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Advertising Strategies in Old and New Economy: an Agent-Based Economic Model of Bounded Rational Consumer Markets

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Abstract

We compare the impact of different advertising strategies in two consumer market scenarios: old and new economy. The markets consist of production firm agents offering their products and cognitive and socially bounded consumer agents. The firm agents are bounded by their advertising budget and advertising strategy. Firm agents seek to maximize their profits by variation of the timing and size of their advertising budget and their target customer group (all, new, or old customers). The consumer agents are embedded in a social structure based on "small-world network" principles. The cognitive model of the consumer agents enables them to make their buying decisions according to the behavior of the adjacent social neighborhood and based on the degree of satisfaction and uncertainty they are facing. Firm agents are able to positively influence the customers' cognitive states via advertising and thus increase the probability of their intention to repurchase. Our simulation results show the impact of the strategies under different market conditions. The results also substantiate empirical evidence and common knowledge of marketing practitioners. Furthermore we can give strategic advice by investigation of the success of different strategies in the two different market scenarios.

1 Introduction

Neoclassical economic theory is based on the assumption of rationally acting individuals, who are able to consider all available information in the decision-making process. As an early critic of economic agents with unlimited information processing capabilities Herbert Simon (1955, 1982) suggested the term “bounded rationality” to describe a more realistic approach to cover human problem solving. Indeed, the complexity of human behavior suggests that a choice model should explicitly capture uncertainty. Real economic agents are restricted at least in their cognitive (knowledge) and computational abilities (Mullainathan and Thaler, 2000). Enriched by a social network perspective, which states that most behaviors are also closely embedded in networks of interpersonal relations, an additional focus lies in the relationships among interacting units. According to Wassermann and Faust (1994) a social network is a set of people or groups of people (“actors” or agents) with certain pattern of interactions (“ties”) between them. Central concepts are:

- actors and their actions are viewed as interdependent
- relationships among actors are channels for transfer of resources
- the network structure provides constraints and opportunities for individual action
- lasting patterns of relations are conceptualized as structure.

Recent work on social networks has focussed on distinctive features of network structure (Newman et al., 2002). One of these is the “small world” effect first described by Milgram (1967). His experiment involved letters that were passed between pairs of apparently distant people. Milgram found that the typical chain from acquaintance to acquaintance only has a length of about six persons (popularly known as “Six Degrees of Separation”). Since then dozens of academic studies have revealed that many networks have related “small-world” properties (see for example Watts and Strogatz, 1998). Usually the topology of a (social) network is assumed to be either completely regular or completely random. However, many biological, technological and social networks lie between these two extremes. These systems are highly clustered, like a regular lattice, but have small path lengths, like random graphs and are named “small-world” networks. From a social systems perspective this means that it only takes a small number of well-connected people to make a world small (Collins and Chow, 1998).

In this article we introduce an agent-based computational economic model, which incorporates boundedly rational agents embedded in a social network structure. Computational economic models bridge the gap between theoretical and empirical economics. They can represent a testbed, which enables us to investigate the predictions of a theory under conditions which are too complex to be addressed analytically. Hence computational models can be used to gain insights into complex systems and furthermore suggest new hypotheses to be tested in empirical studies (for a review of agent-based computational economics see Tesfatsion, 2002).

2 The Markets Model

The model consists of interacting agents in an artificial consumer market. The consumer market simulates the advertising of a product by production firms and the purchase of the product by consumers. The simulator runs in discrete time steps. Simulation steps consist of the following operations:

- Firms select the timing and budget of their advertising strategy which can influence consumers decisions
- Consumers make purchase decisions
- Firms receive an income based on the sales of their product

Dependent on the influence of the market's social network strength (due to network externalities) and consumer agents' incurred comparison costs for different products we distinguish between four major market scenarios (table 1 gives examples):

Table 1: Market differentiation by comparison costs and strength of social network influence.

Social Network Influence (Network Externalities)	Old Economy (Comparison Hard)	New Economy (Comparison Easy)
High	Mobile Phones	Ebay, Hotmail
Low	Walmart	Amazon

The theory of network externalities provides an explanation and quantification of increasing consumer demand and diffusion of network goods or service sales over time (Grajek, 2002). The effects of interpersonal communication in particular are thought to be a key factor (Rogers, 1983; Mahajan et al., 1990). Positive network externalities are defined as utility, which consumers derive from consumption of a good or service, increases with the number of other consumers. Economic literature usually distinguishes between direct and indirect network externalities (see for example Katz and Shapiro, 1985; Economides, 1996). Direct network externalities are related to physical networks (for example telecommunication technologies). The utility, which consumers derive from using these technologies, depends undoubtedly on the number of other users. An obvious reason for a positive dependence is that a larger network allows consumers to satisfy more communication needs and may decrease the common costs of the service. Another explanation might be the bandwagon effect since conspicuous consumption gives rise to a conformistic behavior (Leibenstein, 1950). A negative dependence between network size and consumers' utility might be justified by congestion or by non-conformism of consumers (snob effect). Indirect network externalities apply if a good consists of two complementary components: for example hardware and software. The latter exhibits supply-side economies of scale (see Katz and Shapiro, 1985). Obviously the amount of users of the hardware platform determines the size of the market for software and furthermore enhances the utility gained by use of the hardware.

3 Social Consumer Agents

Explaining why consumers purchase or repurchase products underlies consumer behavior and consumer psychology. Fornell (1992) suggests that the probability of repeat purchase is a function of both satisfaction and switching barriers. Search costs, transaction costs, learning costs, habit, emotional cost, cognitive effort, and various forms of risk or uncertainty may all act as barriers to switching from one brand to another (Fornell 1992; Hirschman 1970). Even when dissatisfaction with the current choice exists—or an alternative appears more attractive—there are many reasons why a consumer might continue to choose their customary brand. Perhaps as a result of deterrents to switching, Fornell (1992) finds that customer satisfaction is lower in industries where repeat purchasers face high switching costs.

Support for Fornell's (1992) view comes from studies of switching behavior in services. Keaveney (1995) identifies several reasons for customer switching (price, inconvenience, service failures, competition, and ethical problems), which Bansal and Taylor (1999) summarize as service performance and costs of switching. As customer satisfaction is strongly linked to impressions of performance, satisfaction and switching barriers are assumed to be the most important antecedents of repurchase behavior, or the intention to repurchase a good or service (Bateson and Hoffman 1999). When some degree of satisfaction exists after purchase and evaluation, the intention to repurchase will be positive. Conversely, if there is dissatisfaction the intention to repurchase will be negative, and a consumer would be unlikely to repurchase the product again. However, in both cases the existence of switching barriers raises the likelihood of repurchase. Every available alternative within a consumer's consideration set creates its own level of intentions to repurchase; but, if neither satisfaction nor switching barriers exist then repurchase is unlikely (McQuitty, 2000).

Our consumer market model takes fully account of the theories and empirical evidence. During a simulation time step, each consumer agent makes an individual product purchase decision based on the following factors:

- its preference in product space (individual needs)
- its cognitive states (satisfaction, uncertainty)
- the behavior of its social network
- the market inherent switching barriers (comparison costs)

Due to these factors the agents are able to commit to repetition, imitation, social comparison and deliberation behavior.

3.1 Consumer Preferences

The product space is represented as a two-dimensional simplex, with product features represented as real numbers in the range [0,1] (see figure 1). Each firm agent manufactures a single product, represented by a point in this two-dimensional space, which define the product's position in feature space. Consumers have fixed preferences about what kind of product they would like to purchase. Consumer preferences (individual needs) are also represented in the two-dimensional product feature space. Each consumer agent is initialized with a fixed random product preference in product feature space.

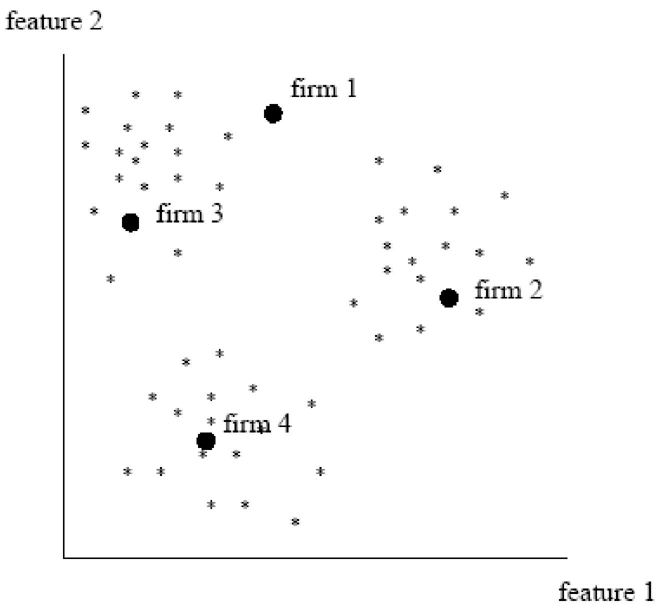

Figure 1: The two-dimensional product space. Consumers have fixed product preferences (denoted by “*”). Firms position their products (denoted by “.”) in the feature space.

The product preference *IN* represents the individual needs of an agent (equation 2). It is calculated each simulation time step and is a function of the distance between the firms’ manufactured products and the consumer agent’s own preferences. The measure is computed as one minus the Euclidian distance (equation 1) between the position of the ideal preferred product of customer *c* (IP_c) and the position of the produced product *i* (PP_i) in the two-dimensional feature space.

$$d_{c,i} = \sqrt{\frac{(PP_i - IP_c)^2}{2}} \quad (1)$$

$$\mathrm{IN}_{c,i} = 1 - d_{c,i} \quad (2)$$

3.2 Comparison Costs

Empirical evidence emphasizes the importance of switching barriers for customer decisions, especially repurchase behavior (see section 3). Our model takes account for consumer switching barriers in the form of comparison costs. Comparison costs may alter consumer perception of absolute product features (like in equation 1 and 2). We implement a threshold for maximum perceived product difference in a way that if the maximum of the distances *d* (equation 1) for all offered products is less or equal this comparison threshold (CTh) the consumer agent is not able to distinguish the products based on their product features, i.e. to him the products are "all the same". Instead the individual needs are assigned a constant average value of 0.5. To distinguish between a market with rather hard product comparison (“old economy”) and the opposite market with easy comparison (“new economy”) we implemented a comparison threshold value of 0.9 for the first and 0.1 for the latter.

3.3 Social Networks

Each consumer agent is embedded in a social network structure which influences its social needs and incorporates a cognitive decision structure which accounts for its committed behavior (repetition, imitation, social comparison, deliberation). Consumer agents react to their individual needs (preferences) and their social needs. The social network topology, which exhibits small world properties, is randomly initialized for each simulation run.

For a social network structure to have "small-world" topology it must fulfill certain conditions. This can be easily described in a graphical example. Figure 2 shows three examples of networks with fifteen consumers, each with an average of four neighbors. Every vertex represents one consumer agent and an edge represents a bi-directional connection between two consumer agents. The left picture shows a completely regular graph (random connection probability per consumer is zero), while the right graph represents a completely random connected topology (random connection rate is one). Although regular networks and random graphs are useful idealizations, many real networks lie between the extremes of order and randomness. For intermediate values of randomness (the middle picture consists of fifteen percent random connections) the graph can be interpreted as a small-world network. To construct small-world network topologies we start out with a completely regular graph. Then with a certain probability we reconnect each edge to a randomly chosen vertex over the entire ring, with duplicate edges forbidden. The small-world networks are much more clustered than a random graph. Hence if consumer A is linked to B and B is linked to C, there is a greatly increased probability that A will also be linked to C, a property that is called transitivity (Wassermann and Faust, 1994). Despite the high clustering small-world networks have characteristic small path lengths, like random graphs (Watts and Strogatz, 1998; Strogatz, 2001).

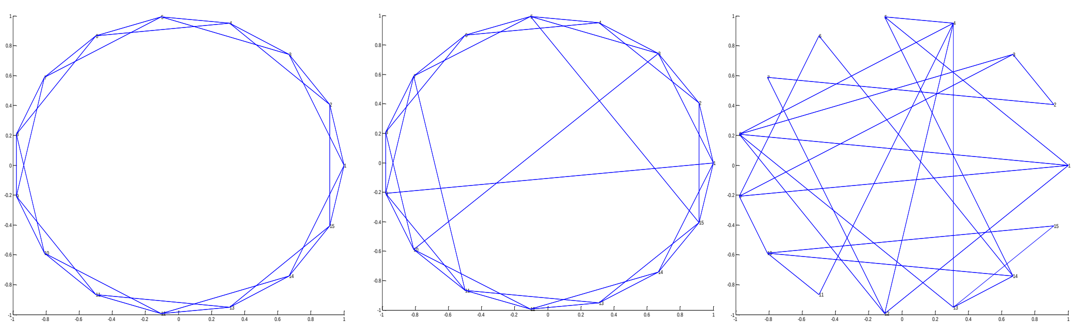

Figure 2: Example of a regular graph (left), small-world network (middle) and a completely random graph. Each graph is consists of fifteen consumers, all connected with on average four neighbors (adapted from Watts and Strogatz, 1998).

We define the "social" market share *SM* (equation 3) to transform the social network into a relevant decision structure for an individual consumer agent *c*. It is represented by the quantity of the last purchases of product *i* in the consumer agent *c*'s social neighborhood

($LPP_{c,i}$) divided by the number of all purchases occurred in its neighborhood (products range from one to n).

$$\mathrm{SM}_{c,i} = \frac{\sum_{c} LPP_{c,i}}{\sum_{c}\sum_{n} LPP_{c,n}} \quad (3)$$

Intuitively, the social market share represents a measure of a product's popularity amongst a "clique" of socially connected people.

3.4 Cognitive States

According to the consumat approach (Janssen and Jager, 2000) two intrinsic cognitive states can account for different types of behavior and decision making. Dependent on their experienced level of satisfaction (S) and uncertainty (U) consumer agents are able to commit to repetition, imitation, social comparison and deliberation behavior.

We define that consumer c experiences the following satisfaction level (S) regarding the purchase of product i (equation 4).

$$S_{c,i} = SM_{c,i} * SNW + IN_{c,i} * (1 - SNW) \quad (4)$$

Thus consumer agents can react to their individual needs (IN) and social needs (SM) with modification of their cognitive parameter satisfaction (S). Furthermore satisfaction weighs the social market share (weight SNW) against individual needs (weight $1\text{-}SNW$).

A consumer agent's experienced uncertainty (U) is defined as the squared deviation of the actual level of satisfaction (S_t) from its expected level of satisfaction which equals the agent's last obtained satisfaction level (S_{t-1}, see equation 5).

$$U_t = (S_t - S_{t-1})^2 \quad (5)$$

To differentiate between possible actions threshold parameters for minimum satisfaction (S_{min}) and maximum uncertainty (U_{max}) are introduced. They also represent an agent's bias to commit to a certain category of action with a certain probability (table 2).

Table 2: Actions resulting from cognitive state variables of consumer agents (according to Janssen and Jager, 2000).

Cognitive state	Satisfied	Not Satisfied
Certain	Repetition	Deliberation
Uncertain	Imitation	Social Comparison

The agent's performed behavior and purchase decision is a result of its experienced levels of satisfaction and uncertainty:

- Repetition: if the agent experiences satisfaction ($S > S_{min}$) and is also certain about its choice (that means that its last choices nearly met its expectations hence $U \leq U_{max}$)

then it has no reason to change his last decision. Therefore the customer agent will consume exactly the same product which it purchased the last time step.

- Imitation: if a customer agent again feels satisfied ($S>S_{min}$) but it experiences uncertainty (its last choice deviated much from its expectations and $U>U_{max}$) then the customer will investigate its social neighborhood and give the product a try, which is consumed most by its friends. If there is more than one product one will be randomly selected among the most purchased products.
- Deliberation: if a consumer is not satisfied ($S\leq S_{min}$) and it is certain (its expectations were met, thus $U\leq U_{max}$) it will purchase the product with the highest overall satisfaction value (according to equation 4). Again if there is more than one candidate product, one will be randomly selected among the most satisfying products.
- Social comparison: if the consumer agent happens to be not satisfied ($S\leq S_{min}$) and uncertain ($U>U_{max}$) the same time step, it will engage in a behavior called social comparison. This means that the agent will consider the product that is consumed the most in its social neighborhood (analogue evaluation of the social market share) but one that also exceeds or reaches its expectations for satisfaction (see equation 4) originating from his last consumption. If there is more than one candidate product, one will be randomly selected from the eligible products.

With this cognitive decision structure implemented and the agents' ability to relate their expectations to their social network we are able to investigate different advertising strategies in consumer markets.

4 Strategic Firm Agents

Before we can go into detail about the firm agents' advertising model we have to clarify certain important topics addressed by marketing literature.

4.1 Product Involvement

According to Zaichkowsky (1985) consumer involvement in a product category is widely recognized as a major variable relevant to advertising strategy. Product involvement affects the time we spend looking for and processing information about the product (Laurent and Kapferer, 1985). The amount of cognitive effort we devote to processing information and advertisements is another consequence of product involvement (Celsi and Olson, 1988). Moreover, product involvement affects our decision processes and the type of information we seek out (Petty and Cacciopo, 1984). Advertisements for high-involvement products face an audience that is prepared to devote some time and effort to seeking and processing information about the product (Celsi and Olson, 1988). Advertisements for low-involvement products, instead, face an audience that are not that interested in learning more about the product and therefore are not willing to spend much time and effort seeking and processing information (Dahlen et al., 2004).

In our simulation we focus in middle-involvement products. Thus our consumer agent model incorporates cognitive effort for the behavior decision process.

4.2 Repurchase Behavior

Review of the relevant literature, which studies consumer repurchase behavior in a dynamic setting, reveals the following important conceptual relationship: intention to repurchase is mainly a function of consumer satisfaction and switching barriers (McQuitty, 2000).

Consumer satisfaction provides the basis for the marketing concept and has been shown to be a good predictor of future purchase behavior. As a reflection of its importance, consumer satisfaction is a popular topic in the marketing literature Cardozo (1965). The most recent literature evaluates the consequences of consumer satisfaction for purchase decisions, sales, and firm profitability (e.g., Anderson, Fornell, and Lehmann 1994; Fornell 1992; LaBarbera and Mazursky 1983).

In our model the firm agents' advertising efforts increase the targeted consumers' satisfaction and decrease their uncertainty level. As a consequence the targeted consumer agents' probability of repurchase is increased.

4.3 The Advertising Model

The firm agents are restricted by their advertising budget and strategy. Firms seek to maximize their profits by variation of the timing and size of their advertising budget and their target customer group (all, new, or old customers). We randomly assign the factor k to each of the two competing firms at the beginning of a simulation run. Then we calculate the entailed budget B which decreases exponentially over time (equation 6). Since we want to restrict the maximum impact of a firm agent's advertising strategy we limit his maximum advertising budget AB by the maximum amount of 0.08 (equation 7). Figure 3 shows examples of different possible advertising strategies.

$$B_t = k * e^{-t*k} \tag{6}$$

$$AB_t = \min\{B_t, 0.08\} \tag{7}$$

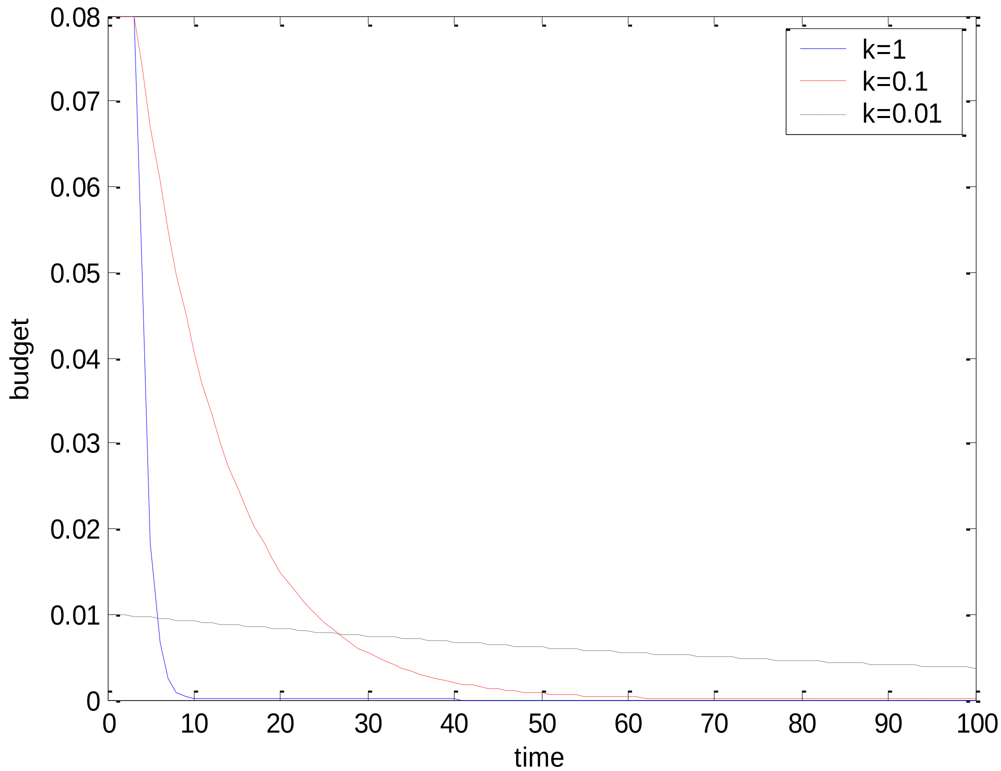

Figure 3: Advertising budget (y-axis) over time (x-axis). Examples of different advertising strategies are shown (defined by the parameter k, see equation 7).

Furthermore firm agents are able to spread their advertising budget (AB, equation 7) over different customer target groups. They are able to

- Uniformly distribute their budget over all customers
- Acquire new customers
- Retain old customers

Market segmentation is a well known and very important concept of practitioners both in "old" or "new economy". A market study from The Boston Consulting Group reports about recent developments in e-commerce regarding customer targeting:

> *"In fact, what's happening in e-commerce is really a very old story, and its moral—one that catalogers have known for years—is about acquiring and serving the right customers. Mail order retailers call it RFM—recency, frequency, monetary value—a straightforward, data-driven formula that permits retailers to segment their customer base and focus attention on the high rollers. Catalogers know they will succeed if they focus on their best customers: the most recent, the most frequent, and the biggest spenders. Rather than allocate huge sums to attract customers whose purchases won't justify their acquisition costs, online retailers*

should segment customers by their potential to produce profits and then invest resources in the most valuable ones."[1]

As known from the marketing literature (section 4.2) firms are able to influence their customers repurchase probability with advertising. Each time step the firm agent can spend a certain amount of advertising budget (figure 3). This budget has a direct impact on a targeted consumer's decision by increasing its satisfaction and decreasing its uncertainty level (equation 8 and 9).

$$S_{c,i} = S_{c,i} + AB_t \tag{8}$$

$$U_t = U_t - AB_t \tag{9}$$

According to our consumer decision model (section 3.4) this results in an increased probability for consumer agents to engage in repetition behavior which simply means repurchase of their last purchased product.

5 Model Parameters

The focus of state of the art modeling techniques is not just to cover every market phenomena observed. Rather it lies on "noncritical" abstraction and careful parameter selection by gradually adding complexity once the previous model has been fully understood. This prevents the modeler from introducing ad hoc parameters to capture important causal relationships.

We are building on the foundation of the validated integrated markets model including consumer, firm and stock trading agents (Sallans et al., 2002 and 2003; Schoenhart et al., 2004). Thus we started out with the originally given parameter values for the consumer agents' social network (Schoenhart et al., 2004) which guarantee a well functioning real-world like consumer market (table 3).

Table 3: Model parameters for the consumer market.

Parameter	Description	Range	Value	Reference
Consumer Agents Social Network				
NCons	Number of simulated consumer agents	N	70	Section 3.3
NNbs	Number of average neighbors per consumer agent	N	16	Section 3.3
PClus	Percentage of randomness of the small-world network	[0, 1]	0.3	Section 3.3
Consumer Agents Product Comparison Costs				
CThNew	Comparison threshold "new economy"	[0, 1]	0.1	Section 3.2
CThOld	Comparison threshold "old economy"	[0, 1]	0.9	Section 3.2
Firm Agents				
ABmax	Maximum available advertising budget per time step	[0, 1]	0.08	Section 4.3

[1] Nina Abdelmessih, Michael Silverstein, Peter Stanger (2001). Winning the Online Consumer 2.0 -- Converting Traffic into Profitable Relationships. URL: http://www.bcg.com/publications/files/022101_Winning_online_consumer_report_summary.pdf

6 Simulation Results

All our simulations are based on two competing firm agents acting in consumer markets initialized with seventy consumer agents (see section 5). For each market type and advertising strategy we calculated 100.000 different model runs to acquire statistically significant results. One model run consists of hundred time steps where consumer and firm agents interact. Thus consumer agents buy one specific product per time step while firm agents may or may not profit due to their advertising strategy. At the end of the periods the profit (sales) of both firms is compared.

6.1 Product Differentiation

To find out if product feature differentiation is a successful strategy in our markets we compare normalized product differences (y-axis) over different market types (x-axis, see figure 4). The market types are defined as described in section 2. The social network strength (SNW) parameter was <= 0.05 for "Shop" and "e-Shop" and >= 0.95 for "Comm(unication)" and "e-Comm(unication)" markets. Comparison cost thresholds are as mentioned 0.1 for "old economy" (which includes "Shop" and "Comm") and 0.9 for "new economy" markets ("e-Shop" and "e-Comm"). The product distance is calculated as shown in equation 1 (section 3.1) and measures the distance between a consumer agent's desired product and a firm agent's offered product. To compare the differences we calculated normalized distances (in the range of [0, 1]) as can be seen in equation 8. The normalized product difference (NPD) is equal to the difference of the loosing product distance (product not sold) and the winning product distance (product successfully sold) divided by the sum of both.

$$NPD = \frac{LPD - WPD}{LPD + WPD} \qquad (8)$$

A significant difference between the two markets with low social network influence (no network externalities) can be found. Our summarized results are as follows:

- Product differentiation has a significant effect in low social network markets ("Shop", "e-Shop")
- Products converge because of easy comparison (e-shop)
- It may not be worth for a firm to compete in product features in a high social network environment ("Comm", "e-Comm") since people stick for a while due to their social network and the market inherent network externalities

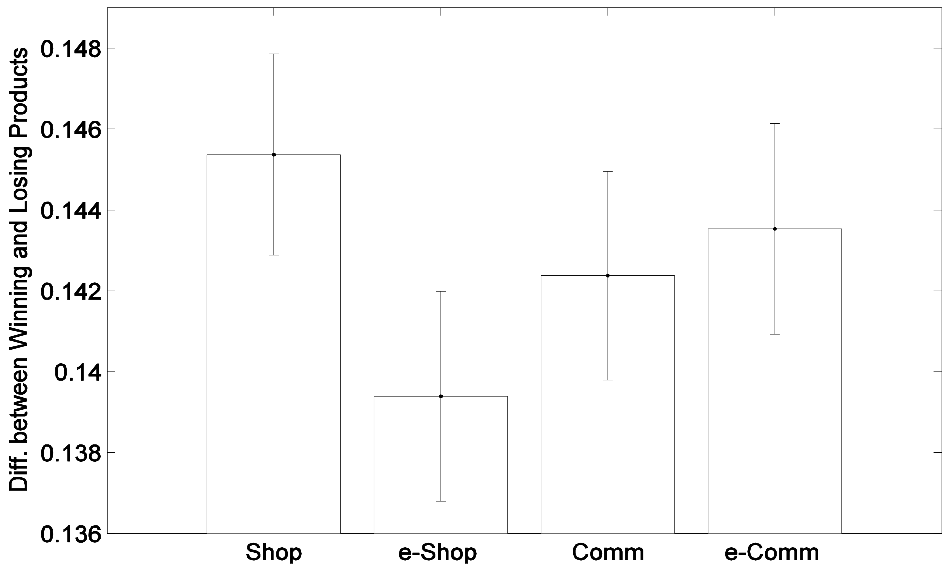

Figure 4: Normalized product difference (y-axis, equation 8) per market type (x-axis).

There is a significant difference between the two markets with low social network influence (no network externalities).

Furthermore we compared normalized firm profits and normalized product differences for high and low social network markets (figure 5 and 6). The comparison shows a similar picture and supports our already drawn conclusions: in low social network markets (“Shop”and “e-Shop”) product feature differentiation makes sense and has a significant (positive) impact on profits (figure 5).

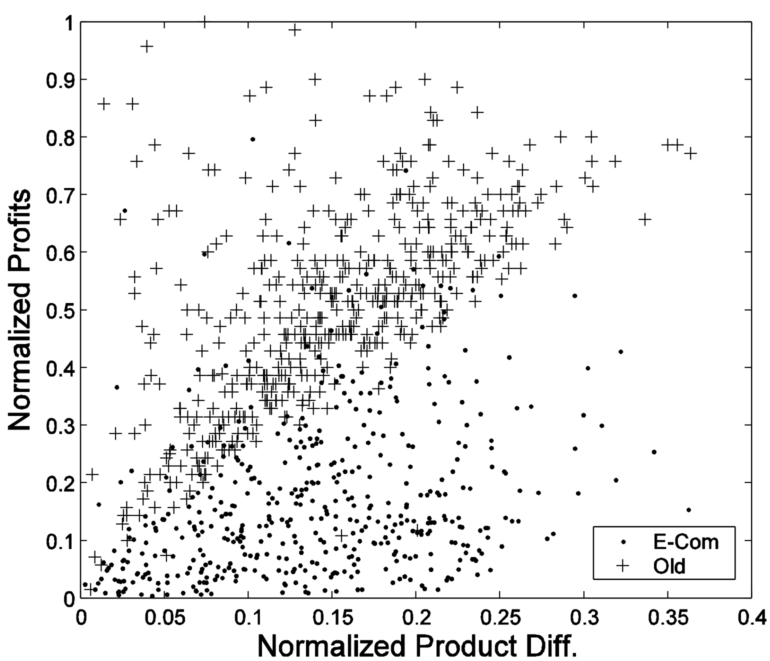

Figure 5: Normalized profits (sales, y-axis) vs. normalized product difference (x-axis) in a low social network market scenario (no positive network externalities). Product differentiation has a significant impact on firm profits.

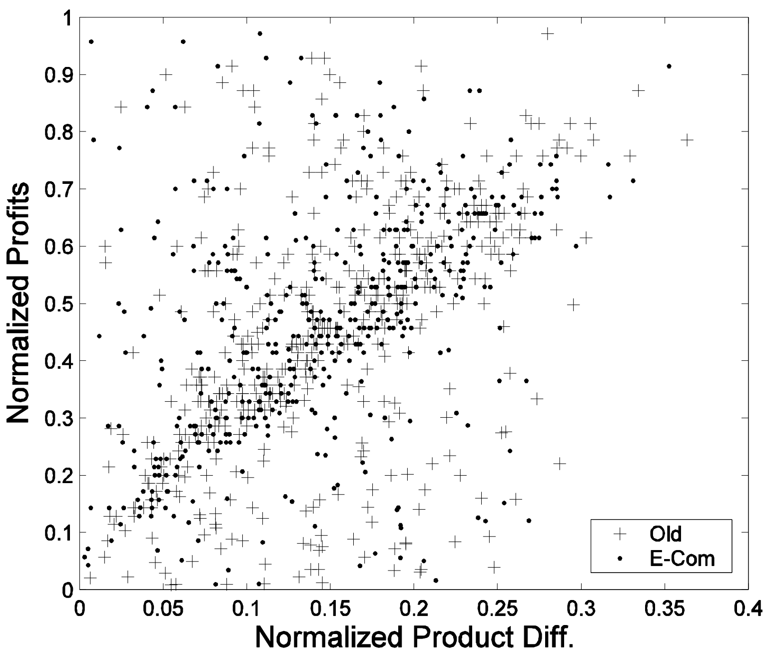

Figure 6: Normalized profits (sales, y-axis) vs. normalized product difference (x-axis) in a high social network market scenario (positive network externalities). Product differentiation has no significant impact on firm profits. Instead profits are randomly varied over normalized product difference.

From a practitioners viewpoint following points and suggestions are useful to consider:

- Consumers profit from e-commerce (low comparison costs, easier product comparison)
- Governments should encourage e-business to get more efficient markets
- In low social network markets the practitioners common sense seems to be true: competition due to product differentiation is profitable
- Effects due to network externalities outweigh impact of comparison costs in high social network markets

6.2 Advertising Strategies Comparison

The firm agents are restricted by their advertising budget and their advertising strategy. Firms seek to maximize their profits by a variation of the timing of their advertising budget and their target customer group (all, new, or old customers, see section 4.3). Firm agents are able to spread their budget per time step over their target customers (section 4.3):

- Uniformly distribute their budget over all customers (uni)
- Acquire new customers (acq)
- Retain old customers (ret)

Since our simulation consists of two firm agents there are nine possible combinations of customer targeting scenarios. Figure 7 shows the firm profits for each market scenario in a “new economy” environment (low comparison costs). The scenarios are named with the strategy of firm agent one then firm agent two. For example “acq, uni” means that firm agent one engages in an new customer acquiring strategy, while firm agent two uniformly distributes his budget over all consumer agents. The x-axis represents the impact of the social network (due to network externalities) and is equal the weight SNW of our consumer decision model (section 3.4). SC (y-axis) stands for “scale” and is calculated as the difference of the advertising budget (equation 7) of firm agent one and firm agent two. It’s normalized in a way that a value of 0.5 means a perfect match of the advertising budget of both firm agents. The more bright an area is the higher is the profit for firm agent one. For example in the “acq,uni” scenario with a good budget match (SC~0.5) and a high social network component (SNW lies between 0.5 and 1) firm one always profits over firm agent two.

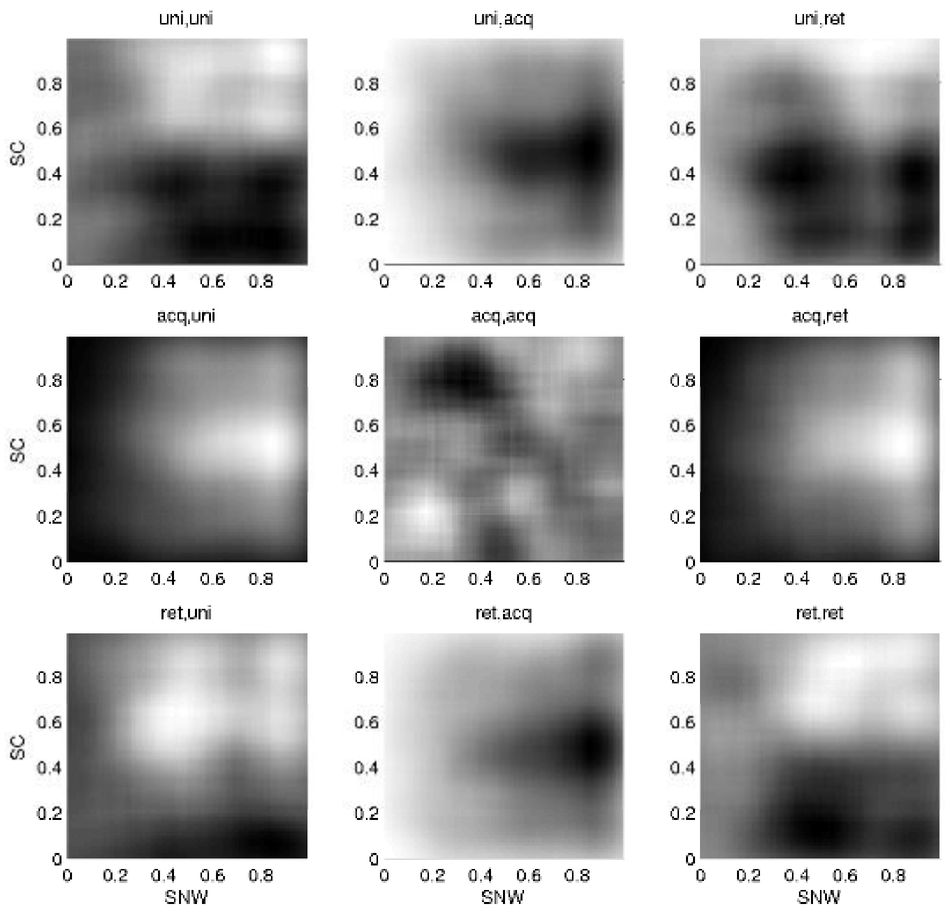

Figure 7: “new economy” firm profits. All possible combinations of customer target strategies are shown (target all customers uniformly, acquire new customers, retain old customers). SC (y-axis) stands for “scale” and is the difference of the advertising budget (equation 7) of firm agent one and firm agent two. A scale value of 0.5 means a perfect match of the advertising budget of both firm agents. The x-axis represents the strength of the market’s social network component (SNW). The brightness of an area shows the profit strength of firm agent one. Black means firm agent two collects higher profits than firm one.[2]

[2] The density plots were generated using the kernel density estimator for Matlab provided by C.C. Beardah at http://science.ntu.ac.uk/msor/ccb/densest.html (Beardah and Baxter, 1996).

Figure 8 shows the standard deviations of the firm profits for each scenario. Thus in the mentioned example firm one's profits are very secure since the standard deviation is very low in the "acq,uni" with SC~0.5 and SNW lies between 0.5 and 1. Hence acquiring seems to be a rather riskless strategy if the firm operates in a high social network environment.

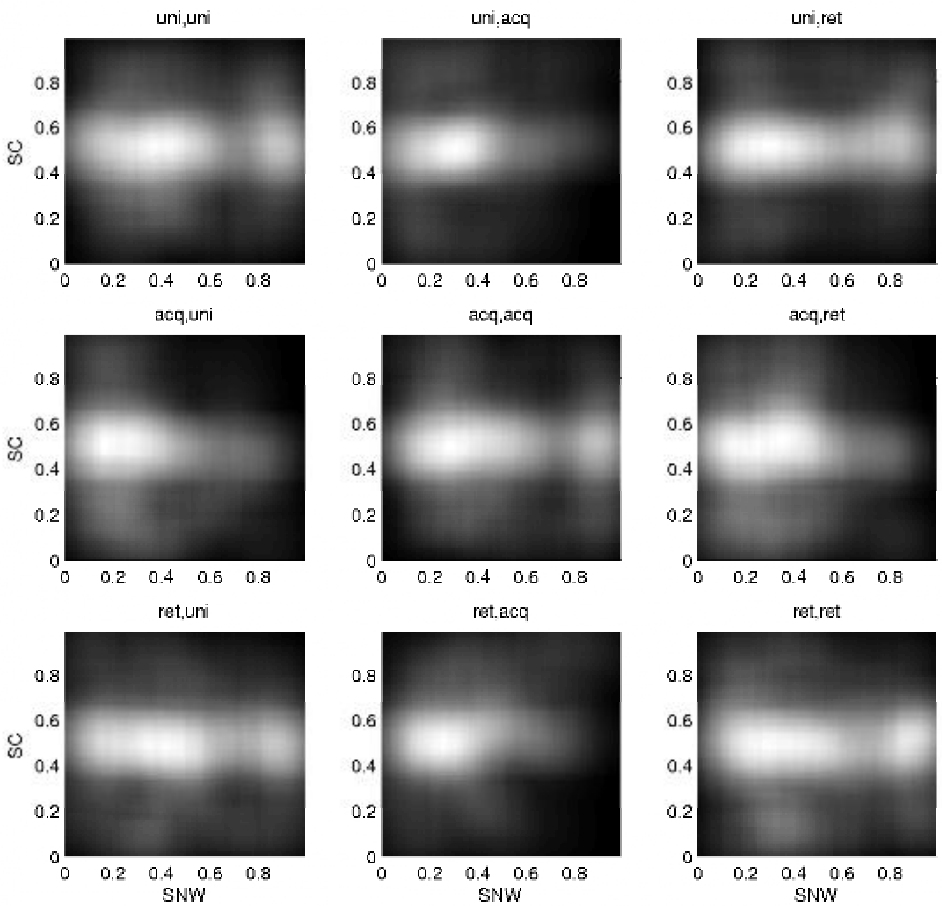

Figure 8: "new economy" firm profit uncertainty (standard deviation). All possible combinations of customer target strategies are shown (target all customers uniformly, acquire new customers, retain old customers). SC (y-axis) stands for "scale" and is the difference of the advertising budget (equation 7) of firm agent one and firm agent two. A scale value of 0.5 means a perfect match of the advertising budget of both firm agents. The x-axis represents the strength of the social network component (SNW). The brightness of an area represents the standard deviation of the profits.

The simulation results for "new economy" markets can be summarized as follows:

- A low risk strategy for high social network (SNW) markets is to match the advertising budget of your competitor and try an customer acquiring strategy
- Acquiring works best in a high social network market but it becomes risky if you do not know the markets SNW factor (for example do a customer survey first)
- Non-acquiring is risky if you do not know the advertising strategy of your opponent

- If both firms engage in acquiring there is no clear strategy to follow regarding the advertising budget

A central message for firms which operate in a “new economy” market environment is that for e-Business it is very important to know the social network strength, since it controls the easiness of customer switching. Table 4 summarizes the “the dos and don'ts” for successfully advertising in the “new economy” markets.

Table 4: The “new economy” strategy advisor. The columns indicate your competitors strategy, the rows your advertising strategy.

You \ Opponent	Uniform low/high SNW		Acquiring low/high SNW		Retain low/high SNW	
Uniform	Match budget (risky)	Frontload budget	Compete	Don’t match budget	Match budget (risky)	Frontload budget
Acquiring	Don’t compete or match budget (risky)	Match budget	Not clear	Not clear	Don’t compete or match budget (risky)	Match budget
Retain	Match budget (risky)	Frontload budget	Compete	Don’t match budget	Match budget (risky)	Frontload budget

Figure 9 shows the firm profits for each market scenario in an “old economy” environment (high comparison costs). The scenarios are named with the strategy of firm agent one then firm agent two. For example “acq, uni” means that firm agent one engages in a new customer acquiring strategy, while firm agent two uniformly distributes his budget over all consumer agents. The x-axis represents the impact of the social network (due to network externalities) and is equal the weight SNW of our consumer decision model (section 3.4). SC (y-axis) stands for “scale” and is the difference of the advertising budget (equation 7) of firm agent one and firm agent two. It’s normalized in a way that a value of 0.5 means a perfect match of the advertising budget of both firm agents. The brighter an area the higher is the profit for firm agent one. For example in the “acq,uni” scenario with a good budget match (SC~0.5) firm one always profits over firm agent two independent of the SNW strength.

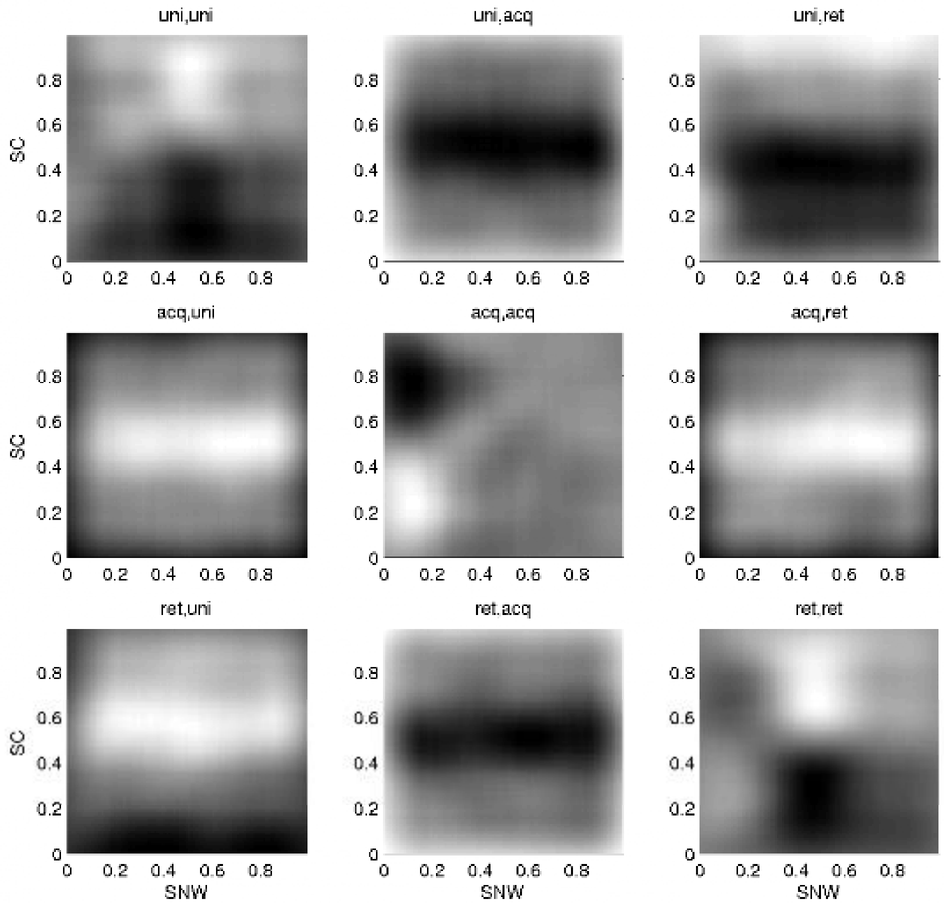

Figure 9: "old economy" firm profits. All possible combinations of customer target strategies are shown (target all customers uniformly, acquire new customers, retain old customers). SC (y-axis) stands for "scale" and is the difference of the advertising budget (equation 7) of firm agent one and firm agent two. A scale value of 0.5 means a perfect match of the advertising budget of both firm agents. The x-axis represents the strength of the social network component (SNW). The brightness of an area shows the profit strength of firm agent one. Black means firm agent two collects higher profits than firm one.

Figure 10 shows the standard deviations of the firm profits for each scenario. Thus in the mentioned example firm one's profits are nearly riskless in a high social network market (SNW>0.5) since the standard deviation is very low in the "acq,uni" market scenario.

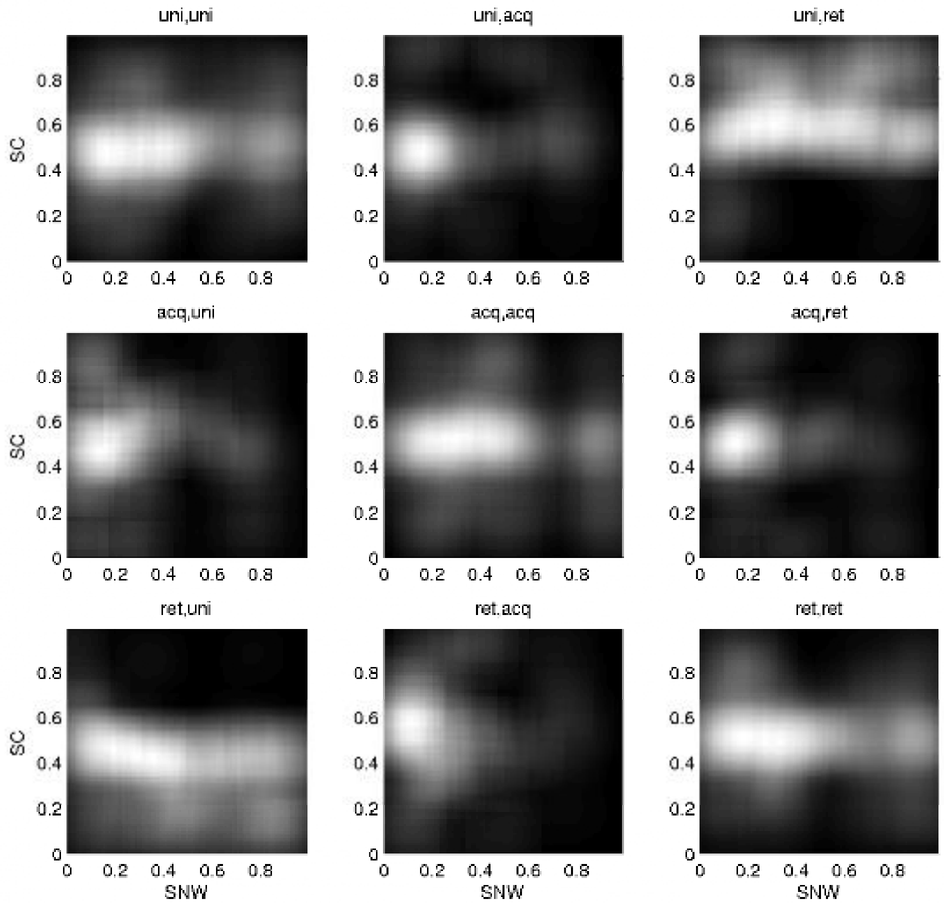

Figure 10: “old economy” firm profit uncertainty (standard deviation). All possible combinations of customer target strategies are shown (target all customers uniformly, acquire new customers, retain old customers). SC (y-axis) stands for “scale” and is the difference of the advertising budget (equation 7) of firm agent one and firm agent two. A scale value of 0.5 means a perfect match of the advertising budget of both firm agents. The x-axis represents the strength of the social network component (SNW). The brightness of an area represents the standard deviation of profits.

An important message for firms which operate in an “old economy” market environment is that it is very important to be able to match your opponent’s budget. Then acquiring new customers is a strategy that works best. Table 5 summarizes the “the dos and don'ts” for successfully advertising in the “old economy” market scenario.

Table 5: The "old economy" strategy advisor. The columns indicate your competitors strategy, the rows your advertising strategy.

You \ Opponent	Uniform low/high SNW		Acquiring low/high SNW		Retain low/high SNW	
Uniform	Frontload budget (risky)	Frontload budget	Never match budget	Never match budget	Heavy frontload budget (risky)	Heavy frontload budget (risky)
Acquiring	Match budget (risky)	Match budget	Endload Budget	Match budget (very risky)	Match budget (risky)	Match budget
Retain	Frontload or match budget (risky)	Frontload or match budget	Never match budget	Never match budget	Frontload budget (risky)	Frontload budget

7 Conclusions

This paper explores the impact of different advertising strategies in two big market scenarios: old and new economy. The markets consist of production firm agents offering their products and cognitive and socially bounded consumer agents. We present a new consumer agent model (section 3) which is embedded in a social structure based on "small-world network" principles (Milgram, 1967; Watts and Strogatz, 1998). Furthermore the agents follow a rather simple cognitive decision structure, but one which is able to account for valid behavioral dynamics such as habits, imitation and social comparison processes (Janssen and Jager, 2000). The firm agents are bounded by their advertising budget and advertising strategy. Firm agents seek to maximize their profits by variation of the timing and size of their advertising budget and their target customer group (all, new, or old customers). Firm agents are able to positively influence the customers' cognitive states via advertising and thus increase the probability of their intention to repurchase.

Our simulation results clearly show that there are different successful strategies for product differentiation and advertising dependent on the market environment. We show that there is a significant difference between "new" and "old economy" markets under the condition of low social network influence (no network externalities). In the "old economy" product differentiation has a significantly higher effect on firm profits. Regarding the markets with high network externalities we conclude that products rather converge because of easy comparison possibilities (low comparison costs) for customers. Thus it may not be worth competing in product features in high social network markets since people stick for a while to their products due to their social network and network externalities. In general consumers seem to profit from e-commerce (low comparison costs) and governments may encourage e-business to get more efficient markets and satisfied customers.

Furthermore our simulation results enable us to give strategic advice by investigation of the success of different advertising strategies under different market conditions. The simulation results for "new economy" tell us a central message for firms which operate in a "new economy" market environment: for successful operations in e-business it is crucial to know the social network strength (for example by customer surveys) since it controls the easiness of customer switching. While in an "old economy" market environment it seems to be more important to be able to match your opponent's budget. Then acquiring new customers is a strategy that works best. The results substantiate empirical evidence and common knowledge of marketing practitioners.

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