they rise and fall again.

The explanations to these two phenomena can be found in the double nature of the advertising in our model: besides the fact that advertising ensures more early consumers for the product, which are important for increasing the speed of the skill accumulation of this particular product, it also ensures less consumers, and slower skill accumulation, for the competitor. Thus, given the equal product qualities, if our product is more user-friendly (relative to the competitor) major contribution of the advertising returns is due to more consumers consuming our product, while minor contribution is due to less consumers consuming competitor's product. While if our product is (relatively) less user-friendly, major contribution becomes due to deterring part of the consumers consuming competitor's use-friendly product, while minor is due to increased consumption of our product. This explains the double peaked nature of the returns/gamma profile. In exactly the middle these two forces are equal, but apparently their joint effect is smaller than when user-friendliness levels are different.

Recall that in simulations reported in the left panel of figure 2 we fixed communication intensity, μ . Besides sheer importance of looking at the effects of this parameter, it is also important to see whether our double-humped shape is due to some peculiar value of communication intensity. In the right panel of figure 2 we present the results from similar simulations, but in this case we fix product qualities and rather vary communication intensity. As we saw from the left panel, interesting dynamics are at place when competitors' products have quality levels which are sufficiently close. So, in this simulation we fix the ratio of qualities to be 1, I vary γ 's the same way as in previous simulations and explore the whole space of the values of parameter μ . Everything else stays the same as in simulations reported in the left panel.

The right panel of figure 2 shows that double-hump shape of returns-gamma profile is present as long as communication levels are away from extremes. When $\mu = 0$ there is no double-hump, but as long as consumers start to communicate with some significant intensity double hump appears. The shape is very pronounced until communication level hits extremely high values ($\mu \approx 1$). As about effects of μ itself, one can notice easily, that substitutability effect of communication to advertising dominates during the extended period of the time, but complementarity effect becomes important for extreme values of communication: returns quickly rise as communication moves away from zero (as long as ratio of γ 's is not very close to unity), and returns also obtain hump close to perfect communication (with the same

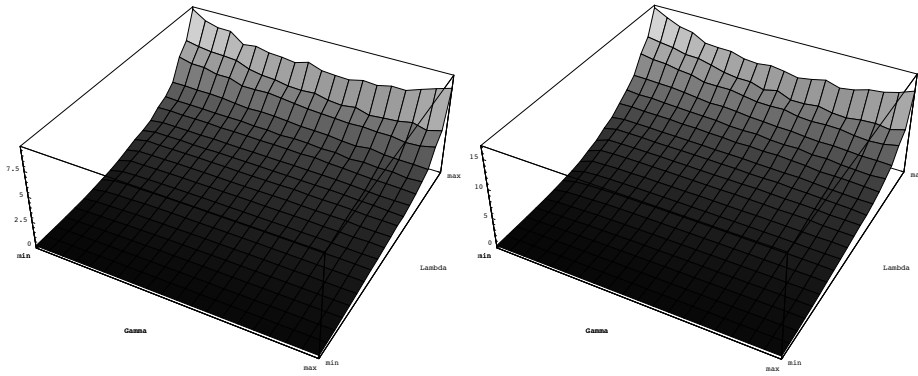


Figure 4: The case of competitive market: dependence of returns to advertising on quality and user-friendliness when the competitors do not advertise (left) and when they do advertise (right).

requirement on γ 's).

The right panel of figure ?? demonstrates another interesting result of the model. It warns that if one uses no communication models to study markets that involve communication she is likely to get not only quantitatively, but also qualitatively incorrect results. To better demonstrate my point, on figure 3 I plot three cross-sectional cuts into the right panel of figure 2: one when there is no communication ($\mu = 0$), one when communication parameter μ is equal to 0.5 and one when communication intensity is extremely high ($\mu = 1$). From figure 3, one can clearly see that no communication results in no-double-hump shape in returns to advertising, which is the major qualitative finding of the paper.

3.2.3 Case of many products

There is no comprehensive way of studying multi-product cases with this model. If one allows more products on the market each of them brings two additional parameters. This increases the burden of the model management. Plus any additional product increases the discrepancy between the results when competitors do not advertise, and when they do advertise. If one wants to allow for some of them advertising, while some others not, these scenarios would be better studied with the model where products have three characteristics instead of two.

But one thing can still be done in this respect. Recall that this model contradicts to the previous theoretical contribution to effects of advertising, which claim that higher quality would result in higher returns to advertising (e.g. Milgrom and Roberts 1986). In our model this is not true: if the product has considerably higher quality than its competitors, returns to its advertising might not be high at all. But positive correlation between product quality and returns to advertising has been found also empirically (e.g. Nichols 1998). Does this mean that current model contradicts to empirical findings?

To test this we can do one more exercise. The monotonic relationship between product quality and returns to advertising has been empirically found on the markets with many diverse producers (e.g. automobiles in case of Nichols 1998). So we have to assume that all the products on the market have different qualities. Consider the case when there are 20 firms on the market. Assume that qualities of the product, as well as user-friendliness levels are distributed normally around some mean. First we generate these distributions, along with the distribution of the skill levels for each products for the consumers.

Then the algorithm picks every combination of λ and γ to be the product under the discussion. Each constellation of γ - λ is different scenario. For each of the scenarios, remaining product qualities are coupled randomly, and they comprise the competitor products. As we have 20 λ s and 20 γ s, we have $20 \times 20 = 400$ scenarios. All these 400 scenarios are run for fixed distribution of λ s and γ s as well as for the fixed distribution of the initial skilled levels. Then, we draw another 20 γ s and 20 λ s from the same normal distribution, plus another 20 skill distributions over consumers and run all 400 scenarios again. We repeat this 40 times and report averages of returns to advertising.

As we argued before if we have more firms, the quantitative difference between two scenarios, one when competitors advertise, the other when they do not, becomes more important. For this multi-firm case we report both situations. The left panel of the figure 4 reports the returns to advertising when remaining 19 producers do not advertise, while the right one reports the results for the case when all the remaining 19 producers do advertise. Two axes where we measure the characteristics of the products, represent mere ordering in the distribution, from the minimal value to the maximal value of given characteristics in the given distribution.

Figure 4 shows, that if we rule out large differences in quality levels on the market with many products (which normal distribution does) then no matter the level of user-friendliness, higher quality results in higher returns to advertising. Thus, our model does not contradict to the empirical findings, but it highlights the importance of the market structure and warns that the relation between product quality and returns to advertising might be more complex compared to what has been believed before.

Summary and conclusion

In this paper we have discussed the two sources of consumer skill acquisition: learning by consuming and consumer socialization. I have analyzed the population of myopic consumers who socialize locally and utilize above mentioned two forces to learn to consume separate products.

Each product on the market has two characteristics in this framework: quality and user-friendliness. Quality is the highest valuation consumers can extract from a given good, although it can vary over the product space, it does not vary from consumer to consumer. The long-term market share distribution depends solely on this characteristics. User-friendliness controls the speed of consumer skill acquisition through learning by consuming. This too is a product specific characteristics and does not vary from consumer to consumer for a given product. This characteristic does not affect the equilibrium market shares, but it does affect the speed of transitional dynamics towards time-invariant market share distribution.

Society is characterized with one parameter, communication intensity, which controls the speed of consumer skill diffusion through consumer socialization. Another characteristics of the society, which has not been analyzed in this paper due to its strait forward effects, is the size of population. Larger size creates greater challenge for the consumer skill diffusion as socialization process is local.

In this framework we have discussed the behavior of the returns to product promotion depending on the variation in characteristics of the product. We have divided analysis of the returns to advertising of a new product in two parts: one, when product enters the mature market, which consists of product which have been on the market long enough for consumers to acquire consumer skills, and the other when there

are more than one new products on the market. The major conclusion is that no matter what the level of products user-friendliness, returns to advertising are higher when product competes against another product of similar quality. If competitor has considerably higher or lower quality returns to advertising fall. This contradicts to earlier theoretical work (e.g. Milgrom and Roberts 1986) which claims that quality of the product is positively correlated with returns to advertising. Although empirical work has supported this claim (Nichols 1998), we have shown that this model results this kind of monotonic behavior in case it following two conditions are satisfied: (1) there are many products on the market, and (2) the quality differences are not very large. If these two assumptions are satisfied, our model results in the same kind of behavior as been found empirically. Thus one can conclude, that empirical findings support much larger class of models (including the one presented in this paper) than it has been believed up to now.

Another finding of this paper is that dependence of the returns to advertising on level of user-friendliness in case of duopoly where products have similar qualities, has a double-peaked shape. This is due to double effect of advertising, which means that advertisement benefits producer not only by gaining more consumers for its product, but also due to taking them from the competitor. The size of these two effects change in different rates across the change of the levels of user-friendliness: in case of our product being more user-friendly than competitor's the first effect dominates, while in case of the reverse situation the second effect is the dominant one. What is important here is that the sum of these two effects is higher in each of the cases (when our product is more or less user-friendly) than the case when competitor's product is also at the same user-friendliness level.

What has also been found is that this double-peaked shape of the returns/user-friendliness profile is present only when there is a consumer socialization. In case of no interaction among consumers the shape only has one local maximum. This points to the fact that interaction among consumers has the impact of a nature that changes the qualitative behavior of returns to advertising. Thus in case of products where consumer skills are diffusing through consumer socialization process use of no interaction models (e.g. representative agent models) is likely to give false results.

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