

# Key Consumer Group for Late Comers in Network Effect Product Markets: A Multi-agent Modeling Approach

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*Abstract:* - The first movers in network effect market enjoy the first-mover advantages. However, through proper strategy, late comers still hold a chance to win the competition. I divide the consumers into 5 categories (active rational, passive rational, active non-rational, passive non-rational and sheep herd) and simulate the market with multi-agent modeling method. Through analyzing the interactions between these consumer groups, I find that the active non-rational group is the most important consumer group for the late comers—late comers should focus on attracting this group first so that they may compete with the first movers. In support of my study, I also provide case studies of China's blog service market and China's online game market.

*Key-Word:* - multi-agent modeling, network effect, consumer group, first mover advantage, consumer behavior, decision making, herd behavior.

## 1. Introduction

Network effect is also called “network externality”. In a network effect product market, the value of the product to a user is decided by the total number of users. According to the Metcalfe law, the value of a network is proportional to the square of the total number of users. Typical network products are fax, telephones, instant messenger software, online games, standards, and B2B websites and so on. Seppo Sirkemaa (2003) [21] provided a discussion on standards in IT infrastructure management in their research. Karetsos, Costopoulou, Pyrovolakis and Georgiou (2007) [22] provided a research on Developing Agricultural B2B Process.

In network effect product market, the “first mover advantage” is especially emphasized. Lisa E. Bolton and Chip Heath (2005) had presented a review of previous literatures in their research [1]. The most important advantage enjoyed by the first mover fall in two parts: (1). there will form a positive feedback between the growth of user number and the growth of product value (the source of the positive feedback is economies of scale on the demand side [2]). So the first movers have a greater chance to reach the positive feedback earlier than the late comers and therefore are more likely to win the competition. (2). the first movers may achieve a lock-in in consumers. However, these advantages dose not necessarily sentence late comers to failure—in the real market, many late comers

managed to hold their position and even over threw the domination by the first movers.

In my research, I divide the consumers into 5 categories—active rational group, passive rational group, sheep herd, active non-rational group and passive non-rational group. The traditional assumptions of rational agent are included in the rational groups. The purpose of my research is to find out the most important consumer group for the late comers in a network effect product market without solid lock-in and derive the corresponding strategy for the late comers to compete with the first movers. I also analyzed two successful cases: Sina's celebrity blog and the online game “ZT Online”.

The network effect product market is a typical complex system. My major research method is to simulate the market through multi-agent modeling. Ali Orhan Aydin and Semra Tunali (2007) [23] provided a literature review on intelligent agents. In support of my research, I build a consumer behavior model, a consumer category model and a system model.

The paper is structured as follows: the next 3 sections focus on the three models. In section 5, I analyze the results of the simulation, and derive the strategy for later comers under 3 different conditions. Section 6 is the discussion. Conclusion and further research follow in section 7.

## 2. Consumer Behavior Model

I mainly derive my consumer behavior model from the textbook "Marketing Management: An Asian perspective" [3] (Philip Kotler et al). In this model, each consumer owns two major properties: cognition of the product, attitude to the product. The cognition value describes to what extent the consumer knows the products, while the attitude describes how the consumers like the product.

Figure 1 shows the consumer behavior model: a potential buyer continuously moves in the environment, receives influences from advertisements, communicates with other consumers

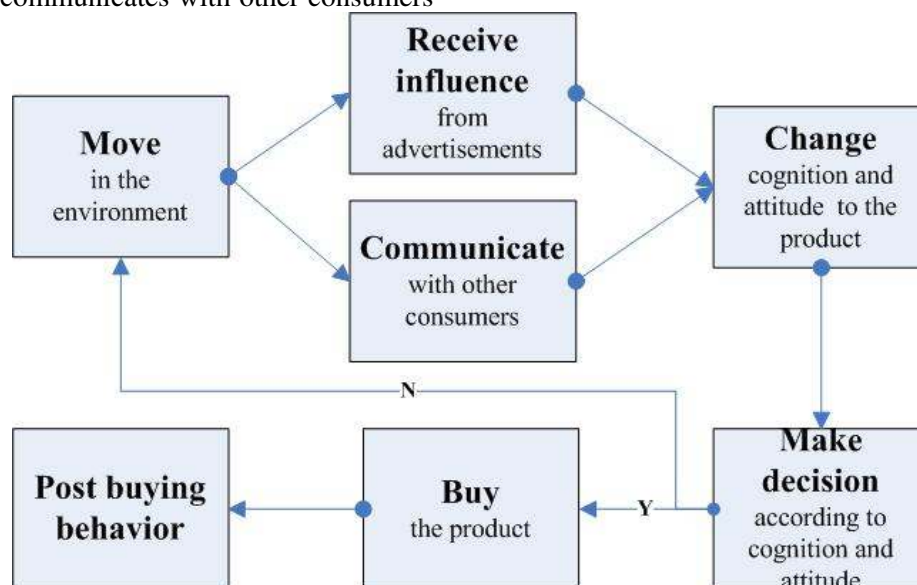


Fig. 1: Consumer behavior model

### 3. System Model

Figure 2 illustrates the system model. There are a pool of potential buyers, a small number of initial buyers and two kinds of products at the beginning. The two products are of the same sort but they are neither compatible nor can be interlinked together with each other. Take the MSN and the Tecent QQ for example; they are of the same sort because both are instant messenger softwares, while they are not compatible because neither of the two can send to or receive messages from the other.

The potential buyers communicate with other consumers (include both potential buyers and buyers) and receive influences from advertisements. Through proper communication and enough influence, they will turn into buyers of product 1 or product 2. The detailed behavior of a consumer is already shown in the above section. After turning

and changes the value of his cognition and attitude accordingly. Then, the consumer will make decisions according to the current state: if his properties satisfy certain condition, he turns into a buyer and continues to adopt post buying behavior; or else he will go back to the beginning of the circle. The post buying behavior fall into two parts: further investing in the product which will again raise the cognition and attitude to the product and changing his current product.

into buyers, the consumers will still communicate with each other and receive influence from advertisements. During this time, consumers will evaluate their current product according to their own criteria (the criteria of each consumer group are in the next section). Once a consumer finds the other product is better than his current one, he will change into a buyer of that product while abandoning his current product.

The following are the major assumption:

- (1) A buyer must be a buyer of product 1 or product 2, but he cannot be the buyers of both at the same time.
- (2) A buyer cannot turn into a potential buyer.
- (3) All consumers can afford the cost of buying and changing the products.

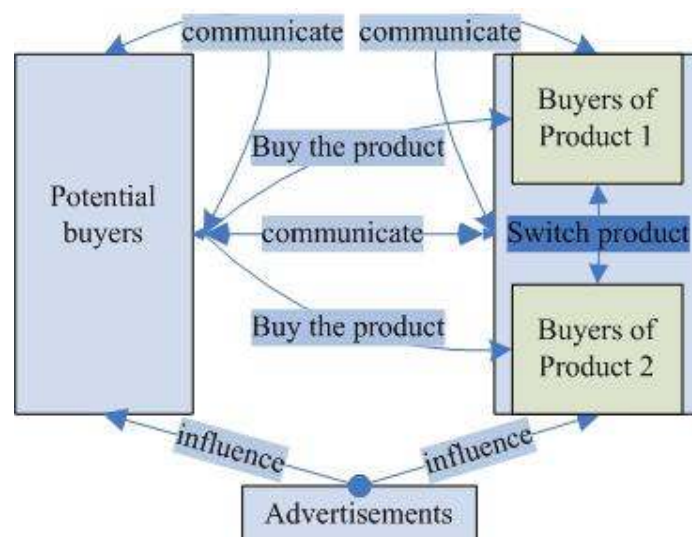


Fig. 2: System model

#### 4. Consumer Category Model

The modeling of consumer groups concerns two strategies: the decision-making strategy and the information searching strategy.

The decision-making strategy tells how a consumer makes his decision to buy a product. This strategy includes: "rational" and "non-rational".

A rational consumer will assess the product objectively, making his buying decision by his cognition of the product and the value of the network formed by the products. Once his cognition and the value of the product satisfy certain condition, he will buy the product. Later, when he finds his current product is lower in value comparing to the other one, he will change his product. In this market, the value of the product or network is mainly decided by the total number of users. One example of users here is rational agent.

A non-rational consumer will make decisions by his subjective feeling about the product (corresponding to the "attitude" in our model). When he feels good enough about the product (the value of his attitude reaches certain condition), he will buy it. Then if he feels better about the other product, he will abandon the current one.

The information searching strategy describes how a consumer search and receive information of the product. This strategy includes: "active" and "passive".

An active consumer will deal with the products actively. He may positively seek information about the product and is eager to learn from other consumers (rational), or he may be easily affected by the advertisements and others' attitudes (non-rational). One example of consumers in this category is fashion-leaders.

A passive consumer will take the product passively. This is either because he doesn't have enough time and energy to learn information about the products (rational) or because he is a conservative (non-rational).

Combining the two variables and considering the people with herd mentality, I get five categories of consumer groups: active rational consumers (AR), passive rational consumers (PR), sheep herd (SH), active non-rational consumers (AN) and passive non-rational consumers (PN). Figure 3 shows the five categories.

The sheep herd (SH) is the group of consumer who is strongly affected by the herd mentality. Herd mentality tells how people are influenced by their peers to take certain actions, such as following trends, purchasing products. People in the sheep herd are eager to follow others while ignoring their own information. In my model, whether a consumer in a sheep herd is a potential buyer or a buyer, he will follow the buying trend (the product with the most new buyers in the recent unit time span) to buy or to change product.

		Information Searching Strategy		sheep herd (SH)
		Active	Passive	
Decision-making Strategy	Rational	Active Rational (AR)	Passive Rational (PR)	
	Non-rational	Active Non-rational (AN)	Passive Non-rational (PN)	

Fig. 3: Consumer groups

### 5. Results Analysis

I realize the models above on the implementation level with Netlogo3.1.2 multi-agent modeling software. There are 2000 agents (consumers) in the environment, two products and 10 initial buyers for each product. The 5 kinds of groups each take 20% of all the consumers. In all figures blow, the x axis stands for the time, and y axis for the number of users.

#### 5.1 The Typical “S” shape

In a network effect product market, growth of user number will usually have an “S” shape. See figure 4. Here I divide the growth into three periods: A—early stage of accumulating first buyers, B—rapid growth, C—stable and slow increase until the final occupation of the market.

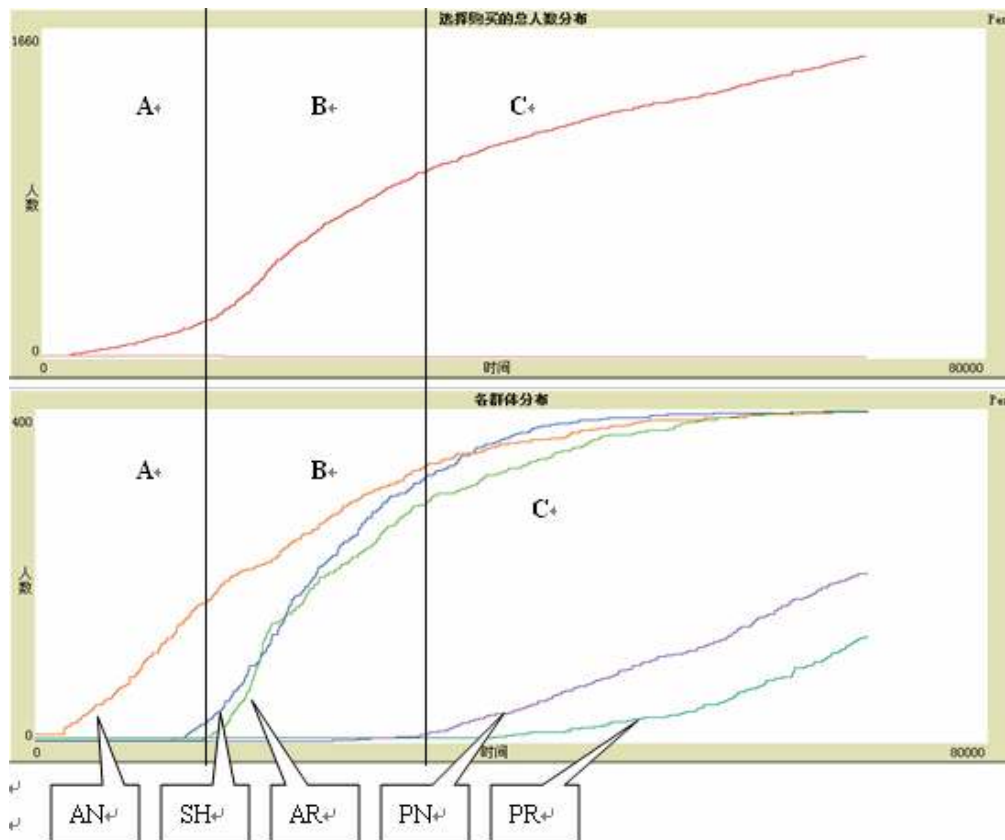


Fig. 4: Growth of the user number in a single product market.

In the upper picture of figure 4, the highest value of Y axis is about 1600, while that of the lower picture is 400 for the 5 groups each takes 20% percent of the 2000 consumers.

In period A, the first buyers are often in the active non-rational group who judge by their subjective feelings and are eager to try new things. Then in period B, as the user number reaches a critical number, rational group starts to find the product is worthwhile and begin to buy. And the

people with herd mentality also begin to follow the mass. Soon, two positive feedbacks form—one between the growth of product value and growth of user number, one between buying action of consumers and following action of people with herd mentality (the more people buy the product, the more SH consumers follow, then there are even more people buying it). Later, in period C, as the number of potential buyers decreases (most of them has turned into buyers), the growth rate falls until the

full occupation of the market. Thus an s-shape growth figure forms.

## 5.2 Key Consumer Group and Strategy for Late Comers in Period A

When the late comer goes into the market at the early stage (period A) of the first mover, since the sheep herd will follow the buying trend, the late comer can not attract the sheep herd directly—they need new buyers from other groups to stimulate the sheep herd to follow. Therefore the late comer has two choices: to attract the rational group or to attract the non-rational group.

The later comer should choose to attract the active non-rational group for 3 reasons:

- (1) Active non-rational group are more eager to try a new product than any other group.
- (2) At the early stage, most buyers are in the active non-rational group. Therefore attracting these buyers will reduce the current users and the future users of the first mover directly.
- (3) At the early stage, it is difficult to attract the rational group who requires that there should be enough users so that this network effect product can give them enough value.

Let the late comer join the market at the early stage and adopt marketing strategy (mainly through advertisements) aiming at spreading good attitude to its product. Figure 5 shows the result.

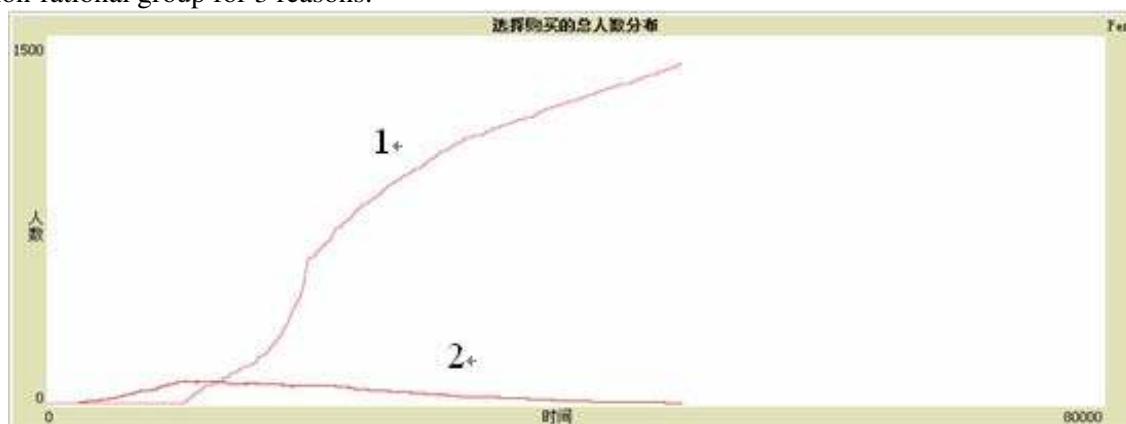


Fig. 5: Early stage competition

In the figure, product 2 is the first mover and product 1 joined the competition a little later. After product 1 started its high attitude strategy, the user number of product 2 began to decline (they change to product 1) and was then outnumbered by the users of product 1. Later the sheep herd started to buy product 1 for there were much more people buying it. Once the sheep herd started to move, the positive feedback between the buying action of consumers and the following action of the sheep herd would form. Then the product 1 had enough users to attract the rational group. Similarly, another positive feedback between the growth of user number and growth of product value would form. At the same time buyers of product 2 continued to shift to product 1 to seek for a greater value (rational group), a better feeling (non-rational group) or a larger group (sheep herd), which contained actually a feedback between the loss of users and the loss of product value. The sheep herd, the rational group and those who changed product together led the rapid growth (period B) and the final success of product 1.

So the strategy for late comers in period A would be: The late comers should focus on attracting the

active non-rational group so that the group's buying behavior will lead to the two favorable positive feedbacks on their product and the one unfavorable positive feedback on the first movers' product. Once they reach feedbacks earlier than the first mover, they will be able to control the trend of the market.

### Case Study: Sina's Celebrity Blog

Figure 6 illustrates the number of active blog users in China [4]. The active blog users is the blog users who updates their most frequently used blog at least once a month.[20]The critical user number of rapid growth lay between the end of 2005 and the end of 2007. By the end of 2004, about 20 first movers [5] had established their blog service, including the famous blogcn.com, blogchina.com, and bulo.163.com. In September 2005, a few months before the rapid growth, Sina Corporation—the late comer—released its blog channel. However, Sina's simple and powerful marketing strategy had brought it a great success. The strategy is "celebrity blog". Since the opening of blog channel, Sina has been inviting celebrities from many fields including commerce, literature, education, IT, sports and

media to write blogs in the channel. When Sina blog had not many users sharing their content and thus was not attractive to rational users, these celebrities were a great attraction for the non-rational groups and the sheep herd to open their own spaces in Sina because the celebrities spread a high attitude to the Sina blog, as well as an illusion that people, especially the famous ones, are rushing to Sina blog. According to a piece of reprinted news from www.ccidnet.com [6], in November 2005—just two months after the opening of Sina blog—the user number had exceeded 1 million, and the celebrities also brought a visiting amount increase of 30% to 40% [7].

On the market side, according to the “China Blog Investigation Report 2006” launched in late

2006, the top motivation (agreed by 83.5% of people investigated) [19] for opening a blog is to record mood and feeling of oneself. This motivation has nothing to do with sharing. And since without sharing there is no difference between recording one’s mood with blog and writing it on a diary book, “recording one’s mood” can not be a motivation of the rational groups (i.e. they do not have to pay energy and cost just to write their diary in a new way). Instead, this motivation is most likely to be of the active non-rational people, who judge by attitude and are eager to try new things. Therefore, we can see that it is the active non-rational group that leads the early growth in the blog service market. This again proved that Sina had adopted a wise strategy.

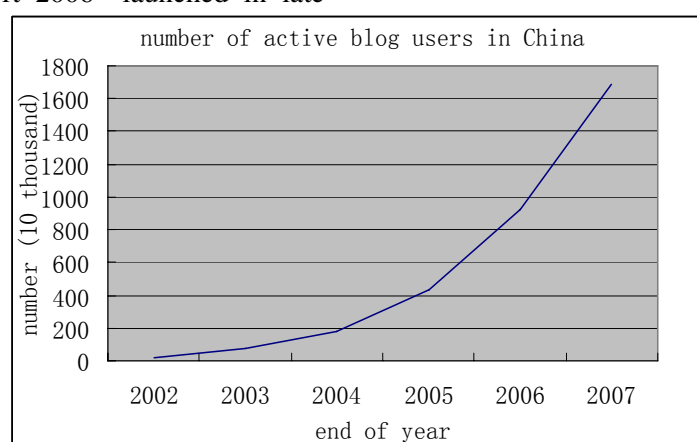


Fig. 6 : Number of active blog users in China

### 5.3 Key Consumer Group and Strategy for Late Comers in Period B

In fact, many new network effect product markets are noticed by potential competitors only when the first movers go into the rapid growth. In period B, besides active non-rational group, both the sheep herd and the active rational group are turning into buyers in large numbers. Therefore, it often takes the late comers great energy and capital so as to attract new buyers and to persuade buyers of first movers to change product. Here, the late comer still has to focus on the active non-rational group. The reasons are:

(1) The rational group will compare the total user number of the products and choose the one with

the most users so as to gain the greatest value, which makes it difficult to attract them because the new comer does not have enough users.

- (2) Active non-rational group (whether buyers or potential buyers) welcome new product as long as it can bring them a better feeling (a better attitude).
- (3) New comer still needs many movers (new buyers or those coming from competitor’s product) to stimulate the sheep herd to come.

Let the late comer face the rapid growth of first movers and adopt marketing strategy aiming at spreading high attitude to the product. Figure 7 shows the result.

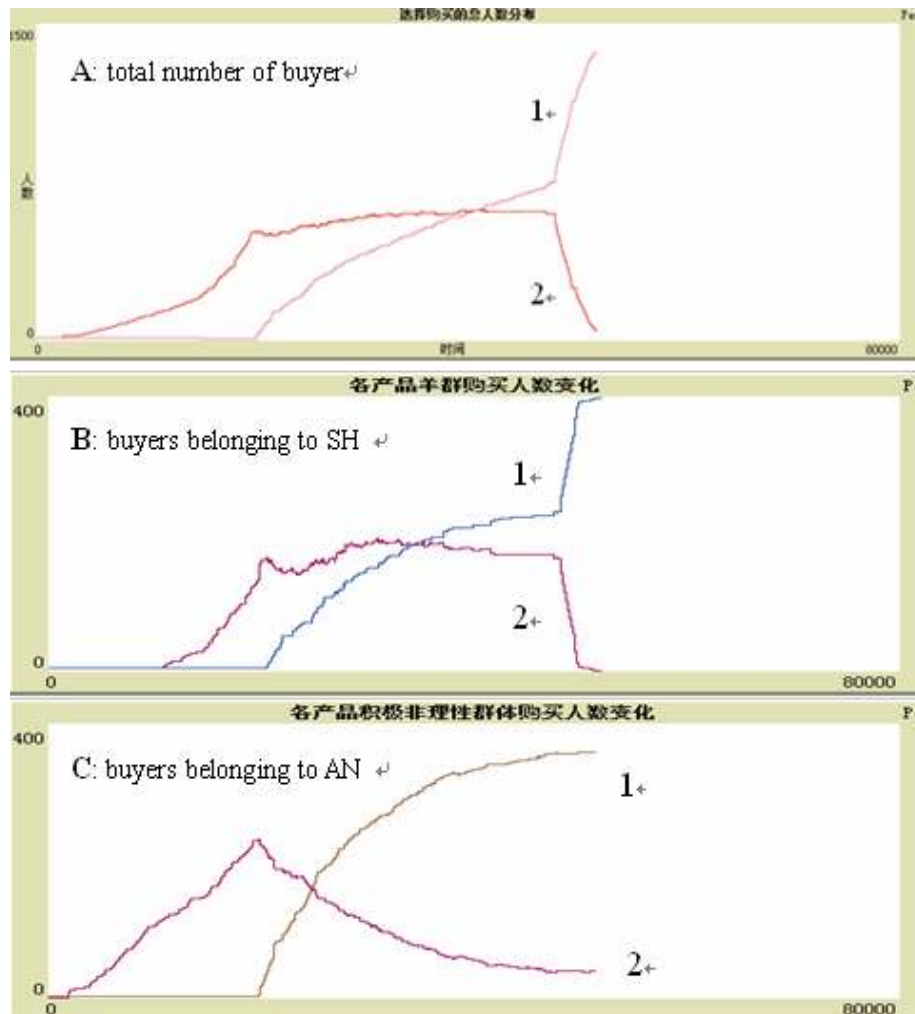


Fig. 7: Competition in period B (x axis—time, y axis--number of users)

In figure 7, picture A is the total user numbers of both products (highest Y axis value around 1500). Picture B shows how the buyers who belong to the sheep herd choose their product (highest Y axis value is 400). Picture C shows the choice of active non-rational buyers (highest Y axis value is 400).

As shown in picture B and C, the high attitude strategy first attracted many potential AN buyers to come and many AN buyers of product 2 to change their product. This soon destroyed the first mover's positive feedback between the buying behavior and the following behavior in the sheep herd—the most buying behaviors shifted from the first mover's product to the late comer's. Therefore though the feedback between the growth of user number and the growth of product value in product 2 still existed, the great decline in AN and SH buyers put a stop to the rapid growth of user number of product 2. As this trend continued, once the users of product 2 were outnumbered by that of product 1, the last feedback on product 2 would end. At the same time, two new positive feedbacks (one between the growth in users and growth in product value; one between the buying action and the following action) on late

comer's product 1 and one positive feedback (between loss of users and loss of product value) on the first movers would form, which led to the final success of the late comer.

So the strategy for the late comers in period B would be: Late comers should put major energy to persuade the AN consumers to buy so that they may destroy the two positive feedbacks on the first movers' product and then generate new favorable positive feedbacks on their own product and new unfavorable feedback on the first movers product.

### Case Study: the Online Game “ZT Online” [8]

Figure 8 shows the number of online game players from 1999 to 2007, from which we can find that online games in China went into rapid growth period between 2003 and 2004. The online game “Zhengtuo Online” was released on November 2005, at least one year later than the rapid growth was reached. In late 2005, GIANT (the company operating ZT Online) must face the fierce competition from first movers such as Shanda [9], The9 Limited [10] and

NetEase [11]. ZT Online's three major marketing strategies in the early promotion was aimed mainly at non-rational groups: (1). Free to play. (2). TV advertisement. (3). Marketing campaign in district (grade) cities and county (grade) cities.

Firstly, the ZT Online was announced to be "free to play". However, the game is not totally free—although players are able to register free and play for free, the game charges when players buy high level virtual material, tools and weapons. In fact, on average the ZT Online is more expensive than many other online games because the players must invest a lot in buying these high level things if they are to enjoy the game. Since the rational groups are not easily persuaded by the "free to play" trick, the major target of this strategy is definitely the non-rational groups who are eager to try new things without concerning the real cost of the game. Secondly, GAINT put TV advertisements of the game on CCTV 1 and CCTV 5 for a month since December 2006 and the content of the advertisements is to spread wonderful attitude to the game [12]. Thirdly, by August 2007, GAINT already had a marketing team of 2000 people and the

number was increasing by 300 per month [13]. Most of them are arranged to engage promotion in district (grade) cities and county (grade) cities, especially to put paper advertisements in internet bars. The target was to create an atmosphere that the ZT Online was a fashionable new star at that time, which is attractive to active non-rational consumers.

In fact, the ZT Online is not the most excellent online game. Even two years after it was released, in aspects of graphics, sound effect and music, ZT Online has never been in the top 5 among most popular online games in China. [18] Its systems (for example, task system, war system, and rank systems) are not quite different from other online games. There were even reviews saying the ZT Online was just a mixture of several other online games. Nevertheless, the marketing strategy did work. ZT Online ranked 7<sup>th</sup> [14] among online games in China in 2006 and the 2<sup>nd</sup> [15] in 2007. According to its official site [16], on 26 April 2008, the game had 2.1 million players online simultaneously, which set a new record and proved its topmost position in online game market in China.

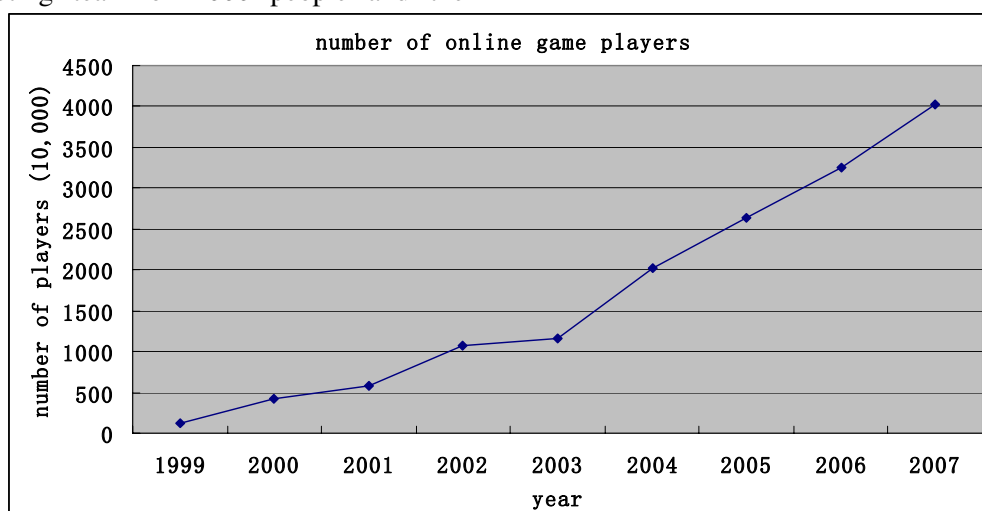


Fig. 8: Number of online game players in China from 1999 to 2007. [17]

new techniques successful in a market affected by positive feedback.

### 5.4 Period C

In most of the time, if the late comer only have a product similar to the first movers', it is impossible to compete with a product which has already occupied the market. More often, late comers in this period will bring new techniques or functions so that they may attract the users to change to their "revolutionary new product". However, this is against my assumption that the two products are similar, so I shall not discuss the strategy for late comers in period C. Readers may refer to [25] for detailed discussion on proper strategies to make a

## 6. Discussion

The consumer category model decides that the results apply to such markets in which there exist the 5 categories of consumers. In fact, rational groups always exist in a network effect product market. And since the passive non-rational group is not a very important group, the key criterion relies on whether there are active non-rational group and sheep herd in a specific market.



Often, in a market in which the buying decision is made by individuals, we will identify the active non-rational group. Typical markets are Blog service, online games, and instant messenger software markets and so on. Correspondingly, in markets where the adoption of the product is decided by a group of people, the effect of active non-rational group is rather small. This is because subjective or emotional behaviors are often questioned and constrained by other people within the group, so that the decisions tend to be rational. Such markets are usually related to enterprises and other organizations. Examples can be enterprise operation systems markets, database software markets and markets concerning industry standards. My results are not quite suitable for analysis of these markets.

As to the sheep herd, it exists in both two types of markets above. It can be referred to [24] for researches on “information cascade”—a kind of herd behavior—among individuals and enterprises.

I also assumed that the two products in my model are not compatible with each other. Therefore, the results do not apply to markets in which the products from different companies can be linked together. Such markets are BP markets, cell phone markets and so on.

## 7. Conclusions and Future Research

The crucial consumer group in the network effect market is the active non-rational group. Once the active non-rational group moves massively, the people with herd mentality will notice and are likely to follow. If there are enough consumers becoming the users of products of the late comers, rational groups will re-consider their choice and buy the new product. Therefore through making the active non-rational consumers their first buyers, the late comers will grasp the key to build two favorable positive feedbacks (one in the sheep herd and one in the rational group) on their own product and to destroy those of first movers’. Once the positive feedbacks form, another positive feedback (between loss of users and loss of value) on the first movers’ product will exist. In this way, the late comers will successfully hold their position and even kick the first movers out of the market.

In the future research concerning the late comers in network effect market, there are several items to be considered seriously:

(1). in my qualitative research, I assume that the five groups each take 20% of total number of consumers. However, in more detailed analysis

of a specific market, it would be better to know the exact proportion of each group.

- (2). the first mover advantage also includes other benefits such as a possible lock-in of users, the first brand, and early experience. Future research should concern these benefits and the corresponding strategy for late comers.
- (3). my model dose not apply to such network effect market that the products are can be interlinked with each other. Late comers in that market face a situation quite different from the one I discussed.

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