Physica A 389 (2010) 1688–1698

Contents lists available at ScienceDirect

Physica A

journal homepage: www.elsevier.com/locate/physa

Market segmentation strategy in internet market

Yawei Ren *, Deli Yang, Xinjun Diao

Institute of Systems Engineering, Dalian University of Technology, Dalian 116024, Liaoning, China

ARTICLE INFO

Article history:
Received 17 April 2009
Received in revised form 11 August 2009
Available online 1 December 2009

Keywords:
Internet market
Competition dynamics
Stability
Market segmentation

ABSTRACT

This paper presents a model to describe the competitive dynamics of web sites on the WWW market and analyze the stability of the model which is composed of one powerful site and two small sites. One of the most important results that emerge from this simple model is that strong competition among websites does not necessarily lead to the demise of the small website on the WWW market. From the stability analysis of the model, we obtain a series of conditions in which small sites can obtain competitive advantages by using the market segmentation strategy.

1. Introduction

Recent surveys show that a few web sites have grabbed almost all the customers while other sites become extinct [1,2]. This so-called 'winner-take-all' phenomenon was proved to come from increasing competition among web sites [3]. The sites with the maximum market share will usually win in the competition and the others will become extinct. Maurer and Huberman first presented a simple model [3] and pointed out that the model will lead to transition from a number of sites sharing the market to the winner-takes-all market, with increased competition among the web sites. The model can be described by the following differential equations:

$$\frac{\mathrm{d}f_i}{\mathrm{d}t} = f_i\left(\alpha_i\beta - \alpha_i f_i - \sum_{i\neq j}\gamma_{ij}f_j\right) \tag{1}$$

where f_i is the fraction of the market which is a customer of site i, α_i is the growth rate which measures the capacity of site i to grow, β is the maximum capacity which expresses the saturation value of f_i and γ_{ij} is the competition rate between sites i and j. The greater the f_{ij}, the greater the loss of users of site i caused by existence of site j will be.

Further works will focus on two main aspects: (i) try to find new models which can better characterize the real market; (ii) try to find proper strategies to help small sites avoid extinction. Luis Lopez, Miguel A.F. Sanjuan [4] and Wang, Wu [5] show that when taking both competition and cooperation into consideration, the web site competition model can show some interesting phenomena which cannot be found in Ref. [3] and propose a series of strategies to help small sites survive in the competition. Wang and Wu [5,10] propose a cooperation–competition model for the WWW market with the assumption that the intrinsic growth rates and maximum fractions are equal. Jiang and Cheng [6] give the complete strategic classification for the model proposed in Ref. [5] without any hypothesis. Xiao and Cao [7] take the time delay in the process of competition into consideration. Li and Zhu [8,9] emphasize the 'richer get richer' phenomena in the process of e-commerce web sites competition, and propose a competitive model of e-commerce web sites.

So, what we are interested in is: apart from cooperation, is there any other way for small sites to avoid extinction? Market segmentation is one of the most commonly used strategies in real market competition. Then how can small sites

* Corresponding author. Tel.: +86 41184749156.
E-mail addresses: renyawei1978@sina.com (Y. Ren), somdyang@dlut.edu.cn (D. Yang), xjddd@126.com (X. Diao).

0378-4371/$ – see front matter © 2010 Published by Elsevier B.V.
doi:10.1016/j.physa.2009.11.023

avoid extinction or even win in the competition by market segmentation? In this article, we present a model to characterize competition between web sites in a market with a market segment. And by analyzing the stability of the model which is composed of one powerful site and two small sites, we get a series of conditions for small web sites to try market segmentation strategy.

2. Web site competitive model with market segment

Consider n websites offering variety of services and competing with each other for the considerable population of customers, which we will take to be much larger than the number of sites. Each site engages in policies, from advertising to prize reductions that tries to increase their share of the users f_i. f_i is the user fraction of website i. In this model, f_i is determined by four main factors. If there is no competition with any other sites, it grows with a rate α_i, and then saturates at β_i. α_i is the growth rate of individual website i, β_i denotes their capacity to service a fraction of the customers. In addition, if other sites offer competing services, γ_{ij} is the competitive strength between site i and site j. Assuming that the probability of using one site is independent of using another, a fraction f_if_j will be using both site i and site j. However, if both sites provide similar services, then some of these users will stop using one or the other site. The rate at which they will stop using site i is given by $\gamma_{ij}f_if_j$, and the rate at which they abandon site j is given by $\gamma_{ji}f_if_j$. Customers were divided into two categories: ordinary customers and customers in the market segment. Ordinary customers show the same interest to all kinds of services provided by different websites, while customers in the market segment are only interested in particular information service. So a website can choose either market aggregation strategy which provides services for all customers or market segmentation strategy which only provides service for customers in the market segment. Among all the n web sites, there are r web sites providing services for all customers and the rest $n - r$ web sites only providing services for customers in the market segment. Let the capacity of the whole market be 1, and θ $(0 < \theta < 1)$ is the capacity of the segment. In order to enhance the understanding of the issue, the entire problem can be divided into two sub-problems.

(1) $n-r$ websites only provide service for customers in the market segment. So there are still r websites providing services to ordinary customers and competing with each other for the $1 - \theta$ market share which is not in the market segment. Let f_i^* be user fraction of website i $(i = 1, \ldots, r)$ in this $1 - \theta$ submarket. Competitive dynamics of these r websites can be expressed as:

$$\frac{\mathrm{d}f_i^*}{\mathrm{d}t} = f_i^*\left[\alpha_i\beta_i(1-\theta) - \alpha_i f_i^* - \sum_{j=1,i\neq j}^{r}\gamma_{ij}f_j^*\right], \quad i = 1, \ldots, r. \tag{2}$$

(2) All websites may provide service for customers in the market segment. So there are n websites competing with each other for the θ market share which is in the market segment. Let $f_i^{\#}$ be user fraction of website i $(i = 1, \ldots, r)$ in this θ market segment. Competitive dynamics of these n websites can be expressed as:

$$\begin{cases} \dfrac{\mathrm{d}f_i^{\#}}{\mathrm{d}t} = f_i^{\#}\left[\alpha_i\left(\beta_i\theta - f_i^{\#}\right) - \displaystyle\sum_{j=1,j\neq i}^{r}\gamma_{ij}f_j^{\#} - \sum_{j=r+1}^{n}\gamma_{ij}f_j\right], & i = 1, \ldots, r \\ \dfrac{\mathrm{d}f_i}{\mathrm{d}t} = f_i\left[\alpha_i\left(\beta_i\theta - f_i\right) - \displaystyle\sum_{j=1}^{r}\gamma_{ij}f_j^{\#} - \sum_{j=r+1,i\neq j}^{n}\gamma_{ij}f_j\right], & i = r+1, \ldots, n. \end{cases} \tag{3}$$

System (2), (3) separately describes the competitive process in two submarkets. According to (2), (3), let $f_i = f_i^* + f_i^{\#}$ $(i = 1, \ldots, r)$, we can easily infer the websites competitive model with market segmentation which is expressed as:

$$\begin{cases} f_i = f_i^* + f_i^{\#}, & i = 1, \ldots, r \\ \dfrac{\mathrm{d}f_i^*}{\mathrm{d}t} = f_i^*\left[\alpha_i\beta_i(1-\theta) - \alpha_i f_i^* - \displaystyle\sum_{j=1,i\neq j}^{r}\gamma_{ij}f_j^*\right], & i = 1, \ldots, r \\ \dfrac{\mathrm{d}f_i^{\#}}{\mathrm{d}t} = f_i^{\#}\left[\alpha_i\left(\beta_i\theta - f_i^{\#}\right) - \displaystyle\sum_{j=1,j\neq i}^{r}\gamma_{ij}f_j^{\#} - \sum_{j=r+1}^{n}\gamma_{ij}f_j\right], & i = 1, \ldots, r \\ \dfrac{\mathrm{d}f_i}{\mathrm{d}t} = f_i\left[\alpha_i\left(\beta_i\theta - f_i\right) - \displaystyle\sum_{j=1}^{r}\gamma_{ij}f_j^{\#} - \sum_{j=r+1,i\neq j}^{n}\gamma_{ij}f_j\right], & i = r+1, \ldots, n. \end{cases} \tag{4}$$