

Study on the price Stackelberg game model under different competitive environment

Hongxing Yao^{1,2}, Yuan Luo²

¹ School of Finance & Economic, Jiangsu University,
Zhenjiang, 212013, China.

² Faculty of Science, Jiangsu University, Zhenjiang, 212013, China.
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Abstract. The product sold in different stores may be not same price, mainly caused by diverse retailers' situations. Meanwhile, maximizing relative interests is the businesses' common goal. Based on the 2-2 suppliers-retailers situation, this paper researches on the market by using dynamic price Stackelberg game model. We consider two cases, one is retailers under the win-win environment (case 1) and the other is they under the malicious competition environment (case 2). Through analyzing and comparing the two cases, this paper finds that the influence of different parameters on the Nash Equilibrium stable range in size is same, while the amplitude of stable range, the prices of goods, sales as well as the businessman profit are all different. These results will be revealed in a series of charts, including the stability diagram, bifurcation diagram, phase plot and histogram. And the conclusions may have a certain reference value for businesses on how to stabilize the market and which competitive measures should be taken.

Keywords: 2-2 suppliers-retailers situation, dynamic price Stackelberg game, the stable range of Nash Equilibrium, different competitive environment ,bifurcation diagram.

1. Introduction

Commodity pricing has been the first thing that businessmen need to consider. Due to different conditions and competitive environment, similar goods may be set into various price by merchants. This paper mainly researches the difference between the effects of goods under different environment, including the prices of goods, sales, the influence of different parameters on the Nash Equilibrium and the businessman profit.

The factors that affect pricing have been studied by many scholars and they found that sales volume, the freight, sales cost are all important for price[1-2]. The price Stackelberg game model is often used to study such economic problems, but the specific models structure is not the same[3-6]. Wang et al.[7] pointed out that the competitive environment had a certain impact on the price strategy. At present, the competitive environment is divided into two categories, namely, win-win and malicious competition situation. Interest allocation in cooperative situation was researched in [8]. The view that businesses may pay more attention to maximize the relative interests in malicious competition was put forward in [9]. Sales volume and prices of products are the most direct factors that affect business benefits. Pi[10] gave the market demand function researching on pricing and cooperating of the dual-channel supply chain under the competitive environment of more brand. This function can be used to reflect the relationship between sales volume and prices. The complexity pricing game and coordination of the duopoly air conditioner market with disturbance demand were researched in [11]. Even if the products are alternative, the basic needs of the market should have a certain degree of difference. When sales volume are expressed in terms of prices, the profit function can be constructed. As Zeng[12] mentioned that retailers can obtain the optimal retail pricing by using the differential extremum principle in the strategy of enterprise sales pricing. Then according to the price Stackelberg game theory, businesses can put the optimal retail price into the profit function and the optimal wholesale price can be got by using differential extremum principle again. Repeating this process, the price adjustment system of wholesale can be obtained. Many scholars[13-15]use this method to deal with the problems of supply chains. The stability of the system is also analyzed in this paper. Ma[16] considered the effect of delay variation on system stability. Yang[17]studied rich dynamics of a nonlinear economic model, then found Chaotic and bubbling phenomena which clearly agreed with phenomena from technology bubbling. The existence of Nash equilibrium point and its local stability of the game as well as the route to chaos was investigated in [18]. Many papers have proved that the increase of the adjustment speed can make

the system lose the stability. The Bertrand duopoly game with differentiated goods was researched, and the conclusion that the fast loss of the stability with fast adjustment speed was drawn[19-20]. Chen[21] analyzed the existence of bifurcation.

Based on the previous studies, the difference between similar businesses (mainly the freight cost) are fully considered, and the special 2-2 suppliers - retailers model is used in this paper. We assume two cases, including retailers in the win-win environment (case 1) and retailers in the malicious competition environment(case 2). Through analyzing and comparing these two environment, we can find a series of conclusions, including the influences of different parameters on the stable range, the prices of goods, sales and so on. These conclusions will be expressed by many graphical representation such as bifurcation diagram ,two dimensional graph,phase plot and histogram.

This paper is organized as follows. In section 2, we introduce the basic game model. In section 3, the dynamic game model will be given and the system stability will be analyzed in section 4.Then,in section 5,we will compare two environment and find the difference between them. At the last section, the conclusion will be given as well as the prospect.

2. The basic game model

Assuming that there exists two manufacturers (A and B) and two retailers (R_1 and R_2) in the market. Two manufacturers provide two similar products (a and b), which are alternative products. Two retailers sell the products by using traditional selling channel.

Firstly, the manufacturers set the wholesale price. Then, the retailers decide the retailer price. According to the market situation, the manufacturers need to adjust the wholesale price again until they achieve the maximization of interests and at the same time ,the market presents the steady state. The manufacturers are the leaders and the retailers are the followers. Manufacturers are competing and so are retailers.

2.1. Assumptions

Face In order to clearly clarify, the following assumptions are proposed :

(1) There are two manufacturers (A and B), two alternative products (a and b) and two retailers(1 and 2) . Retailers bear the freight.

(2) The cost of manufacturing products is normalized to zero. The operating cost and the cost of selling for each retailer are normalized to zero. In fact, this assumption is used for the convenience of calculation. The optimal individual prices of the goods in practical application is equal to the the optimal price in this assumption conditions adding the cost of individual goods.

(3) Sales without stockout or oversupply.

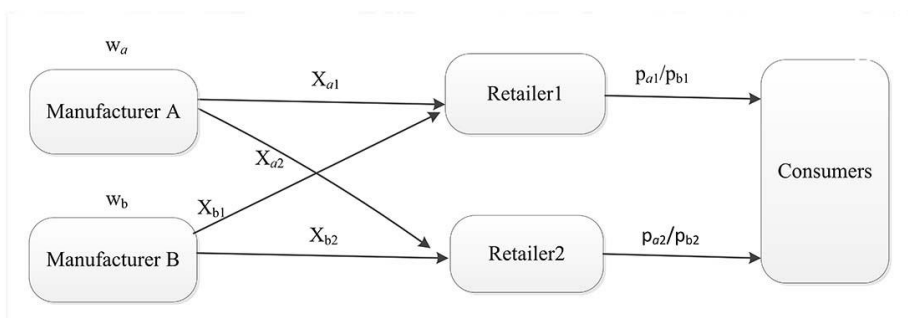


Fig.1. The supply chain system with two manufacturers and two retailers.

2.2. Assumptions

In the market, the demand is affected by the price of itself and competitors. Even if the products are alternative, the market potential of them should have a certain degree of difference.Thus, the demand function[10] is needed to modify. In this paper, sales without stockout or oversupply and then, the sales volume model can be written :